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OILFIELD EXPLORATION AND EXPLOITATION.

Geology.

676. Oil and Gas Prospects in Arizona. P. H. Lund. *Oil Wkly*, 12.3.45, **117** (2), 54.—Many shallow water wells in Salt River Valley area of Maricopa and Pinal counties, Arizona, show oil-seeps, and Cretaceous and Pennsylvanian formations are considered to be favourable for oil and gas accumulation, offering production possibilities at depths of 800–1200 ft. and 3000–6000 ft., respectively. One water well has given about 20 gal./day of paraffin-base crude for ten years, and there has been evidence of gas. The Cretaceous and Pennsylvanian contain some very porous horizons. The area has a monocline dipping south-east at about 50 ft./ml., with signs of small domes and elongated anticlines. Some wells have been drilled without adequate advice. At present five wells are being drilled in southern Arizona. Two wells in Pinal County have reached depths of 1260 ft. and 3690 ft., respectively; two wells in Maricopa County have reached 3090 ft. and 3450 ft., respectively. A fifth well is being drilled at 600 ft. in Cochise County. G. D. H.

677.* Vigorous Exploratory Play Focuses Attention on Rocky Mountain Area. C. J. Deegan. *Oil Gas J.*, 10.3.45, **43** (44), 41.—In 1942 the Rocky Mountain region had 6 new fields or pays and 8 extensions, in 1944 24 new fields or pays and 7 extensions. Currently exploration is very active. Most new finds are on known and mapped surface structures and most new oil is black, high in sulphur, and low in gravity and price. Not all structures have yielded oil, nor does discovery of oil on a structure necessarily mean that it will occupy a substantial part of the closed area. Geophysics is now being widely used, making possible investigation of structures within basins beneath a blanket of Tertiary and Recent beds. Beds thicken towards the centre of the basins.

Once the Rocky Mountain oil production exceeds local demands the costly business of transporting oil to other markets arises. Hence there was no need to search the inner parts of the basins so long as the rim structures provided sufficient oil for the region's needs. It seems possible that within the basins there may be structures which bring the Cretaceous within economic drilling depth. There may also be Tertiary fields. The gravimeter is being used for reconnaissance, followed by the seismograph for detail. Much of the geological and geophysical work has been in the Big Horn, Wind River-Shirley, Green River, Washakie, Uinta and Powder River Basins. G. D. H.

678.* Important Developments in Rockies Centre Round Four Great Basins. C. J. Deegan. *Oil Gas J.*, 17.3.45, **43** (45), 58.—Although exploration and development campaigns have been carried out throughout the entire Rocky Mountain region, the most important results have been obtained largely in Wyoming and northern Colorado. The most important developments have been on rim structures round the Big Horn, Wind River-Shirley, Washakie and Uinta Basins. All recent discoveries and extensions are on local structures. The Osage pool, Wyoming, and Cut Bank pool, Montana, are the only pools usually classed as stratigraphic traps, although the Kevin–Sunburst pool may also be in this category.

Once it was thought that only unfaulted structures would produce oil. The postulate that the oil had been flushed out of many of the structures by water has been abandoned by many geologists. Most Rocky Mountain structures have connate waters of relatively low salinity, and many of the formations have low permeability. Present information indicates that Salt Creek is the only structure filled with oil down to the closing contour, and even there this is true only for one sand. There does not appear to be any clear relationship between steepness of structure and presence of oil. If a structure produces in a shallow formation, it has a better chance of producing in a deeper formation than one that is dry in the shallow sands.

Except for the Rangely pool, bulk of oil found in recent developments is Embar-Tensleep. New oil at Rangely is in Weber (Pennsylvanian). Oil in Embar and Tensleep is often identical, and may be from a single source. Oil has been found in the Madison (Mississippi) limestone.

Estimates suggest that Elk Basin, Oregon Basin and Rangely are largest of 1942–1944 discoveries from the point of view of reserves. Powder Wash produces from the

Wasatch (Tertiary). In most cases Embar and Madison limestones show very low permeability, apart from that due to cracks. Permeability is low in other formations also.

Crudes are generally medium- to high-gravity sweet oils, or low-gravity high-sulphur-content oils, much new oil being of latter type. Palæozoic oils tend to be of low gravity, while Cretaceous and Tertiary oils are generally light and sweet. G. D. H.

679.* Possible Oil Area in Alabama Divided into Two Parts. S. J. Lloyd. *Oil Gas J.*, 30.12.44, **43** (34), 167.—Early in 1944 the Gilbertown field of Alabama was opened, and there are now 9 producers. 35,000–40,000 acres in Alabama are considered possible oil territory, 10,000–15,000 being quite promising. In the Coastal Plain there are Upper Cretaceous and younger beds, the thickness ranging from zero to at least 12,400 ft. in Clarke County, 90 ml. from the coast. At this depth the beds were Jurassic. There are probably 18,000–20,000 feet of post-Palæozoic sediments on the coast. There has been little drilling on the Coastal Plain. The Hatchetigbee anticline is the main structure. It runs southeast for 50 ml. and ends on the north-south Jackson fault. The anticline is 20–25 ml. across. The Gilbertown field is on the northern flank, and possibly associated with a strike-fault. There are other smaller structures. The Gilbertown field, 6–7 ml. long and ½ ml. wide, produces from top of Selma chalk at 2500–2600 ft., and one well produces from the deeper Eutaw.

The Palæozoic area to the north contains the Warrior Basin and the Tennessee Valley. There are numerous structures; bituminous limestones and sandstones outcrop; oil- and gas-shows occur in wells. Two short-lived gas-fields have been found. Fayette gas-field produced from the Pennsylvanian at 2600 ft. Possible oil-producing sands have shown low porosity in this area. Western and southwestern margins of Warrior Basin are masked by a thin cover of coastal rocks, and geophysical exploration will be required. G. D. H.

680.* Helium Production is Centred in United States. M. W. Baden. *Oil Wkly*, 8.1.45, **116** (6), 34.—Helium in natural gas was first found near Dexter, Kansas, in 1903. Richest helium-bearing gases are in Upper and Middle Pennsylvanian. In Kansas shallower sands are richer in helium than deeper sands. Generally where helium is present natural gas is rich in nitrogen. Highest helium content found in Kansas is 2%.

At present largest helium gas-field in U.S.A. is the Cliffside field, Potter County, Texas. Gas contains 1·8% of helium and 24% of nitrogen, and occurs in Permian "Big Lime."

Helium was first produced on a commercial basis when U.S.A. entered World War I. First helium extracted was 27% pure, but reprocessing raised its purity to 90%. Purity has since been raised to 96%. (Some features of early helium plants are described.)

Natural gas containing helium is found in many parts of U.S.A. and Canada, but U.S.A. has almost a monopoly of natural helium reserves. In Las Animas County, Colorado, a very low-pressure gas has 7% of helium. A similar percentage has been found in a Jurassic occurrence in Utah. (Other U.S.A. helium-bearing areas are noted.) Helium-bearing gases occur also in Alsace, Italy, Germany and Russia, but all have relatively small amounts of helium. G. D. H.

681.* Shell Jumping-pound Well Discovers Major Field. F. K. Beach. *Petrol Eng.*, March 1945, **16** (6), 94.—Several wells have been drilled in the Jumping-pound area. One found gas in a sand some distance above the Mississippian limestone. A second met a fault before reaching the limestone. Shell Norman was drilled 24 ml. west of Calgary, and found Rundle limestone at 11,585 ft. quite porous and charged with salt water. A geophysical survey was made, and Shell 4-24-J was located 6 ml. north and 2 ml. east. This entered the Rundle at 9618 ft. Drill-stem tests on two porous horizons yielded gas, the lower one flowing at 6,500,000 cu. ft./day with a pressure of 1700 lb./sq. in., and giving 1¼ stands of 44° crude in the drill-pipe. The limestone was acidized in four stages, and then flowed 12,500,000 cu. ft. of gas/day with 78 brl./day of 51° crude. Various tests were made, and it was clear that operation of this well for oil production would unduly deplete the reservoir energy. Closed-in bottom-hole pressure is at least 3910 lb./sq. in. The oil seems similar to that of Turner Valley. Structure

may be flatter than Turner Valley. Some believe that Shell 4-24-J marks the discovery of a major field. Brief notes are given on drilling and completing the well.
G. D. H.

682.* Petroliferous Provinces in Alaska Justify Additional Exploration. Anon. *Oil Gas J.*, 10.2.45, **43** (40), 70.—Alaskan climate and terrain do not present impossible conditions for oil exploitation. Seeps have been known near Point Barrow since 1909, presumably from Cretaceous beds, and inland from this area are other seeps and oil-shales. Up to 1933 shallow wells gave small oil production in the Katalla district of the Alaskan Gulf area. Formations were dominantly marine, of Oligocene age, with complex thrust and normal faulting. There has been drilling to depths of 2000 ft. in the folded marine Tertiary of the Yakataga district. Oil-shows, but no commercial production, were found in an 8800-ft. test in the Iniskin–Chinitna area. Upper and Middle Jurassic sandstones and shales are exposed. The main anticline runs for about 12 ml. N.E.–S.W. Near Kanatak gas-showings are reported at Cold Bay. Showings were found in a 7500-ft. test on the Bear Creek–Salmon Creek structure. This well was mainly in the Lower Jurassic. A test at Oil Creek failed to find production. The Wide Bay district has seeps. G. D. H.

683.* Alaska Scene of Intense Oil Investigation during 1944. Anon. *Oil Gas J.*, 17.2.45, **43** (41), 80.—During 1944 geological survey parties were sent to the Colville River, and to the Katalla, Iniskin, Wide Bay and Yakataga areas of Alaska, areas which earlier observations had indicated as most promising. New geological features were mapped in the Katalla area. A number of structures were revealed in the Yakataga area, and geology was found to be more complex than was formerly thought
G. D. H.

684.* Gulf, Mexican, and Caribbean Oil-Zones. Seismograph Service Corporation. *Oil Gas J.*, 30.12.44, **43** (34), 182.—*Jurassic.* Mexican Caribbean region embraces the folded coast ranges of California, the faulted Great Basin area with its intrusives and effusives, an off-shoot of the Appalachian–Ouachita-ancestral Rocky Mountain chains, the Gulf Coast plain, and the Florida platform. Pre-Jurassic oil possibilities of this area are very limited. Nearby in U.S.A. the Ordovician and Permian produce in West Texas. In the coastal plain of Mexico the Ordovician would be very deep. Marine Lower Jurassic is abundant in southern Mexico. This sea spread during the Middle and Upper Jurassic, and was predominantly marine, with much limestone. The Jurassic limestones of Mexico have abundant evidences of oil, although no production has yet been obtained. Formations of this age produce oil around the Sabine Uplift. In northern South America the Jurassic oil possiblities are probably nil.

Cretaceous. The Sierra Madre del Sur of Mexico was folded and uplifted at the end of Lower Cretaceous time, and at the close of the Cretaceous Central America and the Antilles suffered strong folding and intrusion. There was also folding in Colombia, Trinidad, and Venezuela. Strong folding has restricted known chances of finding large oil deposits in the Cretaceous to Cuba and around the Gulf of Mexico. There is Lower Cretaceous production in Mexico, in the Edwards of the San Antonio district, East Texas, and southern Florida. Vinales limestone of Cuba is heavily oil-impregnated, and is thought by some to be the source of all the Cuban oil. There is important Upper Cretaceous production only in the East Texas and Mississippi embayments. Some production has been obtained from top of the Cretaceous at Quiriquire and Guanoco, Eastern Venezuela, and Petrolea oil of Colombia may also be in the Cretaceous. There are many oil-seeps in the northern Andean district.

Eocene-Oligocene. At the close of the Eocene there was compression in the eastern Venezuela–Trinidad area, but main Eocene–Oligocene movements were epeirogenic. In Gulf States of U.S.A. Eocene and Oligocene production is largely associated with thinning sands near the wedge-edges. Late Tertiary folding of the Andean chains has made tracing of old shore-lines generally impossible. Considerable numbers of stratigraphic traps associated with lines of folding have been found in Venezuela, and there are high expectations of further discoveries. Eocene and Oligocene oil has not been found in the Llanos area of Venezuela. These beds are deeply buried by late Tertiary and Quaternary beds. Early Tertiary production of next few years will undoubtedly come from inter-montane valleys and basins, such as Magdalena Valley and Maracaibo Basin. Important Miocene discoveries have been made on the south flank of the coastal cordillera. In Trinidad the Tabaquite field produces from the Lower Tertiary. The Louisiana–Texas trends are expected to be extended, especially southwest into Mexico.

Miocene–Pliocene. During the Miocene and Pliocene there was strong folding in the Antilles and at the northern end of the Andes. There was faulting which created depressions in which great thicknesses of sediments accumulated. On the Gulf Coast there is shallow salt-dome accumulation round Houston, and deep-seated Miocene pays occur in the Mississippi delta. The best late Tertiary possibilities in Mexico seem to be in the salt-dome area of Tehuantepec and Yucatan. Trinidad Miocene has yielded 250,000,000 brl. of oil. There are numerous oil-seeps in the coastal and llanos regions of Colombia. Geophysical work will be required in areas covered by Quaternary and Recent beds.

A series of stratigraphical tables give formational equivalents in the different areas, and indicate producing and possible oil-bearing horizons. Maps show outcrops and distribution of various formations, and where they produce oil or are favourable or unfavourable for production. G. D. H.

685.* South American Oil-Zones. Seismograph Service Corporation. *Oil Gas J.*, 30.12.44, **43** (34), 190.—*Devonian.* Principal geological elements of South America are the Brazilian–Guiana shield, part of Gondwanaland, the circum-Gondwana embayments and overlaps, the Andean chains, inter-Andean embayments, and coastal plain areas. The Brazilian–Guiana shield has strongly altered pre-Devonian sediments. There are Silurian beds along tributaries of the Amazon. Two embayments, one in the Amazon valley north of Gondwanaland and the other in Bolivia and western Argentina, to the west and southwest of the shield, contain Devonian. The northern embayment shows a boreal fauna, and Devonian is overlain by Carboniferous and Recent rocks. No oil has been reported. Devonian of the southern embayment has a southern fauna, and yields oil in Bolivia and Argentina. It gives many oil-seeps in the sub-Andean zone.

Permo–Carboniferous. Carboniferous beds are found in the Amazon embayment and in the Andes. Permian deposits are much more extensive, and cover a large part of the Brazilian shield and the Argentine shelf area to the south. Hercynian movements affected both areas, thus reducing the chances of finding oil. In the Amazon embayment Carboniferous deposits, laid down in a retreating sea, are less favourable than Devonian. Lowest Permian is usually glacial, but marine intercalations are reported in southeast Bolivia, and these may be thicker in the Pampas and possibly in Patagonia. However, conditions may not have been favourable for accumulation of much organic matter. Continental and marine beds in great thickness overlie glacial deposits. Oil-shales and bituminous rocks occur in the Parana basin of Brazil. These rocks have been met in wells in southern Brazil and Uraguay. In Argentina the Areniscas Inferiores yield oil in commercial amounts. Location of stratigraphical traps below continental deposits will be difficult. Prospecting by geological or geophysical methods alone may be impracticable, and much test drilling may be necessary.

Mesozoic. Gondwanaland broke up and the South American continent was formed in the Mesozoic. By the end of the period the great Andean geosyncline had been formed and thick sediments deposited in it. Continental deposits were laid down over eastern part of Brazilian shield and in Argentina. In the former area bulk of the sediments are Triassic and probably of little value as oil reservoirs. During the Jurassic the Gondwanaland area was invaded from the west, and sediments of this age form commercial oil reservoirs in Argentina and Bolivia. The sea advanced from the southeast in the Upper Cretaceous in the St. George Gulf area in Argentina, and possibly elsewhere. The Comodoro Rivadavia pays were formed, some being considered to be continental. There are Mesozoic oil possibilities in the inter-montane valleys and in the depression east of the Andes. Seepages from the Cretaceous are common from Eastern Venezuela to Lake Titicaca, and there is commercial production of oil in Eastern Venezuela, the Barco concession, and at Ganzo Anzul. These fields are in inaccessible areas or where large volumes of shallower production are available. The Cretaceous has not been tested in Peru and Ecuador, except possibly at Lobitos. Cretaceous of inter-Andean embayments offers one of the greatest potential oil reserves of South America.

Eocene–Oligocene. Eocene and Oligocene deposits are largely lacustrine and subaerial, derived from the Andes and laid down on the old land surface. Except in the north oil possibilities in these two systems are limited to narrow coastal strips. Peruvian fields produce from multiple pays in the Eocene and Oligocene, but mainly from the former. Eocene is chief producing formation in Ecuador, where structures are bowed round igneous intrusions. Early Tertiary gives a little oil in Brazil, and may have possibilities in Argentina. Miocene and younger beds mask the extent to which Eocene and Oligocene beds occur over Cretaceous and basement rocks in the Orinoco Llanos. Where explored there are shallower producing horizons, and incentive to develop deeper formations has so far been slight. Lower Tertiary production is important in Lake Maracaibo and Magdalena basins.

Miocene–Pliocene. A little Miocene production is obtained in Peru, and bulk of production in Trinidad and Venezuela is from rocks of this age. Elsewhere the rocks of Upper Tertiary age are largely continental or difficult to explore.

A series of stratigraphical tables give formational equivalents in different areas. Maps show the outcrops and distribution of the various formations, and where they produce or are favourable or unfavourable for production. G. D. H.

686.* Las Mercedes Field Proven 6 Miles Long. Anon. *Oil Gas J.*, 30.12.44, **43** (34), 162.—Las Mercedes, Venezuela, field 100 ml. south of Caracas, is over 6 ml long. 35-gravity oil is obtained from depths of 4300–4500 ft. 35 ml. south of the field a wildcat, 2 Manapire, is being drilled. On the Santa Ana structure the Texas Petroleum Co. is drilling 3 Rincon. In the Orinoco delta 2 wells are producing 1100 brl./day. East of the Temblador field a well in Caritos area is closed in. G. D. H.

687.* Outlet Increases Barco's Production. Anon. *Oil Gas J.*, 30.12.44, **43** (34), 235.—During 1944 the Petrolea production was steady at about 11,000 brl./day. In March the Tibu field (formerly called Socuavo-Tres Bocas) began to export oil. Tibu production averaged 1300 brl./day in second quarter and 2600 brl./day in third quarter. No drilling was done at Petrolea in 1944, but a number of Tertiary wells were drilled at Tibu to depths of 4000–5000 ft. A 10,000-ft. Cretaceous well is expected.

Discovery well of Tres Bocas field was near crest of Tibu anticline. It started near top of Carbonera formation and went 300 m. into the Mito Juan formation. Sandstones in the upper part of the Carbonera formation were stained, but contained freshwater. Most sandstones below the Mirador formation showed some staining, but were generally poorly developed and unusually tight. The well was completed in basal sandstone of the Barco formation. In other wells upper Barco sandstones were found to be freshwater-bearing, and the Lower Barco produced. Although Mercedes and Aguardiente members of Uribante formation were not tested, they are believed to be gas- or oil-bearing.

In a test on the seismic crest of the Socuavo anticline the basement was reached at 2982 m. The upper half of the Uribante was found to be oil-bearing, but tight. A second well on the west flank produced from basal sandstone of the Barco formation. Oil and freshwater have been indicated in drill-stem tests of upper Barco sandstones. A sandstone in the Catatumbo showed brackish water on drill-stem test. G. D. H.

688.* Deep Zones in Cuba Attract Operators. Anon. *Oil Gas J.*, 30.12.44, **43** (34), 258.—Cuba has had a small crude-oil production for many years, and has given a few thousand brls./day of natural gasoline from shallow wells.

Two lines of folding run parallel to north coast of Cuba, and show Cretaceous in the core, with Eocene, Oligocene, and Miocene on flanks. Prospective oil-beds are believed to be confined to the Tertiary. Most of Cuba's old shallow production is from the Colon basin, west of the island. Production is from serpentine plugs in areas grouped mostly east of Habana, and in recently discovered Jarahueca distillate field, still farther east. The Moron basin is in the centre of the island and the Canto basin in the east.

The Guanal wildcat is being drilled 36 km. south-east of Pinar del Rio. A core hole is being drilled on Cayo Coco island, off the north coast.

Very porous surface beds several hundred feet thick cause circulation difficulties in drilling. G. D. H.

689.* Arabian American Oil Co.'s Concession in Saudi Arabia has Enormous Potentialities. L. P. Stockman. *Oil Gas J.*, 30.12.44, **43** (34), 242.—De Golyer has estimated Middle East oil reserves at 26,000,000,000 brl.; others believe that reserves exceed 100,000,000,000 brl. Bulk of the oil is British controlled. De Golyer estimated Saudi Arabia's proved and indicated reserves at 4,000,000,000–5,000,000,000 brl. Arabian American's concession in Saudi Arabia totals 439,500 sq. ml., with preferential rights over an additional 117,000 sq. ml. The concession includes practically all the potentially productive oil acreage in Saudi Arabia. Folding is gentle but of great extent, with relatively thin producing horizons for the region. Porosities and permeabilities are high. In Iraq and Iran the folds are relatively sharp, with low porosity and permeability in the producing horizons, which are about 500 ft. thick.

27 wells have been completed in Dammam field of Saudi Arabia. The Abqaiq field has 5 wells. Abu Hadriya is a further producing structure. Dammam covers 10,000 acres and produces from depths of 2500 ft. and 4200–4500 ft. Abqaiq produces at 5500–6000 ft. Abu Hadriya produces at about 10,000 ft. The Arabian production is from Cretaceous and Jurassic.

A 50,000-brl. refinery is being constructed at Ras Tanura at the end of the Dammam-Ras Tanura pipeline. G. D. H.

690. China Discoveries Point to Important Development. D. L. Carroll. *Oil Wkly*, 26.2.45, **116** (13), 48.—China's first commercial oil discovery was made in 1937 at Wu Su in northern Sinkiang, where 26 wells produce 49–52-gravity oil from about 4800 ft. Late in 1939 the Yumen field of Western Kansu was opened, and has 20 producing wells. Two one-well gas-fields have been discovered in Szechuan province as a result of drilling on anticlines with oil-seeps.

The Yumen field has a proved area of 3000 acres, and a small refinery producing straight-run gasoline. Lack of storage and outlet has led to the reduced crude being run off into a nearby stream. The gasoline is hauled over 400 ml. to Lanchow. The Yumen crude is 38-gravity, of intermediate-paraffin base, and is obtained from Cretaceous at 1350 ft. The anticline is displayed in Tertiary beds. Average well potential is said to be 1000 brl./day. A deep test is being drilled to explore all formations down to Jurassic.

Natural gas has been known in Szechuan for over 2000 years and many primitive wells were drilled in the Tzeliuching district. The gas is used for evaporating brine. One of the two modern gas-fields is 4 ml. from Chungking. On a faulted anticline, the well produces from 3300 ft., possibly from a limestone just above the Permian–Triassic contact. Outcropping non-marine Jurassic beds show oil residues. Gas was discovered 60 m. north, again in a Triassic limestone, surface beds showing seepages. In both fields gas pressure is about 1200 lb./sq. in. G. D. H.

691. Russia Gets Production from Lower Devonian. Anon. *Oil Wkly*, 26.2.45, **116** (13), 75.—A deep test in the Tuimazy oilfield, 60 ml. west of Ufa, was completed as a Devonian producer, with an initial output of 1120 brl./day. At Yablonovag in the Samara Bend, two wells are producing from higher levels in the Devonian.

G. D. H.

692.* Reserves. C. J. Deegan. *Oil Gas J.*, 27.1.45, **43** (38), 183.—Newly discovered fields added 204,650,000 brl. to U.S.A. oil reserves in 1944, and extensions and new pays in other fields added 1,943,306,000 brl. Total new reserves exceeded 1944 production of 1,680,000,000 brl. by 467,834,000 brl., and at beginning of 1945 the reserves totalled 20,514,739,000 brl.

Over a period of years ratio of reserves to annual production seems to have had an equilibrium value of 13·8; above this figure there was worry about over-production; below this figure there was worry about discovering new reserves. Present reserve-production ratio is 11·5% below equilibrium value, and cause of worry is effect of a low ratio on sustaining daily production.

Trend of small proven reserves from newly discovered fields seems likely to continue for duration of the war. Lack of materials prevents the rapid development of new fields, thus causing early reserve estimates to be small.

During 1944 two new major regions have been definitely established as areas where potential reserves of great size have been found. They are western Wyoming and

Colorado, and Mississippi–Alabama. The Anadarko Basin may be added to this category.

A chart gives the proved reserves remaining, and total amount produced yearly from 1937 onwards. A table lists by States and districts estimated reserves at beginning of 1944, reserves due to 1944 discoveries, extensions, and revisions, and 1944 production, with reserves at beginning of 1945. G. D. H.

693.* New Oil Reserves—their Location and Size. Anon. *Oil Gas J.*, 27.1.45, **43** (38), 185, 210; *Oil Wkly*, 29.1.45, **116** (9), 208.—U.S.A. 1944 new discoveries, and new pays and extensions, are grouped according to States, with field names, county, producing formation, proven acreage, formation thickness, and estimated reserves. Maps show locations of discoveries and extensions. G. D. H.

694.* December Wildcat Mark Shows Increased Activity. L. J. Logan. *Oil Wkly*, 22.1.45, **116** (8), 44; Anon. *Oil Gas J.*, 27.1.45, **43** (38), 172, 228.—During 1944 U.S.A. had 4324 exploratory completions, against a goal of 5000. During December wildcat completions were at rate of 89 per week. 19·5% of 1944 exploratory completions were productive (20·3% in 1943); 18% more new oilfields were discovered in 1944 than in 1943; increase in new oil pay-zones was 17%, while extensions increased by 2%. Distillate discoveries were about double those of 1943, and gas discoveries were much more numerous.

Rocky Mountain States, Oklahoma, and New Mexico each had three new fields in December.

A table summarizes by States and districts results of exploratory drilling in 1944 and in December 1944. The December discoveries are listed with pertinent data. G. D. H.

695. May Reach Wildcat Goal if January Rate Holds. L. J. Logan. *Oil Wkly*, 26.2.45, **116** (13), 66.—During January 1945 exploratory completions in U.S.A. averaged 86 per week. This was 31% higher than in January 1944. There are doubts whether the P.A.W. goal of 5000 exploratory wells for 1945 will be attained, and it is debatable whether this goal is adequate. Numerous fields are currently producing in excess of efficient rates.

During the past five years exploration has been intensified, and wildcat completions have been consistently above the figure for the preceding five years, but the oil found per wildcat has steadily decreased; and there has been increasing difficulty in finding as much oil as the country has been using.

Texas had 26 productive exploratory completions in January 1945 and Kansas had 9. During January 15·1% of the wildcat completions were successful.

Tables summarize the wildcat completion results by States. The new oil- and gas-fields and new pay horizons discovered are listed with pertinent data. G. D. H.

696.* Record Wildcatting but Less Oil Found than Produced. Anon. *Oil Wkly*, 29.1.45, **116** (9), 144.—4324 exploratory tests were drilled in U.S.A. in 1944, 700 more than in 1943. The exploratory tests include wildcats, outposts, and new pay tests. 805 were productive. 326 new fields and 149 new producing horizons were found. There were 135 major extensions of old producing areas. 144 exploratory wells found gas (102 new fields, 15 new pays, and 27 extensions), and 51 found distillate (32 new fields, 9 new pays, and 10 extensions).

New oil found in 1944 is estimated to be 1,328,947,000 brl. Thus total reserves fell by 349,420,000 brl. to 19,714,723,000 brl. in 1944. Revisions of previous estimates provided 982,630,000 brl. of the new oil attributed to 1944. Volume of oil per wildcat in 1944 was 307,342 brl., the lowest since such statistics became available in 1937. Normal development in 1944 might have resulted in a different picture. Average depth of productive exploratory tests in 1944 was 4775 ft.

Texas accounted for more than a third of the exploratory tests drilled and of the new oil found, nearly half of the new oil-pays discovered, and more than a third of the new oil proved in 1944. Extensions and development of known fields accounted for 449,000,000 brl. of Texas' 531,000,000 brl. of new oil.

Tables give numbers of new oil, gas, and distillate fields found in U.S.A. each year from 1937; accumulated discoveries, accumulated production, and proved remaining reserves each year from 1918; new oil found by new fields and new pays, and by revision of previous estimates and extensions in old fields, for each State, together with production, and proved reserves at beginning and end of 1944; new oil found and developed, annual output, number of dry holes drilled and oil found per dry hole each year from 1918; new oil added by revision of estimates and extensions in known fields, and by new pools, each year from 1937; and results of exploratory drilling, by States and districts, in 1944. G. D. H.

697.* Wildcat Drilling Fails to Open Substantial Volume of New Reserves. C. J. Deegan. *Oil Gas J.*, 27.1.45, **43** (38), 224.—Despite heavy wildcatting, reserves added by new fields in California in 1944 were very small. Most new fields were in San Joaquin Valley, and none looks like becoming exceptionally large. Important additions to reserves were made by extensions and new pays at Elk Hills, Buena Vista Hills, and San Miguelito.

In Rocky Mountain area potential reserves indicated by further development of 1943 discoveries and probable ultimate recoveries from 1944 new fields indicate that relatively enormous proven reserves will be established by further development of existing fields and adjacent structures. Wyoming had 18 oil discoveries. Big Sand Draw, Crook's Gap, Little Buffalo Basin, Winkleman, Steamboat Butte, and Bailey appear to be important. Montana had 4 oil-wells among 61 wildcats. A well in the Morrison at Dry Creek seems to be the only one of importance. Rangely pool has been extended, and will probably prove to be Colorado's largest pool. Extensions and new pays at Powder Wash have opened new prospects for Tertiary structures over a wide area.

28 new fields were discovered in Kansas in 1944. None seems important. Most were on Central Kansas Uplift, some extending trend to the northwest. Oklahoma had 29 new pools in 1944. West Edmond was expanded into a major pool, and there is a possible further 5-ml. south extension. Washington and West Noble remain of doubtful status. West and South Moore failed to develop into large areas in Ordovician pays, but there are prospects of substantial Bartlesville sand production.

None of Illinois' 15 1944 discoveries appears to be of any great size. In northeast Louisiana the Lake St. John and North Lake St. John pools are a single field on a salt dome, with Tuscaloosa condensate production high on the structure, and oil lower, together with some Wilcox production. Conditions are same at Holly Ridge and Holly Ridge North pools. A new prospective area has been opened by discovery of oil near Delhi on flank of Monroe–Richland igneous uplift.

Heidelberg, Eucutta, and Cranfield pools of Mississippi are probably associated with deep-seated salt domes. Baxterville may be the same. Winnsboro and Sand Flat seem to be most promising of 9 fields discovered in East Texas in 1944. New Hope may become a rather large field. Good production technique is causing many companies substantially to increase East Texas field reserve estimates. Many small discoveries were made in North and West Central Texas in 1944. Gas-fields in Hansford and Sherman counties of the Panhandle were extended, but no new producing areas were opened in 1944. In the Permian Basin important additions to crude reserves were made in Devonian limestone of Andrews, Crane, and Ector counties. Multiple pays were proved at some locations in deep Wheeler and Keystone Ellenburger fields. Ellenburger production was established in Todd Deep field. Productive limits of basin were extended 30 ml. north into Lamb county by a Lower Permian producer. A number of fields were extended.

In the second half of 1944 important Upper Permian production was found in Turner area of Lea County. Lower Permian pay of east flank of Penrose field also appears important. Ellenburger production has been found in southeast Lea County. None of the 13 oilfields opened in South Texas appeared outstanding at end of 1944. A new deep pay was opened at East Alta Mesa. 42 new fields were discovered on Upper and Lower Gulf Coast in 1944; some of them may show important reserves on further development. Wilcox production has been developed in Livingston pool of Polk County. Fannett and Lovell Lake fields have been extended, and important production has been opened on southwest flank of Blue Ridge field. 5 new Cockfield sand areas have been found on an old trend, but none seems to have large reserves.

13 new fields were opened in Southern Louisiana in 1944. Commercial production has been found on the Bayou des Glaise dome. Few new fields have had much development drilling. At West Tepetate two producers opened different pays with high

potentials; this may prove to be a major discovery. Production has been found on southeast flank at West Gueydan. G. D. H.

698. Vigorous Exploration Activity Marks 1945. L. J. Logan. *Oil Wkly*, 19.3.45, **117** (3), 32.—During the nine weeks ended 3rd March, 1945, exploratory completions in U.S.A. averaged 82 per week (67 per week in 1944). Of these, 17·6% were successful. Louisiana, Mississippi, Oklahoma, Wyoming, West Texas, and the Upper Gulf Coast of Texas have shown noteworthy increases in exploratory drilling this year. Texas had 24 successes out of 126 completions. Results are summarized by districts and States. G. D. H.

699.* Wildcat Completions and Discoveries. Anon. *Oil Gas J.*, 13.1.45, **43** (36), 119; 20.1.45, **43** (37), 113; 27.1.45, **43** (38), 297; 3.2.45, **43** (39, 97; 10.2.45, **43** (40), 151; 17.2.45, **43** (41), 147; 24.2.45, **43** (42), 204; 3.3.45, **43** (43), 113; 10.3.45, **43** (44), 111; 17.3.45, **43** (45), 149; 24.3.45, **43** (46), 124.

	U.S. wildcat completion results.				
	Oil.	Distillate.	Gas.	Dry.	Total.
Week ended :—					
6th January, 1945	9	0	1	56	66
13th ,, ,,	7	0	2	84	93
20th ,, ,,	15	0	3	74	92
27th ,, ,,	10	0	3	54	67
3rd February, 1945	12	0	4	53	69
10th ,, ,,	7	0	4	59	70
17th ,, ,,	13	1	5	63	82
24th ,, ,,	11	0	1	73	85
3rd March, 1945	23	0	2	56	81
10th ,, ,,	11	2	3	58	74
17th ,, ,,	17	0	2	35	54

For each week the completions are summarized by States and districts. G. D. H.

Geophysics.

700. Case Histories and Quantitative Calculations in Gravimetric Prospecting. D. C. Barton. *Petrol Tech.*, November 1944, **7** (6), A.I.M.M.E. Tech. Pub. No. 1760, 1–49.—*Gravity Anomalies of Nash and Damon Mounds, Fort Bend, and Brazoria Counties, Texas*, 2–9. Attention was directed to Nash by H_2S in water, and by a faint suggestion of a salt-dome mound. Presence, position, and depth of the Nash dome were predicted from torsion balance data with good accuracy, entirely in advance of drilling.

Damon Mound is marked by a conspicuous topographic mound. Like Nash, it is marked geophysically by an anomaly consisting of a maximum at centre of a very much larger minimum. On deep domes there is a minimum without a maximum; a few shallow domes have maximum compensated out, and no gravity maximum is evident, although a fairly thick cap is present at a moderately shallow depth.

Lost Hills, California—an Anticlinal Minimum, 9–15. The regional variation of gravity gradient and of differential curvature reflect regional major structure. They indicate the huge synclinal trough filled deeply with relatively light sediments, and that the southwestern flank is composed of older and relatively heavier beds rising sharply from great depths. There are indications in geophysical data that southwestern margin of the valley is marked by faults downthrown to northeast.

A sharp gravity minimum marks the sharp Lost Hills anticline. The crest of the minimum lies $\frac{1}{8}$ ml. southwest of the crest of the anticline as shown by the producing zone. Northeast flank is steeper, and this is shown by gravity data.

The minimum may be caused by thickening of diatomaceous McLure shale and the base of the Reef Ridge formation in the core of the anticline.

Gravity Minimum at Tepetate on Very Deep Salt Dome, Acadia Parish, Louisiana, 15–22. Tepetate is an example of a salt-dome minimum badly obscured by a regional trough of minimum, and of uplift so slight in producing horizon that regional gulfward dip of beds has shifted structural crest 1 mile up-dip from centre of the minimum.

History of Tepetate shows necessity of a periodical re-evaluation of geophysical data. Knowledge of significance of anomalies accumulates with passage of time, and so the geophysicist's skill in interpretation of anomalies increases.

Quantitative Calculations of Geologic Structure from Gravimetric Data, 22–49. Calculations from results of a torsion balance survey may give valuable information concerning parameters of the geological structure which causes the gravitational anomaly. For calculations to be practicable the form of the mass must be geometrically rather simple; it must differ appreciably in specific gravity from surrounding medium, and both it and surrounding medium must be homogeneous in specific gravity, or their specific gravity must vary according to some simple known law. Observed anomaly must not be complicated by overlapping anomalies of other features, although presence of a simple regional gradient is not necessarily prejudicial to such calculations.

G. D. H.

701.* Quantity Interpretation of Gravity Meter Surveys. S. J. Pirson. *Oil Wkly*, 16.4.45, **117** (7), 34.—Quite often the interpretive technique used with gravity meter data consists merely of the removal of regional gradients by empirical methods, and commonly structural anomaly is found to be displaced relative to gravity map anomaly. Evjen has described a technique which consists of calculating gravity anomalies at a depth assumed spatially close to the surface of formations of different density. On applying this technique to a hypothetical structure, curves derived gave apex and width of the structure closely, and the closure within 10%. Interpretation of an actual gravity meter map is also given, based on the same technique.

Errors which limit effectiveness of quantitative interpretation are enumerated. It is preferable to base quantitative gravimetric interpretations on measurements uncorrected for regional gradient. The technique has a rather large margin of error, but if there is some geological or well control the margin of error in structural computation may be considerably reduced.

The gravity meter is essentially a structural tool, but it is not completely devoid of potentialities in search for stratigraphic traps, particularly those associated with truncated structure. G. D. H.

702.* Geophysical Work in Paraguay Indicates Extent of Exploration in South America. W. A. Sawdon. *Petrol. Eng.*, March 1945, **16** (6), 81.—Gran Chaco extends from Northern Argentina into Western Paraguay. In Paraguay it covers some 100,000 sq. ml., and is generally flat, with swampy areas in the east. Union Oil Co. has contracted with the Paraguayan Government to explore 54,000,000 acres of this area. Outcrops are lacking, and therefore geophysical work is required to procure data on structure and on sediment thickness. Peru, Bolivia, and Argentina have oilfields on the east flank of the Andes. One seismograph party is already at work. G. D. H.

Drilling.

703.* New Portable Exploratory Rotary Drill Embodies Revolutionary Principles. N. Williams. *Oil Gas J.*, 31.3.45, **43** (47), 304–305.—The new drill is said to reduce cost of seismograph shot holes materially, and its principles are believed adaptable to application on larger rigs for deeper drilling. One-man operation of the unit is a feature made possible by a central control panel at the back of the truck on which it is mounted. The unit and its operation are described and illustrated. A. H. N.

704.* Power-Driven Rotary Slips Operate Successfully on Gulf Coast Well. E. H. Short, Jr. *Oil Gas J.*, 10.3.45, **43** (44), 50–51.—Operation and mechanism of power-operated slips are described. A feature particularly emphasized is the impossibility of the slips setting accidentally. Air pressure is used as motive-power agent. A. H. N.

705. Chain and Sprocket Locking Device Extends Life of Line. Anon. *Oil Wkly*, 5.12.45, **116** (10), 36.—A novel means of anchoring the dead end of the drilling line.

Instead of merely anchoring the dead line to a fixed object, involving tight loops, line clamps, etc., that end of the line was wound on a heavy reel set up at ground level on the side opposite the draw-works, and there bolted to the derrick substructure. Securing the reel and line was accomplished by use of two salvaged sprockets, one of them being a small pinion, and a short length of used rotary chain, together with the aid of the welder in attaching the pinion and a bracket. A. H. N.

706. Substituting Adjustable Runway for Rat Hole Lowers Drilling Costs. Anon. *Oil Wkly*, 12.2.45, **116** (11), 41.—The kelly is put down a runway instead of a rathole to prolong the life. While runways of this general type are not uncommon in oilfield practice, this has particular interest in the flexibility of use and ease with which it may be broken down and transported, as well as the means by which it is tied to and adapted to the rig itself. The runway consists of two lengths of 10-in. channel iron bolted together in the middle to form a single chute accommodating the longest kelly that might be used on the rig. The supports and other details are described and illustrated. A. H. N.

707. British Use Time-Saving Drilling Methods. D. L. Carrol. *Oil Wkly*, 12.2.45, **116** (11), 44–46.—The drilling practices adopted in British oilfields and the economies in drilling times achieved are briefly reviewed. Field history and conditions are also briefly discussed. A. H. N.

708. Fold-Away Mud Line is Feature of Portable Pump Unit. Anon. *Oil Wkly*, 19.2.45, **116** (12), 52.—Greatly speeding up the work of moving portable drilling rigs from one location to another, is the method used by one company in unitizing and breaking down the mud-pump suction lines on its small trailer-mounted pump unit. Near the intake end of the pump unit skid base, the rigid part of the mud suction line was cut and weld flanges were installed. While flanges were bolted together, a shop-made hinge was fashioned atop the two flange halves, welding it to the line with heavy fillets provided on either side to lend extra strength. On moving the unit to a new location the flange is unbolted in normal manner, but the usual time-consuming task of breaking down and stowing the hose sections and fittings is eliminated. Instead, the assembly from the hinged section out is raised to any convenient height with the aid of a small winch permanently mounted on the unit. A. H. N.

709.* Extending Wire Rope Life. E. Sterret. *Oil Wkly*, 26.2.45, **116** (13), 52.—Hints on reeling, using, and maintaining wire rope in good condition. Lubrication of the rope is studied in some detail. One device consists of a narrow strip of tough leather, supported and wrapped to form a funnel through which the line is run. At the bottom of this funnel squeeze is effected through the use of rubber contractors, so as to force the leather against the wire with pressure enough to hold back excess lubricant. A helper with a pot of warmed—not hot—lubricant pours enough of the material into the top of the funnel to maintain a puddle entirely surrounding the line for some 4–6 in. Drum speed is reduced to one half the normal the next trip into or out of the hole after lubricating the drilling line so as to avoid throwing off the lubricant which had collected in the space between adjacent strands during the treatment, and to give further time for capillary distribution of this supply into the line. Other practices are described. A. H. N.

710. Electrical Well Logging. H. Guyod. *Oil Wkly*, 7.8.44, **114** (10), 38; 14.8.44, **114** (11), 34; 21.8.44, **114** (12), 44; 28.8.44, **114** (13), 34; 4.9.44, **115** (1), 42; 11.9.44, **115** (2), 26; 15.9.44, **115** (3), 36; 2.10.44, **115** (5), 48; 9.10.44, **115** (6), 44; 16.10.44, **115** (7), 36; 23.10.44, **115** (8), 45; 30.10.44, **115** (9), 38; 13.11.44, **115** (11), 40.—Following a brief review of well-logging methods in general, the discussion is restricted to resistivity measurements. Single-point and multiple electrode methods are described, the principles, advantages, and disadvantages being given. Various simple cases are discussed theoretically, and relationships between true and apparent resistivities are examined, many ideal curves being given. Effects of hole diameter and mud resistivity are described.

Recommendations are made for solution of common problems. Limitations of interpretation are discussed, and fundamental data for interpretation are enumerated, with a final discussion of determination of fluid content of reservoirs from electrical logs. G. D. H.

711.* World's Deepest Well Drilled With Conventional Equipment. N. D'arcy, Jr. *Petroleum World*, January 1945, **42** (1), 35–40.—Equipment and methods used in drilling the deepest well (Standard Oil of California's KCL 20–13) up to date—below 16,000 ft.—are described. Equipment is same as used on other wells drilling to 11,500 ft. A. H. N.

712.* Influence of Drilling Practices on Drilling-Mud Programmes. E. R. Albert, Jr. *Oil Gas J.*, 2.12.44, **43** (30), 2.—See Abstract No. 545. A. H. N.

713. Plastic Coating Used to Prevent Corrosion of Oil-Field Equipment. E. H. Short, Jr. *Oil Gas J.*, 2.12.44, **43** (30), 59.—See Abstract No. 380. A. H. N.

Production.

714. Treatment of Heavy Oil Emulsions in Mississippi Field Presents Problems. N. Williams. *Oil Gas J.*, 3.2.45, **43** (39), 59.—Water emulsion problem in one field producing asphaltic base oil carrying a b.s. and w. content of 3–15% was solved by using both heat treatment and chemicals. Chemicals are injected directly into the lead lines by means of conventional small chemical pumps. In most instances the injection is made at the well head with an individually installed pump. In other cases a single pump is installed at central battery for a group of wells. Combination heaters and treaters are used exclusively with one unit being set at each central lease battery. These units of commercial design and manufacture, function not only as heaters and treaters, but also as separators for gas and gun barrels for settling and removal of the b.s. and w.

Four different types of treaters, representing as many manufacturers, are being employed in the field. One unit is provided at each central battery for lease. Through this the production of all wells on the lease is pumped. Largest single installation now is handling the production of 10 wells, with capacity for additional wells as completed. The operation of the units is described and discussed. A. H. N.

715. Geological Eccentricities in Mississippi Pose Completion and Production Problems. N. Williams. *Oil Gas J.*, 24.2.45, **43** (42), 124.—Production of oil and gas from South Mississippi is complicated because it comes from at least 7 horizons differing greatly in geological and lithological character. These complications and their influence on production practices are explained. A. H. N.

716.* Tubing and Casing Corrosion Combated by Treated Water. F. B. Taylor. *Oil Gas J.*, 31.3.45, **43** (47), 306.—Corrosion has been a major problem in western Kansas. Waters of certain formations are particularly bad, the Dakota sandstone offering an outstanding example in this respect. As the fields are water drive, the problem of corrosion usually starts early in the life of a field, or as soon as wells begin producing appreciable volumes of water. Various counter-measures have been attempted and expanded with varying degrees of success. One such method is now gaining wide attention and more extensive use, and is currently being applied in Carmi-field. It involves the use of stabilized water in the tubing-casing annulus to prevent entry of formation fluids with their resultant corrosive action, and is showing results. It is described in some detail. A. H. N.

717.* Examples of Sucker-Rod Pumping Below 8000 ft. P. Reed. *Oil Gas J.*, 24.2.45, **43** (42), 139.—An example of an unusually deep Gulf Coast well is one in the New Iberia field, which has been pumping from 8345 ft. Sucker rods are 3-in., installed because of inability to obtain ⅞-in. rods of proper specifications. In spite of the apparent overstressing, it is reported that after a considerable period of service there had not been any down time since the rods were put on the beam at that depth. Fluid had been raised with a Pacific rod sectional liner 1¼-in. pump operated at a speed of 7 s p.m. with a polished-rod stroke of 108 in. The pump has been operated by a

Parkersburg 11 AK unit with a rating of 446,000-in. peak torque and 30,000-lb. walking-beam capacity. Production has been 35 brls./day with 0% b.s. and w. of 28° A.P.I. gravity. Load and stress data have been as follows: peak polished-rod load, 21,5000 lb.; peak polished-rod stress, 48,650 p.s.i. ($\frac{3}{4}$-in. rods). Fluid level data have been as follows: operation fluid level at 8345 ft.; static fluid level at 6990 ft.; and estimated pressure at the top of the sand, 679 p.s.i.

Similar details are given for a well in Texas pumping from 8450 ft. with $\frac{7}{8}$-in. × 25-ft. rods. A. H. N.

718. An Analysis of Material-Balance Calculations. R. W. Woods and M. Muskat. *Petrol. Tech.*, January 1945, **8** (1), Tech, Pub. No. 1780, 1–16.—A least-square analysis procedure has been developed and applied for study of deviations in estimates of oil in place as given by material-balance equations. Data used are those obtained from field observations on the Jones sand, Schuler pool, Arkansas, and the Monroe dolomite, Reed City pool, Michigan. Possible effects of water intrusion are taken into account by expressing the cumulative water influx in terms of various functions previously proposed. Formulæ have been developed and values calculated for minimum deviations and minimal percentage deviations in calculated values of volumes of oil in place from average values, as could be obtained by suitable choice of water encroachment and initial gas-cap volume parameters.

Results show that fluctuations in these calculated values are very insensitive to values selected for rate of water intrusion and initial gas-cap volume, and hence cannot be safely employed in discriminating between spurious values for these parameters and such as actually pertain to producing reservoirs. Moreover, exact form of the water-intrusion function seems to have but little effect on fluctuations in values of computed oil in place. Accordingly it is concluded that the material-balance method does not in itself provide a satisfactory criterion for determining the basic physical unknowns of producing reservoirs, or for making conclusive decisions regarding nature of the production mechanism, unless independently established geological control data are available for eliminating unreasonable values for reservoir parameters, even though they may still satisfy the material-balance formulæ. If, however, from core or logging data the initial oil in place and the gas-cap volume can be established in advance, the material-balance formulæ can be inverted to give water intrusion. Moreover, by determining by such calculations the water-intrusion coefficient, future production performance can then be predicted by aid of the material-balance formulæ for specified operating conditions. This type of application may be of particular value in predicting results of pressure maintenance operations.

G. D. H.

719.* Proper Maintenance and Equipment Economies Are Stressed at North Burbank. K. B. Barnes. *Oil Gas J.*, 2.12.44, **43** (30), 62–63.—In the present North Burbank gas-prepressuring programme 1916 wells on 180 leases are involved. Because average well production is only 6 brls./day, and with one-half of the active producers making but 3 brls./day or less, proper maintenance, economic equipment, and efficient operating practices are definite necessities. This is accentuated by the fact that original development of the field took place in 1921–1926, or approximately 20 years ago, and consequently the installations lack many modern features in design and construction. Nevertheless, the properties have been maintained in excellent condition, and numerous changes and practices made at small cost to assist in realizing full benefits from the gas return work. The work is briefly described. A. H. N.

720. Salt Water Disposal in East Texas. Part 6. Anon. *Petrol. Engr.*, March 1945, **16** (6), 342.—The systems adopted by three oil companies are discussed in this paper.

A. H. N.

721.* Examples of Fitting Production Programme to Pool Conditions in Illinois Basin. K. B. Barnes. *Oil Gas J.*, 3.2.45, **43** (39), 42.—Character, producing conditions, general behaviour, and oil recovery to date for four oil reservoirs in the Illinois basin are described. Of unusual interest is the fact that for each of the reservoirs one operator, by reason of location and extent of his leases, was able to conduct development and production programmes which were tailored to fit reservoir conditions specific to the particular pool. The aim was high ultimate recovery. A wealth of production data, pressures, samples, tests, etc., have been collected and summarized in charts and diagrams. A brief recapitulation of production mechanisms and principles is given, followed by a study of the four examples. A. H. N.

722.* Gulf Coast Innovations in Gravel-Packing Technique. E. H. Short, Jr. *Oil Gas J.*, 10.2.45, **43** (40), 97.—Hydraulic method of placing gravel at the bottom of the well between a screen liner and wall of the underreamed hole is practically unchanged. However, the comparatively recent utilization of two separate tools (a special casing milling tool and the callipers) in connection with gravel packing has not only enhanced the possibilities for obtaining a more satisfactory thickness of gravel pack but has opened a new field for application of this type of workover. When a hole is underreamed below the casing the chances are good that it will be reamed out to the intended diameter, except for a few irregularities. Many wells, however, have been completed by setting the casing on bottom, and then perforating it opposite the pay formation. Some wells completed in this manner have ceased to produce, either because of plugged perforations or too frequent plugging of tubing to permit economical operation. To gravel pack a well of this type it is necessary to cut out a section of casing. This method as used in a particular well is fully described. A. H. N.

723.* Water-Flood Operations Automatically Controlled in Eastern Kansas. F. B. Taylor. *Oil Gas J.*, 17.2.45, **43** (41), 88–89.—Deals with the automatically controlled plant used to flood a shoestring sand. Main plant units are engineered around the conventional flood plant with a 120-h.p. main engine, fueled by crude oil, furnishing operating power. Main water pump is a triplex driven from the stub shaft of the main unit, and is capable of delivering 4500 brls. daily to input wells at a pressure of 600 lb. The operator is generating lease power for the project by means of a 50-kw. generator, " V "-belt driven from the main engine, delivering 110-volt current at 60 cycles for operation. While as much of the lease equipment is electrically operated as is consistent with good practice, this generator is entirely sufficient, for production will be flowed except at some of the edge wells. By flowing rather than lifting the production, the general power load is materially reduced. A complete control panel at the main plant includes control switches for raw water supply, obtained from a well drilled into siliceous lime below 1400 ft. Water is lifted from this source by means of a 4½-in. casing pump at 400 ft., and has been tested at 3000 brls. daily. A beam unit is employed with a 20-h.p. motor drive which can be turned off or on by means of relays connected to the main panel control. The plant and its operation are briefly discussed. A. H. N.

724. Condensates May Occupy Apparent Negative Volume In a Gas Reservoir. D. L. Katz and C. M. Sliepcevich. *Oil Wkly*, 26.2.45, **116** (13), 30.—In the course of preparing a cylinder of natural gas for use in the laboratory, an unusual behaviour was observed. The cylinder of natural gas, free from liquid at 75° F. and 2005 lb./sq. in., was cooled at 32° F. About a pint of liquid was drained from the cylinder, and the temperature brought to 75° F. Pressure on the cylinder had risen to 2060 lb. It would follow that if the removed liquid were reinjected into the cylinder the pressure would fall.

After clarifying the difference between " partial volume " in its thermodynamic significance and " apparent volume " as used in this paper, the authors develop the importance of this phenomenon of negative apparent volumes to condensate pool production. Theoretical studies of compressibility of gases are given. High-pressure gases bearing condensate in the reservoir as a single-phase mixture are produced to the surface of the earth, stripped of the normally liquid hydrocarbons, and the residue gas is often returned to the reservoir. A table indicates that if the stripping process could be limited to the butanes and heavier, the residue gas would probably have a volume equal to or in excess of the original volumes of the wet gas at reservoir conditions. If the apparent volumes of condensate removed were negative, residue gas volume in the reservoir at original temperature and pressure would exceed that of the rich gas. However, actual stripping processes must be considered, which processes usually include removal of some of the methane and ethane along with the condensate. A figure represents the cycling plant which employs the absorption process and removes methane and ethane as well as the normally liquid constituents from the rich gas. When 90 mol. % of the original wet gas is returned to the reservoir, this 90% of the gas occupies 94·5% of the original volume. Removal of methane and ethane in the liquid masks the negative apparent volumes of the normally liquid constituents. In practical operations the methane and ethane in the absorbed liquid are required for plant fuel, and hence are not available for return. However, the effect of the negative apparent volumes for the condensate still would enter into the material balance for a plant on a mol. basis when converting these quantities into reservoir volumes. A. H. N.

725. Gas Repressuring Increases Glenn Pool Recovery. J. F. Sage. *Oil Wkly*, 19.2.45, **116** (12), 32.—History and development of the Glenn Pool are briefly given. Reconditioning of old wells as well as drilling new wells are described. Repressuring is usually done in the pool with natural gas, though a few of the projects are served with air-compressor plants. In one case a separate gas-injection system was constructed from a compression-type gasoline plant that had been in operation for many years with the purchase of additional gas for the system. One company, instead of building a large general plant to serve many leases, has installed smaller plants capable of serving only the lease on which the plant is located. The compression unit has two single-stage cylinders, one for air and one to gather and compress casing-head gas. The compressed air and gas are co-mingled in a discharge line to the input wells. Due to scarcity of gas, the compression units are driven with electric motors. This type of plant usually serves a 160-acre lease. Companies using this small-plant system have found it to be more economical than the large general plant system. Injection rates of 25 M. cu. ft. per 24 hours are used for the smaller-size pattern. Where an input well serves a territory of 10–30 acres injection rates of 40–60 M. cu. ft./24 hours are used. In many cases new input wells take gas under vacuum for some time; later it is necessary to inject gas in input wells at pressures from 5 to 50 lb./sq. in. One project in the north extension requires injection pressure of 225 lb./sq. in.

Until secondary recovery was started at Glenn Pool, estimated recovery was 4000 brl./acre in the north extension, and 25,000 brl./acre in Glenn Pool. From data from other secondary recovery projects of a similar type of sand, it is believed that 5000–10,000 brl./acre should be recovered from Glenn Pool under secondary recovery methods, and the pool should be fairly well depleted in the next ten years. Estimated accumulative increase in oil production due to secondary recovery on April 1, 1943, for the 18 older projects was 580,914 brl., and on December 1, 1944, for the 36 projects was 1,985,696 brl. A graph illustrates the increase. A. H. N.

726. Production Histories of Oil Producing Gas-Drive Reservoirs. M. Muskat. *J. Appl. Phys.*, March 1945, **16** (3), 147–159.—A theory has been developed for predicting behaviour of solution gas-drive oil-producing reservoirs, on the basis of previously established empirical laws on flow of heterogeneous fluids through porous media. Treatments are given both for simple pressure depletion history without gas injection, and for systems in which gas is injected during oil production. Specific results provided by theoretical analysis include ultimate oil recovery, and pressure decline, gas–oil ratio, and productivity factor histories. Two types of gas injection have been considered—namely, (1) that in which returned gas is supposed to diffuse through and be produced continuously with the oil zone; and (2) that in which the injected gas remains locked in the gas-cap, which merely expands as oil production and gas injection proceed. In the latter case the rate of growth of the gas-cap is also obtained as a function of cumulative oil recovery. The theory is illustrated by numerical application to a hypothetical virgin oil reservoir with an original pressure of 2500 p.s.i. producing by gas-drive, and with no initial gas-cap. It is so found that if no gas is injected into the system the physical ultimate oil recovery will be 14·5% of the pore space, or 27·1% of the original stock-tank oil content, assuming that the formation initially has a connate water saturation of 30%. Gas–oil ratio first declines as production is started, then rises sharply to a maximum of 4400 cu. ft/brl., and finally falls steeply as the pressure is depleted to atmospheric. If there is no gas segregation and 60% of the produced gas is returned to formation, ultimate oil recovery will be increased by 27·6%. Gas–oil ratio history will be similar to that with no gas injection, but will rise to a maximum of 10,300 cu. ft./brl. If 80% of the gas is returned, recovery increase will be 48·8%, the maximum in gas–oil ratio history reaching a value of 19,450 cu. ft./brl. If all the gas is returned, gas–oil ratio rise will be so rapid that by the time 20,000 cu. ft./brl. is reached only 23·5% additional oil will be recovered. During these operations productive capacities of wells will fall by factors of the order of 10, because of the increasing viscosities of the oil and decreasing permeabilities to the oil as the pressure declines and oil saturation decreases.

For the case where the gas remains trapped in the gas-cap, ultimate oil recovery will be 163% greater than by direct pressure depletion, if residual oil after gravity drainage is 15% of the pore space. This recovery will be essentially independent of the amount of gas return, although the final reservoir pressure at the time of complete gas-cap expansion will be greater as more gas is returned. Increased oil viscosity and decreased permeability to oil will here reduce specific production capacities of the wells to $\frac{1}{4}$ or $\frac{1}{5}$ of the initial values. A. H. N.

727. Correlation of Gas–Oil Ratio, Yield, and Content. K. M. Fagin. *Petrol. Engr*, March 1945, **16** (6), 290.—A table of equivalents gives gas–oil ratios (cu. ft./brl.) in terms of yield (brls./M.m.c.f.) and content (gals./M.c.f.). The relationships are derived. A. H. N.

728.* Mammoth Gas-Repressuring Project to Start in West Pampa Pool. K. B. Barnes. *Oil Gas J.*, 10.2.45, **43** (40), 74.—A co-operative scheme for gas injection is contemplated for a pool worked by 26 operators for 49 owners. Development of the field and proposed scheme are discussed. It is planned to convert one well/160 acres to input service and inject about 100 M.c.f./day/input well. At the start, approximately 70 input wells are contemplated, using a total daily injection rate of approximately 7,000,000 cu. ft. It is expected that further expansion will be dictated by experience, but ultimate number may be of the order of 145–230 input wells, and total daily injection rate about 30,000,000 cu. ft. To determine input characteristics for the field, a number of gas-injection tests were made with portable compression equipment. It was found that for the 100 M.c.f./day rate injection pressures ranged from 155 to 415 p.s.i., being lower in the southern section and higher in the northern section. Present bottom-hole pressure is approximately 300 p.s.i. and low permeable capacity of formation is indicated by wells requiring 100–125 hours to build up to equilibrium static condition. It was found most desirable to have this done as an adjunct service to existing gasoline plants in field. Design of field-wide injection system has been made in anticipation of a maximum future load of 30,000,000 cu. ft./day. Surplus residue gas from five gasoline plants serving the pool will be gathered and compressed, and that to be injected in northwestern portion of the block will be handled by one compression service agent and that for southeastern by a second service agent. Installation of hydrogen sulphide treaters to reduce content to 1 gram/100 cu. ft. is planned, together with dehydrators, so gas freezing will not obstruct operating conditions. Oxygen content will be held below 1%. Organizational details are briefly given. A. H. N.

729.* Resaturate While Repressuring. A Wartime Suggestion. F. Squires. *Oil Gas J.*, 10.3.45, **43** (44), 67.—It was noticed that in gas-repressured areas undesirable properties were apt to develop in the form of the gas by-passing the oil between input and output wells. The paper shows how the rules developed for relation between degree of liquid saturation and amount of liquid movement may be applied to improve oil production in repressured areas. " Blowing through " may be reduced by adding water through gas input wells in quantities sufficient to increase liquid content of the sand to the point at which, when gas injection is resumed, permeability of the sand to gas is reduced and gas reacquires its ability to move oil. Experimental investigations appear to support the hypothesis propounded. A field test is also described.
A. H. N.

730.* Control and Detection of Reservoir Gas Movement in Pressure-Control Operations. N. Van Wingen and E. P. Valby. *Oil Gas J.*, 2.12.44, **43** (30), 77.—See Abstract No. 559. A. H. N.

731.* Determining Fluid Movement in Wells. S. L. Pease. *Oil Gas J.*, 2.12.44, **43** (30), 82. (*Paper Presented before The American Institute of Mining Engineers.*)—A tracer set free at a particular point in the well and a sample taken at another point can be used to study movement in the well. Normally on first run the sample is obtained near the releasing point, and thereafter samples are taken near the base of the upper sand if migration is indicated by dilution or absence of tracer in the initial sample. Length of time between releasing tracer and sampling is varied for successive runs, attempting first to establish the rate within limits. Rate of migration can be calculated from relationship of time interval to volume represented in the interval, between the releasing and sampling points. It is the author's opinion, based on field results, that approximate rates of fluid movement in 6⅝-in. casing from less than 100 to over 1000 brl./day can be determined. For the tracing material, solutions of brilliant water-soluble aniline dyes have been found satisfactory in wells having an appreciable water cut. Use of a series of contrasting dyes for successive runs serves to identify each run. To reduce eddy currents as much as possible, the unit is lowered through the intervals to be tested at a very slow rate, and is held just off bottom several minutes to allow currents to subside before bottle is broken. A. H. N.

732.* Mechanics of Producing Oil, Condensate, and Natural Gas. Part 5. Permeability, Type of Pay, and Interstitial Water. P. J. Jones. *Oil Gas J.*, 2.12.44, **43** (30), 73–75.—Formulæ are derived for calculating and estimating permeabilities. Interstitial water in core sample of pay, when not contaminated by drilling fluid, equals water saturation in the core samples, whereas total water saturation in contaminated core samples of pay is usually greater than their interstitial water content. Extent of contamination commonly ranges anywhere from zero up to 30% of porosity. Tracers may be used for estimating degree of contamination. Aside from tracers, three methods are available for estimating interstitial water in pay : (1) From electric-log data, (2) from type of pay and its permeability, and (3) from capillary pressure *vs.* water-saturation data. Electric-log data are not considered in this paper (they are to be considered in a future part of this present series). A. H. N.

733.* Mechanics of Producing Oil, Condensate, and Natural Gas. Part 14. P. J. Jones. *Oil Gas J.*, 3.2.45, **43** (39), 51.—Deals with the volume factor/brl. of condensate in production problems. Condensate is defined as the liquid obtained when the production of retrograde gas from a well is processed in a plant. Composition of condensate and quantity/unit of well production depend on plant conditions as well as on composition of the production. In turn, composition of well production depends on composition of reservoir fluids which are displaced, or expand, into a well-bore. The gases may contain a small per cent. by volume of a reservoir liquid. A gas out of which a liquid condenses at reservoir temperature on reduction of pressure is called a retrograde gas. Volume factor for a condensate is the space occupied in a reservoir by a barrel of condensate. Other things equal, the number of barrels of condensate in a reservoir is inversely proportional to the volume factor for condensate. The purpose of this article is to illustrate how volume factors/barrel of condensate are obtained. The discussion is limited to under-saturated reservoir faces, gases at dew-point pressure, and to gases in which the volume/per cent. reservoir liquid is comparatively small. A. H. N.

734.* Mechanics of Producing Oil, Condensate, and Natural Gas. Part 15. P. J. Jones. *Oil Gas J.*, 10.2.45, **43** (40), 99.—Deals with the volume factor/brl. of oil as it appears in production problems. Oil is defined as liquid found in a stock-tank when production from a well is passed through one or more separators. Composition of oil and the quantity/unit of well production depend on separator conditions as well as on the composition of the production. In turn, the composition of well production depends on the composition of the reservoir fluids which are displaced into a well-bore. This article is limited to reservoir liquids, and it is assumed that the composition of well production is the same as that of reservoir liquids. Under these assumptions, the composition of oil and quantity/unit of well production depends on gas–oil ratios. The higher the gas–oil ratio for a given well production, the smaller the volume of oil/unit of well production. Volume factor for oil is the space occupied in a reservoir by a barrel of oil. Other things equal, the number of barrels of oil in a reservoir is inversely proportional to the volume factor for oil. The purpose of this article is to illustrate how volume factors vary with pressure, temperature, gravity of oil, and gas–oil ratios. Illustrations are for reservoir liquids—that is, for under-saturated oil, for oil at saturation pressure, and for oil at bubble-point pressure plus evolved solution gas. A. H. N.

735.* Mechanics of Producing Oil, Condensate, and Natural Gas. Part 16. P. J. Jones. *Oil Gas J.*, 17.2.45, **43** (41), 99.—Deals with computation of volume factors for liquids. Volume factors are obtained from experimental data on either surface or subsurface samples. If these are not available, a volume factor may be estimated by one of the methods considered. A study of the methods will bring out their limitations relative to experimental methods of determining volume factors for reservoir liquids. The methods are limited to reservoir liquids at, or near, saturation pressure. A. H. N.

736.* Mechanics of Producing Oil, Condensate, and Natural Gas. Part 17. P. J. Jones. *Oil Gas J.*, 24.2.45, **43** (42), 140.—Deals with application of equilibrium constants in production problems. Equilibrium constant is the ratio of the mole fraction in a gas phase to the mole fraction in a co-existing liquid phase in equilibrium with the gas phase. Each component has its own K value. Equilibrium constants vary with pressure, temperature, and composition. Because of this variation, general application of K values to production awaits further correlation and research. There are insufficient data at this time for general application. Estimates of phase behaviour of reservoir gases and liquids are limited to the available K values. Part of the available data on K values is reproduced for illustrative purposes. A. H. N.

737.* Mechanics of Producing Oil, Condensate, and Natural Gas. Part 19. P. J. Jones. *Oil Gas J.*, 10.3.45, **43** (44), 71.—Deals with applications of Darcy's law to flow of fluids in porous media. Darcy's law is reviewed and illustrated by examples of oil and gas displacement in reservoirs and into wells. Linear, radial, and semi-spherical displacements are illustrated by examples. Darcy's law for linear displacement is used for estimating the rate of migration of oil or gas across a lease or from one portion of a reservoir to another. Darcy's law for radial displacement is used for estimating the productivity of oil, condensate, and gas wells. Darcy's law for semi-spherical displacement is used for estimating rate of oil or gas displacement into wells which do not penetrate their entire pay thickness. Oil and gas pays contain interstitial water. Permeability of a pay to a reservoir liquid or gas is called effective permeability. Effective permeability with water, a reservoir liquid or gas may be less than the permeability of the pay. Water tends to reduce effective permeability. The variation of effective permeability of a pay to saturation will be considered later. In this article the phrase " effective permeability " is used to signify that the influence of interstitial water on the permeability of pay to reservoir fluids was accounted for. Aside from interstitial water, this article limited to homogeneous reservoir fluids, that is, to either a reservoir liquid or a gas. Displacement into a well is exclusive of any pressure drop because of mud on the face of a well bore or cement liner, or casing in a well. A. H. N.

738.* Mechanics of Producing Oil, Condensate, and Natural Gas. Part 20. P. J. Jones. *Oil Gas J.*, 17.3.45, **43** (45), 107.—Deals with displacement of oil by water from a point. Oil is displaced by water daily in hundreds of reservoirs. Source of water may be bottom water, edge water, or injected water. Oil can be displaced because of pressure differences. It can be displaced also by gravity. But the effect of gravity, which can be the principal cause of oil displacement in some reservoirs, is not considered. Permeability of media to a fluid at less than 100% saturation is called effective permeability. The ratio of effective permeability to the permeability at 100% saturation is called relative permeability. Relative permeabilities to water and to reservoir liquids are used in estimating displacement of oil by water. Many oil reservoirs contain more than a million barrels of reservoir space. One barrel of reservoir space is commonly less than one millionth part of a reservoir. Data referred to 1 barrel of reservoir space are called point data. This article is limited to displacement of oil by water from a point. A. H. N.

739.* Mechanics of Producing Oil, Condensate, and Natural Gas. Part 21. P. J. Jones. *Oil Gas J.*, 24.3.45, **43** (46), 71.—Illustrates the discussion of previous part by examples. Curves of displacement of oil by water from a point in a reservoir were derived in the preceding article. The curves may be used directly in estimating oil recovery from 1 brl. of reservoir space. Aside from gravity, the curves may also be used to obtain the per cent. cut in production from a barrel of space. Oil recovery from a reservoir by water displacement is equal to the sum of the recoveries from individual points. Recovery from individual points may vary from zero up to 90% of the oil originally in place. Point recovery, and therefore oil recovery from a reservoir, is influenced by several factors. Among these are (1) location and number of wells, (2) rate of production, (3) operating pressures, (4) permeability and variations in permeability, (5) effect of gravity, (6) economic limit in barrels of oil/day/well, and (7) economic limit in barrels of water/barrel of oil. Consequently, the curves cannot be applied directly to oil recovery from entire reservoirs. Nevertheless, there are some types of production problems for which a reasonable estimate can be made directly from the curves for point data. Under certain conditions oil recovery from reservoirs or from a well is controlled by water saturation, pressure difference, and water–oil ratio at economic limit. Problems of this type are illustrated by examples and graphs. A. H. N.

740.* Patents on Drilling and Production.—W. A. Abegg, assr. to Abegg & Reinhold Co., Ltd. U.S.P. 2,362,042, 7.11.44. Appl. 19.9.42. Elevator and table support for drill-pipes.

D. Silverman, assr. to Stanolind Oil & Gas Co. U.S.P. 2,362,164, 7.11.44. Appl. 11.4.42. Radioactivity logging.

C. J. Gibson. U.S.P. 2,362,198, 7.11.44. Appl. 18.4.41. Oil-well and casing cleaning brush.

J. M. Reynolds, assr. to O. E. Reynolds. U.S.P. 2,362,403, 7.11.44. Appl. 22.9.41. Means for cleaning well-screens.

E. C. Baily. U.S.P. 2,362,442, 14.11.44. Appl. 29.11.40. Apparatus for flowing oil- or gas-wells.

G. J. Barrett and S. Robichaux, assr. to A-1 Bit & Tool Co., Ltd. U.S.P. 2,362,529, 14.11.44. Appl. 30.8.40. Side-tracking apparatus.

D. F. Troupe. U.S.P. 2,362,680, 14.11.44. Appl. 17.5.41. Electrothermic oil-well processor.

C. K. Morgan, assr. to Lane Wells Co. U.S.P. 2,362,766, 14.11.44. Appl. 22.12.41. Liner hanger.

W. Sprecher and C. Ware. U.S.P. 2,362,777, 14.11.44. Appl. 12.10.43. Hydrostatic pump.

M. M. Kinley. U.S.P. 2,362,829, 14.11.44. Appl. 18.8.41. Explosive screen-cleaner.

A. M. Rossman. U.S.P. 2,362,860, 14.11.44. Appl. 22.12.41. Earth-boring rock-bit.

F. L. Scott, assr. to Hughes Tool Co. U.S.P. 2,363,202, 21.11.44. Appl. 19.7.43. Teeth for drill-cutters.

H. G. Doll, assr. to Schlumberger Well Surveying Corpn. U.S.P. 2,363,234, 21.11.44. Appl. 6.10.41. Delayed-action fuse.

M. Schlumberger, assr. to Schlumberger Well Surveying Corpn. U.S.P. 2,363,269, 21.11.44. Appl. 26.7.40. Method for sealing borehole casings. A. H. N.

Development.

741.* World Production Reached New High in 1944. Anon. *World Petrol.*, March 1945, **16** (3), 43.—During 1944 world oil production was approximately 2,598,000,000 brl., 351,000,000 brl. more than in 1943. The outstanding increases were in U.S.A.

(177,000,000 brl.), the Middle East (38,000,000 brl.), and the Soviet Union (30,000,000 brl.).

A table gives the output of the leading countries in 1941, 1942, 1943, and 1944. G. D. H.

742.* Sharp Gain Boosted World Crude Production to Peak. Anon. *Oil Wkly*, 29.1.45, **116** (9), 100.—In 1944 world oil production reached the all-time high of 2,621,840,000 brl., 343,000,000 brl. more than in 1943, daily average being higher at the end than at the beginning. U.S.A., if it continues at the later levels, would have a daily average of 4,725,000 brl. in 1945, and Venezuela 1,000,000 brl.

Of the 33 producing countries 13 increased production in 1944 and 11 established an all-time high. U.S.A. has more than doubled its production since 1932, but the rest of the world has not shown a similar increase. Outputs in 1944 were: U.S.A. 1,678,376,000 brl.; Venezuela, 267,000,000 brl., a new record; Russia, 275,000,000 brl.; the Persian Gulf area nearly 150,000,000 brl.; Roumania possibly only 20,000,000 brl.

Since 1859 world production is over 46,500,000,000 brl., nearly 30,000,000,000 brl. having come from U.S.A., over 5,000,000,000 brl. from Russia, and nearly 3,000,000,000 brl. from Venezuela. Tables give annual production by countries yearly since 1859, and compare U.S.A. and the rest of the world annually from 1918. G. D. H.

743.* 1945 will See Intensified Search for Foreign Reserves. H. S. Norman. *Oil Gas J.*, 30.12.44, **43** (34), 159.—Proven oil reserves outside U.S.A. are estimated at 31,431,522,000 brl. American companies and affiliates control 32·6% of this. Russia is credited with 5,661,598,000 brl. In the Western Hemisphere U.S. companies and affiliates control 62·8% of the proven reserves. In the Middle East U.S. companies control 30·3% of the proven reserves, but the proportion is higher if indicated reserves are included. Proven reserves of the Caribbean area are 6,314,100,000 brl., 71·8% being held by American companies and affiliates, the bulk being in Venezuela.

There are signs that the U.S. Department of State will lend support to American oil ambitions in foreign countries. There are rumours that Mexico will revise its petroleum policy. Argentina and Peru have intensely nationalistic petroleum policies. Estimated proven crude-oil reserves of the principal areas, and the proportions controlled by American companies are tabulated. G. D. H.

744.* A.P.I. Tally of Petroleum Reserves Shows 20,453,231,000 Brl.; 2,000,000,000 Brl. Gain. Anon. *Oil Gas J.*, 3.3.45, **43** (43), 48; *Oil Wkly*, 26.2.45, **116** (3), 27.—Despite record crude-oil production of 1,678,000,000 brl. during 1944, net gain in proved oil reserves in U.S.A. was 389,000,000 brl. Louisiana and Mississippi led all other states in the reserves added by discovery. Texas, with reserves of 11,375,000,000 brl., has 55·6% of the U.S. reserves, and California, Louisiana, Oklahoma, Kansas, Wyoming, and New Mexico follow in that order. During 1944 the new reserves resulting from new fields were 511,000,000 brl., the highest figure since 1938, while additions to reserves by development added another 1,556,000,000 brl. At the end of 1944 total proved reserves were estimated at 20,453,231,000 brl. Tables give reserve estimates by States and total reserves yearly from 1936. G. D. H.

745.* Annual Statistical Summary of the U.S. Petroleum Industry, 1944. Anon. *Oil Gas J.*, 1945, **43** (38), 169–260.—Includes detailed statistical breakdown of drilling plans for 1945; completions by States for 1944; production by States; crude runs; natural gasoline production and reserve estimates; proven reserves, location and size; and location drilling and production data of discovery wells drilled during the year. J. C. W.-M.

746.* U.S. 1944 Record Production of Crude should Fall in 1945. Anon. *Oil Wkly*, 29.1.45, **116** (9), 112.—During 1944 U.S.A. produced 1,678,376,000 brl. of oil, 175,000,000 brl. more than in 1943, and 276,000,000 brl. more than the pre-war peak of 1941. Nine of the 25 producing States exceeded their 1943 outputs. It is likely that the 1945 output will exceed that for 1944, and continuation of the January 1945 rate should give a total of 1,800,000,000 brl. In making its 1944 record U.S.A. absorbed all surplus efficient producing capacity estimated to exist, except for a minor amount in the Rocky Mountain area. Despite the large 1944 increase, production did not meet needs, and stocks of refinable crude fell by 20,000,000 brl.

Texas produced 748,268,000 brl. of oil in 1944, 155,000,000 brl. more than in 1943; California's output was 311,776,000 brl., 27,500,000 brl. more than in 1943; Louisiana replaced Oklahoma as third largest producing State, and yielded 129,000,000 brl. Tables give production by States yearly from 1859; the country's total and daily average yearly from 1918; and the daily average production in the country in December and the years 1941, 1943, and 1944. G. D. H.

747.* 25,267 Wells Estimated for 1945. Anon. *Oil Wkly*, 29.1.45, **116** (9), 132.—It is expected that 25,267 wells will be drilled in U.S.A. in 1945, 4653 being wildcats. The total footage is expected to be 91,629,000 ft. P.A.W. has asked for 27,000 wells in 1945, of which 5000 are to be wildcats. Forecasts of new wells and footage are tabulated by States and districts. G. D. H.

748.* Substantial Gain Over 1943 Shown in U.S. Drilling. Anon. *Oil Wkly*, 29.1.45, **116** (9), 122.—24,451 wells were completed in U.S.A. in 1944, compared with 19,245 in 1943, but 1944 figure is based on a 53-week year, thus adding 449 wells. During six years preceding the war average was 30,000 wells per year. In 1944 375 old wells were deepened, and 1873 wells were drilled as input or disposal wells. 15,456 of the new wells drilled in 1944 produced oil, gas, or distillate (13,095 oil, 2302 gas, and 59 distillate).

Texas had 6233 completions, 39·9% more than in 1943. Pennsylvania, New York, Ohio, and West Virginia had 6308 completions. Pennsylvania had 1268 water-input wells. Tables give details of types completed yearly from 1918; and completions for 1944 and 1943 by States and districts. G. D. H.

749.* Footage Drilled at Highest War Level. Anon. *Oil Wkly*, 29.1.45, **116** (9), 128.—During 1944 a total of 81,847,198 ft. of hole was drilled in the U.S., compared with 58,706,985 ft. in 1943 and 65,179,338 ft. in 1942. The average drilling depth in 1944 was 3347 ft., the previous record being 3131 ft. in 1937.

West Texas drilled 7,273,050 ft. in 1944 (4,067,030 in 1943); California 7,298,224 ft. (4,600,048 ft.). Texas had 6234 completions in 1944 with 27,720,589 ft. of hole. South Louisiana's average drilling depth was 9191 ft., and for Louisiana as a whole the average was 7430 ft.

Water-input, gas-input, and salt-water disposal wells accounted for 2,974,397 ft. of drilling in 1944, oil-wells for 46,291,774 ft., gas-wells for 6,879,026 ft., and distillate-wells for 416,433 ft.

Tables give the number of completions, total footage, and average well depth annually from 1925, and an analysis by States and districts of the 1944 well completions, the data including the numbers of oil, gas, distillate, dry, water-input, gas-input, and salt-water disposal wells, with corresponding average depths. G. D. H.

750.* Producing Oil-Wells in U.S. Reached a New High in 1944. Anon. *Oil Wkly*, 29.1.45, **116** (9), 156.—At the end of 1944 U.S.A. had 412,852 producing oil-wells; at the end of 1943 there were 407,581. In 1941 the gain was 10,066, and over the period 1931–41 the average gain per year was 8773.

The daily per-well production rose from 10·1 brl. in 1943 to 11·2 in 1944.

Texas has 99,252 producing wells, Pennsylvania 82,911, Illinois 27,062, and California 21,255.

47,191 of the producing wells are flowing wells.

The number of producing wells and the daily production per well are listed yearly from 1918, while the numbers of producing wells, flowing wells, and wells on artificial lift are tabulated by States and districts for the end of 1944 and 1943, together with the average daily production per well.

Record wildcatting took place, but less oil was found than produced. G. D. H.

751.* Rigs in Operation Rise to Near Pre-war Levels in 1944. Anon. *Oil Wkly*, 29.1.45, **116** (9), 162.—On 1st January, 1945, U.S.A. had 4683 rigs in operation; at the beginning of 1942, 1943, and 1944 the figures were respectively 4336, 2797, and 3595. At the beginning of 1945 67·9% of the rigs in operation were rotary. Texas had 1451 rigs in operation at the beginning of 1945, 506 of which were in West Texas. Pennsylvania (342), Ohio (232), and West Virginia (134) were using cable-tool rigs only. G. D. H.

752.* Production of Natural Gasoline Rises Sharply. Anon. *Oil Wkly*, 29.1.45, **116** (9), 164.—U.S.A. 1944 production of natural gasoline and allied products reached an all-time high of 102,000,000 brl. At the beginning of 1944 daily output was 252,000 brl., and about 300,000 brl. at the end. In 1943 the production was 88,179,000 brl. Texas produced 42,936,000 brl. in 1944. Natural gasoline production yearly from 1918 is given. G. D. H.

753.* Only Thirty Fields Yield 25,000 Barrels per Day. Anon. *Oil Wkly*, 29.1.45, **116** (9), 174.—In U.S.A. 2 fields are producing more than 100,000 brl./day, 8 produce between 50,000 and 100,000 brl./day, and 20 produce 25,000–50,000 brl./day. At end of 1944 East Texas was producing 370,965 brl./day from 24,237 wells, Wilmington was giving 101,440 brl./day, and Coalinga 93,912 brl./day. Of the fields giving more than 25,000 brl./day, 15 are in Texas, 10 in California, 3 in Oklahoma, and 1 each in Mississippi and Illinois. Fields are listed in descending order of daily average, with year of discovery, number of producing wells at end of 1944, and average daily production for the whole field. G. D. H.

754.* East Texas Field First in U.S. to Produce 2000 Million Barrels. Anon. *Oil Wkly*, 29.1.45, **116** (9), 176.—Since its discovery in 1930 East Texas has produced 2,104,173,790 brl. of crude, nearly twice as much as any other U.S.A. field. Seminole has produced 1,231,819,939 brl. No other U.S.A. fields have exceeded 1,000,000,000 brl., but 54 have given over 100,000,000 brl.; California has 19 such fields, Oklahoma 14, Texas 13, Illinois 2, and Arkansas, Kansas, Louisiana, New Mexico, and Wyoming 1 each. The leading fields in this category are: Long Beach (702,628,909 brl.), Midway-Sunset (674,139,069 brl.), Oklahoma City (618,911,517 brl.); Santa Fe Springs (496,568,092 brl.), Coalinga (472,296,069 brl.), Smackover (402,683,352 brl.), Cushing (368,354,217 brl.), Huntingdon Beach (344,058,823 brl.), and Salt Creek (313,171,072 brl.). Fields which have produced over 100,000,000 brl. of crude are tabulated with their cumulative, 1944, and 1943 productions, and their year of discovery. G. D. H.

755.* Producing Oil-Wells and Crude-Oil production in U.S.A. Fields. Anon. *Oil Wkly*, 29.1.45, **116** (9), 178.—Tables give by fields, grouped according to States, the year of discovery, numbers of wells flowing, and on artificial lift at end of 1944, 1944 production, daily production at end of 1944, and cumulative production. G. D. H.

756.* Two Months Completions Gain over 1944; February Averages 434 Weekly. Anon. *Oil Wkly*, 12.3.45, **117** (2), 32.—U.S.A. had 3823 completions in January–February 1945, compared with 3426 in the same period of 1944. This year's increase has been mainly in the southwest and California. Some States, including several in the Middle West and East, have had fewer completions than a year ago.

The relatively low completion rates, considering the number of rigs in operation, is due to manpower, equipment, and transport shortages. G. D. H.

757. Drilling Meets P.A.W. Demands. Anon. *Oil Wkly*, 16.4.45, **117** (7), 52.—During March U.S.A. well completions averaged 448 per week. For the first quarter of 1945 the total was 5624, against 4996 in 1944. In Texas 1945 completions are 37% more than for same period of 1944; in Mississippi, nearly 400%, while Louisiana shows a 47% and Oklahoma a 57% increase. Appalachian States and Rocky Mountain region have had less drilling than in 1944. Results are summarized by States and districts. G. D. H.

758.* Latin America Key to War Strategy. Anon. *Oil Gas J.*, 30.12.44, **43** (34), 175.—In 1945 drilling in Latin-American oil countries is expected to be at twice the 1944 figure, with stress on development drilling. Greatest efforts will be in western parts of South America.

Casabe field, Colombia, with about 30 wells, has a potential of about 15,000 brl./day.

A 4-in. pipeline has been completed from the Tibu-Socuavo area, and new production has been developed in the Upper Magdalena Valley. During 1944 Colombia's production averaged 62,840 brl./day, and it may rise to about 75,000 brl./day in 1945.

Neither Ecuador nor Peru has new fields capable of substantial expansion to meet war needs.

Venezuela's production averaged 560,100 brl./day in 1944 and in the latter half of the year ranged up to 775,000 brl./day. It will probably be required to supply 800,000–850,000 brl./day in 1945. Correlation and similarity of crudes and pressures indicate that the Jusepin, Santa Barbara, Mulata, and Travieso fields form one reservoir. The new 16-in. pipeline from Jusepin to Puerto de la Cruz provides an additional outlet for 90,000 brl./day of crude. Mercedes field has 6 wells closed in waiting a pipeline outlet.

Diagrams indicate drilling trends outside U.S.A., Canada, and Argentina, and give production of major countries. G. D. H.

759.* Three Promising Oil Areas in Mexico to be Explored. Anon. *Oil Gas J.*, 13.1.45, **43** (36), 49.—According to Pemex, 3 promising areas are to be explored in the States of Guerrero, Lower California, and Puebla. It is also planned to drill 26 wildcats in an area along the U.S.A.–Mexico border, 13 in Tampico, and 10 on the Isthmus of Tehuantepec. 1944 oil production was 36,120,000 brl., compared with 33,795,000 brl. in 1943. G. D. H.

760.* Alberta Operators Intensify Exploration in Western Area. J. L. Irwin. *Oil Gas J.*, 30.12.44, **43** (34), 249.—During 1944 Alberta produced 965,000 brl. less than in 1943, because the decline at Turner Valley was not offset by increases elsewhere. Up to 30th June, 1944, Turner Valley had produced 69,562,986 brl. of oil, 55,524,807 brl. having been obtained from the Madison. Alberta had 32 completions during first nine months of 1944. The north end of Turner Valley seems to offer the most attractive possibilities, and large producers have been completed there. The field is now about 20 ml. long and 1 ml. wide. Further developments in gas and oil conservation are being made at Turner Valley. Gas is to be returned to the gas-cap or sent to Bow Island.

There are 11 small producing fields outside Turner Valley. Vermilion is most prominent with 51 wells giving 15° oil from about 1900 ft. Lloydminster, 30 ml. east, also gives heavy crude from a similar depth. Princess field produces 32° oil from a Devonian limestone at 3937–3983 ft. Conrad has 2 producing wells in basal Ellis sand at about 3050 ft.—oil is 25·4-gravity. Ram River has a major gas-flow with indications of oil. An earlier well was a small producer. Drilling is being continued below 4715 ft. in Devonian limestone.

A preliminary estimate puts Alberta's 1944 production at 8,500,000 brl.

G. D. H.

761.* Fifty-one Productive Wells in Norman Wells Field. J. S. Stewart. *Oil Gas J.*, 30.12.44, **43** (34), 250.—At the end of September 1944, the Norman Wells (Canada) oilfield had 51 producing wells, with an estimated efficient potential capacity of 4506 brl./day. Productive area delineated is probably 4300 acres, a large part being covered by the Mackenzie River. Average depth is 1668 ft. and total cumulative production to end of September 1944 was 1,304,077 brl. The oil is in a limestone reef which forms a stratigraphic trap on the south limb of a broad anticline. The oil is 39–41° A.P.I. gravity, flows naturally, and reservoir pressure is abnormally high. Gas recycling has begun.

Intrusion of water in Goose Island wells has caused a number of wells to be restricted, reducing estimated efficient potential to 3900 brl./day in November. G. D. H.

762.* Nationalistic Policy in Peru Hampers Future Oil Prospects. Anon. *Oil Gas J.*, 30.12.44, **43** (34), 253.—Peru's oil output rose slightly in 1944, in spite of unfavourable political developments. New Constancia field, near the older Zorritos field, has 4 wells, averaging about 1000 ft. Its current potential is reported to be 1200 brl./day. Normal declines in producing areas of La Brea-Parinas, Lobitos, and Zorritos may offset probable increase in Constancia output. International Petroleum Co. completed 71 new wells in 1944, and 77 workovers. Lobitos Oilfields had 35 new wells and workovers in its Lobitos and Restin-El Alto fields, and produced 2,500,000 brl. in 1944. The Government company produced 27,000 brl. from the Zorritos and Cope areas, and 53,000 brl. from Constancia.

The Agua Caliente field of eastern Peru produced 48,000 brl. in 1944, about 20% of its capacity. Structure is 15 ml. long and 9 ml. wide, and it is believed that the field could produce 5000 brl./day if outlets and markets were available. G. D. H.

763. Colombia's Tres Bocas Field Slated for Greater Attention During the Year. Anon. *Oil Wkly*, 5.2.45, **116** (10), 48.—Twelve wells produce at Socuavo and 2 at Tres Bocas, from the Lower Eocene at depths of about 5200 ft. in both cases. The 2 fields are on domes separated by a saddle, and it is possible that they will eventually be joined. It is likely that the Cretaceous of the Tibu area will be thoroughly tested, since the Petrolea field, 12 ml. to the southeast, has 6 pay horizons in the Cretaceous. Tests at Tres Bocas and Socuavo have met strong gas-distillate flows, but were shut in. Both these wells were high on structure, so down-flank wells may tap oil-flows in the same horizons. The Cretaceous oil at Petrolea averages 46-gravity, indicating the probability of distillate in gas-cap accumulations in the same zones. At Petrolea the greatest producing depth is 1675 ft., and the shallowest 85 ft. G. D. H.

764.* Colombia Assured its Greatest Producing Year. Anon. *Oil Gas J.*, 30.12.44, **43** (34), 235.—Colombia's average production in 1944 was 62,841 brl./day. During 1945 production will probably reach 80,000 brl./day. Arrangements have been made for Casabe crude to pass by pipeline from Barranca Bermeja to Cartagena. There is also a pipeline outlet from the Tibu field of the Barco concession to Covenas. Acceleration of development of Tertiary sands at Tibu is planned, and the Cretaceous, which has produced in two inconclusive tests, will be fully explored. Tropical Oil Co. has been given a further 5-year tenure of the De Mares concession.

Casabe field's 23 producing wells have an efficient potential of about 15,000 brl./day. La Cira-Infantas production currently averages about 50,000 brl./day. Production has been developed on Cimitarra Concession (Cantagallo), 15 ml. north of Casabe. The field will probably extend under the river and possibly to the eastern banks. Two of Cimitarra wells are in the 3000 brl./day class. G. D. H.

765.* Jusepin Field a Model Operation. J. A. Holmes. *Oil Gas J.*, 30.12.44, **43** (34), 215.—Jusepin field, Venezuela, produces 32° A.P.I. oil and was the first light-oil find in what had been considered a heavy-oil area. Subsequently nearby light-oil fields of Santa Barbara, Mulata, and Travieso were found along the same trend, and may prove to be one continuous reservoir. Jusepin proper covers 14,000 acres at present, but is not fully outlined. Its two producing zones total several hundred feet in thickness. Oil is in Upper Miocene sands, on a monocline dipping south at 5–10°. There are minor folds, but the reservoir is essentially stratigraphic in type. Edgewater occurs down dip. Wells average 4750 ft. in depth. Recently a deep Oligocene horizon has been developed.

Conventional steam rigs and drag and rock bits are used. Mud control has been successful in overcoming unusually high pressures met above first oil-zone. Some 130 wells were flowing naturally in mid-1944, giving 32,000 brl./day, with a cumulative production of 30,000,000 brl. Dual completions are used, as there is evidence that with a common oil-string one zone may feed the other. Initial spacing is on a 666-m. equilateral pattern, giving 95 acres/well. Some areas are on a 32-acre spacing, this being dictated by sand conditions.

Periodical subsurface pressure surveys are made, and flow tests and analyses of subsurface fluids are routine operations. The oil is slightly undersaturated with gas at original pressure of about 2700 lb./sq. in. Early pressure decline was rapid, but careful control of withdrawals has checked this. Wells flow 200–300 brl./day, a rate at which the gas–oil ratio is a minimum, and the possibility of channelling is reduced. Water-drive appears unable to support reasonable withdrawal rates and return of gas to the reservoir is being considered. The Caripita (Oligocene) formation is of high permeability, in contrast with the low-permeability Miocene sands. Jusepin has a 45-ml. 10-in. pipeline to Caripito, and a 110-ml. 16-in. pipeline to Puerto de la Cruz is under construction. G. D. H.

766.* Socony-Vacuum Concentrating on Development Drilling in Venezuela. Anon. *Oil Gas J.*, 30.12.44, **43** (34), 206.—Under the 1943 Petroleum Law Socony-Vacuum Oil Co. holds concessions of 1,627,000 hectares in Venezuela. All wildcatting has so far been in Eastern Venezuela, and the company has developed the Guario and Guico fields near Mene Grande Oil Co.'s Oficina-Puerto de la Cruz highway. The former is a northeastern extension of San Joaquin field, and the latter a western extension of West Guara field. At Anaco a small northeast extension of El Roble field has been developed. Socony-Vacuum has drilled 16 wildcats totalling 61,167 ft. None was a discovery well, and fields mentioned were extensions of known fields. Outlying wildcats have been drilled with diesel rigs.

Guario field has 10 producing wells, 4 of which exceed 10,400 ft. in depth and have proved crude oil and condensate in the Merecure series. Six wells produce from shallower Oficina series. Present production is 3900 brl./day, and there is shut-in condensate potential of about 5000 brl./day. Drilling and operating techniques are briefly described. G. D. H.

767.* Production is Restored in Ukraine Oilfields. Anon. *Oil Wkly*, 22.1.45, **116** (8), 58.—Production has been restored in several small oilfields of the Western Ukraine, east of Kiev. The fields of Rommy, Poltava, Drogobych, and Borislavl are reported to have exceeded output quotas in the last four months of 1944. G. D. H.

768. Near East to Assume a Major Rôle in Markets of the World. Anon. *Oil Wkly*, 11.12.44, **116** (2), 74.—So great are known and probable reserves of oil in the Middle East, that it ranks on equal footing with the U.S.A. as a future source of oil, even on a most conservative basis. When consideration is given to large number of undrilled favourable prospects and vast areas practically unexplored, it appears that the Middle East eclipses even U.S.A. in oil potentialities. Large reserves of the Middle East have been revealed by fewer than 150 wildcats due to fact that the search began when modern oil-finding technique had become highly developed. Proved reserves of the Middle East are 15,500,000,000–16,500,000,000 brl., while proved and indicated reserves are 25,000,000,000–27,000,000,000 brl. Iran and Saudi Arabia rank high as regards undrilled prospect values.

Current production of area is small compared with the potential.

During 1944 refining facilities in the Middle East have been expanded and tentative plans laid for new pipelines. At end of 1944 refining capacity will probably be 500,000 brl./day, and production will probably be twice this soon after the war.

Proposed U.S.-financed pipeline would have been 1500 ml. long, with a trunk line of 24- and 26-in. pipe, capable of carrying 200,000–250,000 brl./day from Saudi Arabia, Bahrein, Qatar, and Kuwait to a projected Mediterranean refinery. British interests also planned similarly to increase production and refining capacity. Iraq pipelines were also to be increased. At present Kirkuk is producing 80,000 brl./day from 6 wells. This satisfies existing pipeline capacity.

Post-war surplus of tankers will provide much transport even if pipelines are not built.

Very little drilling would be needed to provide the 1,000,000 brl./day planned. At beginning of 1944 the Middle East was producing about 400,000 brl./day.

British interests, including Royal Dutch-Shell, hold 61% of the proved reserves, and American interests a little over 30%; of the proved and indicated reserves the holdings are respectively 54% and 41%.

Tables give proved and indicated reserves, daily production early in 1944 and later in 1944, and refinery capacities at the corresponding dates. G. D. H.

769.* Middle East Petroleum Reserves Support Huge Expansion Programme. Anon. *Oil Gas J.*, 30.12.44, **43** (34), 170.—It seems likely that further exploration and development may confirm assertions that the Middle East petroleum reserves are of the order of 100,000,000,000 brl. Conservatively, reserves of Iran, Iraq, Kuwait, Saudi Arabia, Bahrein, and Qatar are placed at 15,500,000,000 brl., while proven and definitely indicated reserves are fixed at 26,000,000,000 brl. Plans have been made for producing 1,000,000 brl./day as soon as transportation facilities can be provided and markets developed in Europe and Asia. Two additional crude-oil pipelines to the Mediterranean and a products line from Abadan to Haifa are under consideration.

A new 50,000-brl. refinery is being built at Ras Tanura, and Bahrein refinery is being enlarged to 58,000 brl./day. Abadan refinery capacity has been raised to 362,000 brl./day, and that of Haifa refinery to 80,000 brl./day. Maps show concessions, pipelines, refineries, and export movements to Europe and the Near East.

G. D. H.

770.* Production Pushed to New Peaks. Anon. *Oil Gas J.*, 30.12.44, **43** (34), 173.—During 1944 Iran's production averaged 273,000 brl./day, current output being 355,000 brl./day; this rate may be sustained in 1945. Iraq is producing over 100,000 brl./day; average in 1944 was 76,500 brl./day, with only 5 wells producing at Kirkuk, remaining 58 being plugged. Kirkuk structure is 60 ml. long and 3 ml. wide, with 350–400 ft. of producing formation. When producing 60,000 brl./day the bottom-hole pressure decline was 17 lb./sq. in. annually. There is combined gas-cap- and water-drive. Four wells have been completed on the 35-sq. ml. Ain Zelah structure. Oil is in Cretaceous at 4500–6500 ft., and of 32° gravity, sulphur-free. Four other structures in Iraq have only been tested by a few wells.

Masjid-i-Sulaiman, Haft Kel, Gach Saran (Gach-i-Qaraguli) are the main producing fields in Iran, and output is controlled by refinery capacity and reservoir behaviour.

Currently Saudi Arabia is producing 40,000 brl./day. Dammam is Saudi Arabia's most developed field, but most of the 27 producing wells were plugged because of threatened German occupation. Abqaiq field, south of Dammam, has 5 wells, and deep Abu Hadriya field is scheduled for early development.

Lack of outlet precludes production from Burghan field, Kuwait, and from Qatar wells. Kuwait's reserves are estimated at 4,000,000,000–9,000,000,000 brl. The two Qatar wells are about 7000 ft. deep, and capable of producing 5000 brl./day of 45° sulphur-free oil.

Exploratory work has been resumed in Egypt after a lapse of four years. A well is being drilled 50 ml. west of Cairo, and another on the Sinai Peninsula. In 1944 Egypt produced 9,500,000 brl. G. D. H.

771.* Polish Petroleum Prospects Bright Despite Decline under Nazi Operation. Anon. *Oil Gas J.*, 30.12.44, **43** (34), 264.—In 1942 Poland's crude production is estimated to have been 7724 brl./day, about 25% less than in 1938. Crude was processed in local refineries. Up to end of last war gas was obtained with oil, but in 1917 a gas-bearing horizon was developed near Jaslo. Other gas-fields were opened near Stryj, Drohobycz, Kalusz, and Przemysl, and there are indications that others may occur in this line paralleling the oil-bearing zone in the foothills of the Carpathians. 30,000,000,000 cu. m. of gas is estimated to be present in the areas investigated but not exploited. In 1920 405,000,000 cu. m. of gas was produced, in 1938 584,000,000 cu. m. About half the gas was used in mines and refineries, and the rest domestically and in generating electricity. Long-distance gas-lines were built. The Germans extended these and raised the output to 660,000,000 cu. m./yr. In 1920 natural gasoline production was 565 tons; in 1938 40,864 tons. It fell by 38% under German rule.

Poland produced 507,000 tons of oil in 1938, 64·1% from the Drohobycz-Boryslaw, and 26·8% from the Jaslo, region. In 1934 42% of Polish production was exported; in 1938 less than 10%. Better drilling technique led to increased oil production in pre-war years, and post-war prospects appear bright. G. D. H.

TRANSPORT AND STORAGE.

772. Economic Prevention of Evaporation Losses. H. J. D'Aragon. *Petrol Engr*, March 1945, **16** (6), 179.—Breathing and filling losses are described and discussed, and from wide tests carried out at a number of refineries on various-sized cone roof-tanks holding gasoline of winter and summer vapour pressures 9 and 12 p.s.i., a comparison is made of the losses based on an 80,000-brl. cone roof-tank with conventional pressure and vacuum relief-valve.

Tables are given showing: (1) standing evaporation losses—motor gasoline in cone roof-tanks; (2) expansion roof capacities for 5- and 10-ft. lift. The elimination of (1) breathing, (2) filling losses in single tanks is discussed, and the elimination of breathing and filling losses in multiple tank installations is described, discussed, and shown in diagrams. By connecting vapour spaces of several cone roof-tanks by a vapour line with the vapour space of one of the tanks equipped with an expansion-type roof. The resulting system will permit vapour to pass from one tank to another when breathing or in the process of filling or emptying. The expansion roof then is not only designed to provide for expansion of vapours in the entire system due to daily temperature increase, but acts as a reservoir for vapours displaced in the tanks when total filling exceeds emptying. Such closed systems formed by manifolding tanks using an expansion roof as the " balancing " unit may be successfully employed to store a variety of products simultaneously, and tanks containing sweet and sour crudes have been included in the same system without fear of contamination. A graph—expansion roof-tank diameter/protected storage in thousands of barrels, for use when one or more tanks are manifolded with an expansion roof tank is shown. Results from the chart are sufficiently accurate for calculations involving normal operations based on an average daily temperature variation in the vapour space of 50° F. W. H. C.

773. Determining Soundness of Welds in Line Construction. W. E. Crenshaw and D. E. Abbey. *Petrol. Engr*, March 1945, **16** (6), 233.—Magnaflux method of locating faults or discontinuities in metal structures, formerly applicable only where high line voltage existed, can now be used in the field, or at installations where only direct current is available. Mobile equipment is available in which high-amperage, low-voltage current produces the required magnetic field in which the part to be inspected is placed. Wherever a discontinuity crosses the magnetic field at right angles, or nearly thereto, a resistance is offered to its passage, with the result that some of the field, taking the path of least resistance, pushes into the external air. Local north and south poles are set up along the edges of the discontinuity and, when a specially prepared powder of finely divided paramagnetic particles is sprinkled or blown over the area of inspection, those particles are attracted to the poles and build up, outlining the extent of the discontinuity. As discontinuity may occur longitudially or axially with a part, it is necessary to control the direction of the magnetic field in a way to assure its intersection with the discontinuity at right angles. The procedure of testing is briefly described.

Advantages of determining soundness of welds are discussed, and the type of faults found in pipeline and other welds, in manufactured parts, and in repair welds of such structures, are outlined and discussed. Nine illustrations show some of the points discussed. W. H. C.

774. Relation of Wall Thickness to Pipelife. K. H. Logan. *Petrol. Engr*, March 1945, **16** (6), 186.—Corrosion phenomena is summarized as follows: (1) all ferrous materials commonly used underground corrode at nearly the same rate; (2) soils differ widely in corrosiveness; (3) the rate of pitting tends to decrease as the exposure is prolonged; (4) the decline in the rate of pitting differs greatly under different soil conditions; (5) on the average, the deepest pit on a large area will be deeper than on a small area. As a corollary, a leak may be expected to develop on a long line sooner then on a short one, other conditions being the same.

The data presented as to the effect of different types of soil on ferrous materials, and the maximum pit depth found in old lines and calculated by Ewing's pit depth-area time equation, etc., are discussed. The manner by which extension of pipe life may be accomplished and the costs for the various types of protective coatings, *i.e.*, cement, paint, bituminous paints, and coats, with and without various reinforcing wrappings, cathodic protection with zinc anodes, or by increasing the metal wall thickness and combinations of some of these methods are shown. W. H. C.

775.* Loading Terminal Embodies New Features. F. H. Love. *Petrol. Engr*, March 1945, **16** (6), 169.—Products have to be pumped 32 miles from the Old Ocean Refinery to the loading terminal at Old Brazos River, Gulf of Mexico. A 5·9/16-in. line is provided for aviation gasoline and a 4½-in. line for motor gasoline, diesel, or furnace oil. Two pumping units each of two centrifugal pumps, and two 200-h.p. gas-gasoline engines, operating at 650–1000 p.s.i. deliver into four 100,000-brl. tanks. Owing to unconsolidated ground, these are supported on concrete with piles driven 40 ft. down. At the terminal 15 Deepwell vertical centrifugal loading pumps, driven by 15 engines, as described, under 750–800 p.s.i., each deliver 1800–1100 gal. minute. The pumps are fed by 24-in. lines connected to 24-in. headers sunk in a concrete pit 90 × 12 × 12 ft. Delivery is made through two 14-in. lines to dock side, where each has four 10-in. points with swivel joints for discharge to tankers. A Foamite fire-fighting system is described. As hurricanes are liable to occur, an ingenious method has been provided to prevent collapsing of tanks through a storm arising when the tanks are empty or partly empty. For this purpose a 90-in. concrete line is provided from the river to the 90-ft. pit described. In such an emergency the pit is easily filled with sea-water which flows through two 24-in. lines to the pump-pits, whence suction is made. The tanks can be filled in a few hours. Two 135-h.p. oilfield-type boilers provide any steam required at the terminal. W. H. C.

776. Economic Design of Pressure Vessels. Article 5. Gas Storage : Miscellaneous Factors. E. F. Brummerstedt. *Nat. Petrol. News, Technical Section*, 4.10.44, **36** (40), R. 684.—Unit cost of storing gas at atmospheric pressure is directly related to volume of holder. Cost per cu. ft. recently quoted for 250, 500, 750, 25,000, 50,000, and 250,000 cu. ft. capacity were 7·56, 4·02, 3·60, 0·56, 0·44, and 0·33 dollars, respectively, exclusive of foundations, etc. It is often practical, and also desirable, to store gas under pressure, and so reduce size of storage vessel. A cost comparison is given for vessels to hold 50,000 cu. ft. of gas at normal pressure under 10, 25, 50, and 500 atm. (abs.), the temperatures remaining constant. This shows the diameter, area, thickness of plate, and weight of (1) cylindrical and (2) spherical vessels. Cost figures reveal that storage at pressures which do not require excessive thickness of plate is economical, but saving is not so great as it appears, as no account has been taken of cost of compressing and cooling gas to maintain constant pressure. Nevertheless, where a plant is operated at high pressure, and particularly for hydrogenation, pressure storage is not only desirable, but economical. Miscellaneous factors affecting design of pressure vessels are discussed in relation to foundations, supports, number of shell courses, etc. W. H. C.

777. Storage of Butadiene and *iso*Butylene. Anon. *Petrol. Engr*, March 1945, **16** (6), 85.—Growth of synthetic rubber industry made it necessary to study factors involved in solution of butadiene and *iso*butylene storage problems. Container materials, protective coatings, conditions of temperature and pressure, and most economical type of storage plant have been investigated. Dimerization and polymerization reactions of butadiene have been studied and the latter found to be influenced by several factors, including temperature, light, contact with various metals, and alloys and impurities. Polymerization of butadiene has delayed production, with increased costs and loss of material. *iso*Butylene does not show any great tendency to polymerize as does butadiene. Storage requirements are similar; neither substance is corrosive to mild steel at ambient temperatures. Nine types of storage vessels have been studied for both raw materials, capacities ranging from 100 to 700 tons. Thickness of the insulating material, corkboard, or similar substance, determines capacity and average cooling load of refrigeration plant. Costs of storing either butadiene or *iso*butylene are tabulated showing only slight differences. 1 : 3-Butadiene should be stored as a liquid at its lowest temperature economically feasible. This is about 32° F. with a corresponding working pressure of 3 lb./sq. in.; and 4 lb./sq. in. for *iso*butylene. Loss of product at about 32° F. through dimerization or polymerization is negligible. Low pressure containers (under 15 lbs./sq. in.) should be of welded construction using mild steel or for higher pressures of welded construction using flange or fire box boiler grade steel. Amount of steel for containers at 32° F. is less than half of that required for containers in which storage is at ambient temperatures. Mill scale should be removed by blasting. G. A. C.

REFINERY OPERATIONS.

Refineries and Auxiliary Refinery Plant.

778. Temperature Measurements in High-Velocity Air Streams. H. C. Hottel and A. Kalitinsky. *J. Appl. Mech.*, March 1945, **12** (1), A25–A32.—When a stream of air is partly stopped by an inserted temperature probe, temperature increase due to conversion of kinetic energy affects reading of the probe. The fraction of total kinetic temperature rise which is registered by the probe, *i.e.*, the so-called "recovery factor" of the probe, is a function of a number of variables. Tests dealing with the effect of probe shape and air velocity on this recovery factor, and with the influence of radiation on accuracy of measurements, are reported. Bare-wire probes gave recovery factors of approximately 0·65 in transverse flow and, in axial flow, approached 0·87 as the air velocity increased (in good agreement with theoretical predictions for flow over flat plates). With a spherical enlargement at thermocouple junction, recovery approached 0·75. Recovery of twisted-wire couples varied from 0·72 to 0·83. A reduced-scale model of Franz probe was found unsatisfactory after extensive study. Two simpler probes were developed, having high recovery (above 0·98 as velocity approaches sonic) and satisfactory insensitivity to yaw and radiation errors. A. H. N.

779.* Practical Approach to Packing of Chemical Pumps. S. L. Lopata. *Chem. Met. Eng.*, December 1944, **51** (12), 104–107.—Types of yarns available are classified under asbestos, metallic, synthetic, and glass. Lubricants are also discussed and a table given of general recommendations for packings for pumps handling chemicals. Of these, the following are of particular interest to petroleum refining : phenol, hydrochloric acid, nitric acid, phosphoric acid, sulphuric acid, oleum or mixed acids, for all of which African blue asbestos lubricated with graphited glyceride-free non-oxidizing lubricant is recommended. Sodium hydroxide can be handled with Canadian white asbestos lubricated with graphited glyceride-free lubricant or plastic shredded Canadian white asbestos or shredded white metal similarly lubricated. These packings are also recommended for acetone, methyl alcohol, ethyl alcohol, methyl, butyl, and amyl acetate, naphtha, kerosine, formaldehyde, benzene, toluene, and xylene. Halogenated hydrocarbons should be handled with plastic-shredded African blue asbestos packing with graphite and lubricant. Grease and water seals are discussed.

A. H. N.

780.* Bending of Curved Thin Tubes. L. Beskin. *J. Appl. Mech.*, March 1945, **12** (1), A1–A7.—Stress distribution in curved tubes under action of applied couples acting either in the plane of tube curvature or perpendicularly to that plane greatly differs from conventional beam distribution, especially in case of tubes with thin walls and a great curvature of centre line. For that reason, curved tubes with thin wall are much more flexible under applied couples than corresponding straight tubes. Stress distribution in curved tubes, and its influence on rigidity are examined in the case when ratio of the radius of centre line to radius of the tube is great. It is also shown that, when this ratio is small, the result relative to rigidity remain fairly accurate, while the results relative to stress distribution are incorrect and require a more complete analysis. A. H. N.

781.* Sliding Bearings for Hot Towers and Tanks. W. H. Blank. *Refiner*, March 1945, **24** (3), 108–109.—Design of sliding supports for hot towers and tanks in order to relieve temperature stresses is discussed and illustrated. A. H. N.

782. New Formula Developed for Kiln Time. R. A. Bayard. *Chem. Mer. Eng.*, March 1945, **52** (3), 100–102.—Formulæ are developed for the passage time of material through kiln fitted with rings, and nomographs based on these formulæ are given.

A. H. N.

783.* Recent Experience with Chemical Removal of Scale From Condenser Tubes. J. S. Rush and W. S. Jennings. *Refiner*, December 1944, **23** (12), 477–480.—Experiences of Dow Chemical Company power-house, containing six turbogenerators, delivering regularly 115–120% of their rated power, are discussed. Particular attention is paid to removal of scales from condenser tubes. A chemical method used is compared with a mechanical system. A. H. N.

784.* Rôle of the Laboratory In Refinery Efficiency. J. J. Stadtherr. *Refiner*, December 1944, **23** (12), 435–487.—Requirements of efficient use of a laboratory are discussed and analyzed, particularly from human and general co-operation aspects.

A. H. N.

785.* Control of Refinery Corrosion Dependent upon an Eternally Vigilant Programme. Anon. *Oil Gas J.*, 31.3.45, **43** (47), 246.—A review is given of methods combating seven main types of refinery corrosion, viz : (*a*) corrosion in topping units from acids released during distillation of crudes ; (*b*) acid attack in distillation of acid-treated distillate stocks ; (*c*) acid attack from breakdown of organic sulphur compounds and alkaline earth salts in charge to thermal cracking units ; (*d*) H_2S attack in gas-treating and stabilizing units ; (*e*) direct chemical attack from substances used in treating and processing units ; (*f*) pitting of lines and equipment from salts and oxygen contained in cooling water, and (*g*) atmospheric, fume, and spray corrosion. Protective measures considered include : (1) selection of corrosion-resistant metal, such as chromium steel alloys for cracking units ; 70 : 30 Cu : Ni, exchanger tubes where water corrosion is important ; and 4–6% Cr alloy tubes where H_2S corrosion is experienced ; (2) use of protective coatings such as metal liners, electrodeposited, hot-dip, or weld-deposited metal coatings, and plastic, synthetic rubber, or cement liners and coatings ; (3) chemical neutralization with ammonia or caustic soda, the use of inhibitors such as quachrom glucosate in the presence of H_2S, and chemical extraction of H_2S from feedstocks with caustic soda, soda ash, or tripotassium phosphate ; (4) chemical treatment of water serving condensing and cooling equipment to provide protective films on metal or to remove the oxygen present, *e.g.*, with sodium hexametaphosphate, caustic soda, sodium dichromate, glucosates, etc. ; (5) electrical methods, including cathodic protection and electrical dehydration of crudes, and (6) mechanical methods, including the use of flushing oils (soluble oils) in vacuum compressors handling gases rich in H_2S, to remove or reduce deposition, the use of mechanical or coalescent-type water separators, and mechanical deaeration of cooling water. C. L. G.

786.* North American Operating Refineries. Anon. *Oil Gas J.*, 31.3.45, **43** (47), 296.—Lists show operating company, plant location, crude oil and cracked gasoline capacity and type of refineries operating in the U.S.A., Canada, and Mexico.

C. L. G.

Distillation.

787.* Effect of the Diameter of Laboratory Columns with Fenske Packing on Their Efficiency and Capacity. B. A. Kazanskii, A. L. Liberman, and O. D. Sterligov. *Refiner*, December 1944, **23** (12), 493–495. (Translated from *Zhurnal Obschei Khimii*, 1943, **13**, pp. 125–130. By J. G. Tolpin.)—Reference to work by Lecky and Ewell is made, and it is shown that change of reflux ratio did not materially affect efficiency of fractionation. Effect of the diameters of the tubes is pronounced. Columns with different types of packing behave differently in this respect. Thus, H.E.T.P. of a column packed with chains decreases to almost one half when diameter increases from 2 to 5·3 cm., while efficiency of a column packed with carding teeth changes with same change of diameter more than three times. Effect of diameter on efficiency and capacity, using single-turn glass spirals, is discussed. Doubling diameters was found not to affect efficiency, whilst capacity increased sharply. A. H. N.

788.* Fractionation and Other Vaporization Processes. Part 10. R. L. Huntington. *Refiner*, **23** (11), 451–455.—Principles of fractionating column design are given together with an illustrative example. McCabe–Thiele graphical method of fractionator design is described and illustrated. A. H. N.

789.* Fractionation and Other Vaporation Processes. Part 11. R. L. Huntington. *Refiner*, December 1944, **23** (12), 498–501.—Deals with fractionation of multi-component systems and with application of McCabe–Thiele diagram to complex mixtures. Worked examples illustrate the methods. A. H. N.

790.* Fractionation and Other Vaporization Processes. Part 14. R. L. Huntington. *Refiner*, March 1945, **23** (3), 111–116.—Design of absorber columns and evaluation of the effects of pressure temperature and of gas/oil ratios are discussed. A numerical example is worked out in full. A. H. N.

Solvent Refinery and Dewaxing.

791.* Propane Deasphalting of " Cat-Cracker " Feed-Stock. H. Dimmig and N. L. Dickinson. *Nat. Petrol. News, Technical Section*, 4.10.44, 36 (40), R. 686.—Propane treatment of heavy reduced crudes on a commercial scale for preparation of catalytic cracking feed-stock has resulted in a noteworthy advance, in that the deasphalted oil provides an augmented supply of the most desirable type of feed-stock, viz. : a heavy gas oil, and also reduces the amount of heavy fuel oil requiring disposal. As processing need not be so sharp as that required for deasphalting lubricating oil, the propane/feed-stock ratio is lower, so that both investment and operating costs are reduced. Propane/feed-stock ratios around 4 : 1 give satisfactory results. The propane deasphalting process is described and shown in a flow-sheet, and typical deasphalting results and results of catalytic cracking of blends of heavy gas oils and deasphalted oils are shown.

An example of the advantages of deasphalting is shown: An East Texas crude—normally giving 8–10% asphalt bottoms, or when cut back for No. 6 Fuel, 10–12%, of the crude—when processed to give all products including 650° I.B.P. heavy gas oil and the residue is propane deasphalted, the blend of the 650° I.B.P. heavy gas oil and the deasphalted residue amounts to 4–6% more for cracking, and the asphalt bottoms are decreased to 4%, against 8–10% and when cut back to No. 6 specification, gives 5·25% against 10–12%. Where 650° E.P. gas oil is sold for diesel fuel the deasphalting process increases the catalytic feed stock by 10–20%. W. H. C.

Cracking.

792.* Butane Dehydrogenation by the Houdry Process. R. C. Lassiat and F. D. Parker, *Refiner*, November 1944, 23 (11), 409–414. (*Paper Presented before California Natural Gasoline Association.*)—Theory and practice of dehydrogenating hydrocarbons over chromic oxide–alumina type catalysts at high temperatures and pressures are given. Effects of temperature, space rates, pressure, feed composition, and catalyst activity as revealed by laboratory studies are presented graphically and discussed. Commercial plants and applications are discussed in brief. A. H. N.

Hydrogenation.

793.* British Research on Petroleum Substitutes—5 (1) Hydrogenation of Tar Products. R. M. Bridgwater. *Petroleum*, April 1945, 8 (4), 68.—The Chemical Research Laboratory has investigated the chemical constitution of low-temperature tars with a view to obtaining products other than fuels; whilst at the Fuel Research Station work has been on the conversion of these tars to motor spirit. Work at the Chemical Research Laboratory has resulted in the identification of a large number of tar constituents, and these are tabulated.

To aid research on hydrogenation-cracking of tars the behaviour of typical pure compounds was examined. Batch experiments first determined most suitable conditions for hydrogenation; followed by preliminary experiments in a Bergius plant erected for the hydrogenation of coal. Later, two other plants were built, the second on a semi-technical scale processing 22 gallons of tar per hour, and capable of use up to 400 atm. Two continuously operated experimental units were also constructed to treat small quantities of tar.

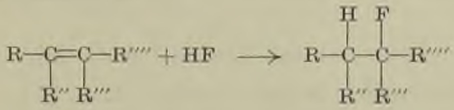
Preparation of a reliable active catalyst for use in the experiments was studied, and also effect of variables in small continuous plants. Yields of 50–60% by volume of 200° C. end-point spirit could be obtained in semi-technical scale plant. Attempts to re-cycle the product boiling above 200° C. to obtain motor spirit were limited by accumulation of refractory material. Results did not differ materially from those obtained in the smaller plants. G. A. C.

794.* British Research on Petroleum Substitutes—5 (2) Hydrogenation of Tar Products. R. M. Bridgwater. *Petroleum*, May 1945, 8 (5), 93.—It has been found that hydrogenation of high-temperature carbonization tars should be carried out in two stages, unless the liquid is free from solids and hydrogenation-resistant material. Best catalysts for vapour-phase treatment are 0·2% of hydriodic acid, or a mixture of 0·1% acid with 0·1% of molybdenum trioxide.

The Fuel Research Station have investigated the hydrogenation of cannel coal tar, shale tar, and cresoste to produce diesel oil. Products obtained had cetane numbers of 60, 56, and about 45, respectively, and other properties showed them to be of poor quality. Effect of turbulence on the reaction between tar and hydrogen was studied. Oils containing considerable quantities of phenol were hydrogenated, and a continous plant processed 2 litres per hour, converting 60% of the cresols in cresylic acid to toluene. G. A. C.

Alkylation.

795. Fractionation of Hydrofluoric Acid and its Significance in H.F. Alkylation. R. Maas. *Petrol. Engr*, February 1945, **16** (5) 194.—H.F. from the alkylation plant is regenerated in a similar manner to that of its manufacture, but contaminants are different. In alkylation acid contaminants are water, sulphur, hydrocarbons, and organic fluorides. Equations for H.F. alkylation of *iso*butane and unsaturateds producing an alkylate (monamer), and polymerization of unsaturateds giving a dimer are shown, and reaction equation of H.F. and an unsaturated hydrocarbon forming an organic fluoride is presumed to be :—



$$R{-}\underset{R''}{C}{=}\underset{R'''}{C}{-}R'''' + HF \longrightarrow R{-}\overset{H}{\underset{R''}{C}}{-}\overset{F}{\underset{R'''}{C}}{-}R''''$$

The equation is reversible by heat, etc.

Effect of contaminants and design of regenerating tower are discussed in relation to efficiency of operating and lessening of corrosion. Regeneration of H.F. as practised employs azeotropic methods. *iso*Butane and H.F. form a minimum azeotrope, *i.e.*, a constant-boiling mixture (C.B.M.) which boils at a lower temperature than either of its components. Regeneration of wet H.F. feed is carried out in rectifying section of the column, using *iso*butane for refluxing which progressively cools the vapours and condensate and allows both to reach the C.B.M. phase, and so removes the azeotrope at a lower boiling point at the same time that contaminants are rectified from the combination. In this way 99–100% H.F. is recovered as an overhead with less than 0·2% H.F. in the bottoms.

As liquid descends in the tower and becomes hotter, the H.F.-water phases tend to approach the C.B.M., which is a maximum azeotrope, containing 55% H.F., which boils at a higher temperature than either of its components or any of their other mixtures. This means that progressive heating will eventually result in the vapour and liquid attaining the C.B.M., final vaporization taking place at this composition. As the H.F.-water azeotrope is the most corrosive of any such mixtures, this tendency for its formation must be avoided to keep down corrosion. Methods adopted to lessen corrosion are described, use of monel metal so far giving the greatest satisfaction.

In the alkylation process described it is shown that organic fluoride concentration is a direct function of acid concentration to contactors and rate of acid contamination increases with increased contamination—presumably the organic fluoride. The hydrocarbon stream from the reactor after acid settling is stripped of its H.F., and is treated twice with bauxite after fractionation in (1) the deisobutanizer and (2) in the debutanizer. The reaction between bauxite and organic fluoride is shown for both aluminium and silica constituents of the bauxite and indicates the deleterious products liberated (H_2O, SiF_4, and subsequent H.F. and H_2O) which cause trouble in the operations—these are discussed. The best means of combating the difficulties has been by maintaining the acid contamination around 3–5%—*i.e.*, with an acid strength of 95–97%. W. H. C.

Isomerization.

796. Butane Isomerization. Method of Continuous Operation by Universal Oil Products Co. Using Aluminium Chloride as Catalyst. J. A. Chenicek, C. G. Dryer, R. E. Sutherland, and J. O. Iverson. *Nat. Petrol. News. Technical Section*, 4.10.44, **36** (40), R.678.—U.O.P. butane isomerization process embodies a continuous method of introducing the $AlCl_3$ catalyst and HCl promoter; a reaction zone, provision for removal of $AlCl_3$ and HCl and their recycle, and means for neutralizing the isomerate. A distinctive feature is that *n*-butane feed is passed through granular $AlCl_3$ in a saturator and passes to the reactor, meeting streams of recycle HCl and $AlCl_3$ and recycle butane, before contacting the quartz chips packing in the reactor. By this arrangement bulk of the catalyst ($AlCl_3$) does not come in contact with the liquid $AlCl_3$-hydrocarbon complex formed when the HCl promoter is present, as this complex coats the granular catalyst and lowers catalyst life, activity, etc. In the reactor a part of the $AlCl_3$ deposits and a viscous $AlCl_3$-hydrocarbon complex forms and spreads over the packing. Isomerization reaction occurs after the streams mix and pass through the packing. The complex eventually separates and drains from the reaction stream as a sludge which is drawn off from the bottom and neutralized. Reactor effluent passes to the $AlCl_3$ tower, where the $AlCl_3$ is separated, taken off at the base, and recycled, to the reactor. The product and HCl pass as an overhead to the HCl tower, operated at high pressure, where the HCl from the overhead is recycled, the bottoms are drawn off, and caustic washed before passing to the alkylation fractionator for separation of the *iso*butane and butanes. When operating at 150–300 p.s.i. and 125–250° C., conversion to *iso*butane up to 30% per pass is obtained. The catalyst life is greater than 50 gallon *iso*butane per pound of $AlCl_3$ introduced to the reactor.

W. H. C.

Chemical and Physical Refining.

797.* Commercial Isomerization of Light Paraffins. B. L. Evering, N. Fragen, and G. S. Weems. *Refiner*, November 1944, **23** (11), 423–429. (*Paper Presented before American Chemical Society.*)—Five commercial plants are described in which normal butane, normal pentane, and normal and slightly branched hexanes are converted to *iso*-compounds for aviation-gasoline manufacture. Feed-stock mixed with anhydrous HCl is passed upward in small liquid drops through a liquid aluminium chloride–hydrocarbon complex catalyst. Fairly pure neohexane can be made by fractionation and recycling remaining hexanes. Hexanes and pentanes may be isomerized together. Very high liquid yields are obtained. A. H. N.

798. Graphical Solution of Friction Loss Problems in Fluid Flow. A. E. Kroll. *Chem. Met. Eng.* March 1945, **52** (3), 110–111.—Graphs are given which reduce the process of solving the problems practically encountered in problems of flow to the multiplication of three factors read off the graphs. Accuracy is claimed to be high enough for practical purposes. A. H. N.

799. Solving the Heat Exchange Problem in Cooling Hot HCl. A. Lippman, Jr. *Chem. Met. Eng.*, March 1945, **52** (3), 112–114.—To handle continuously a large daily tonnage of relatively weak HCl gas at temperatures approaching 800° F. placed heavy burden on existing heat-exchange equipment and led to extensive tests of various metallic and non-metallic materials of construction. Impervious graphite-base material was installed because of higher rates of heat transfer, greater strength, and resistance to corrosive attack. A new trombone-type cooler reduced required length of cooling tubes and consequent ground area to only a fraction of the previous installation, at the same time permitting production of more concentrated acid. Plants are described and illustrated. A. H. N.

Special Products.

800. Up-Flow Neutralization of Acid Wastes. H. W. Gehm. *Chem. Met. Eng.*, October 1944, **51** (10), 124–125.—The method uses a limestone bed for neutralizing mineral acidity. Concentration of sulphuric acid should not exceed 5000 p.p.m. at any time, as such concentrations destroy reactivity of the bed. Predilution can be employed to eliminate this difficulty. Presence of appreciable quantities of acid salts reduces effectiveness considerably. This is particularly true of salts which form precipitates on neutralization—*e.g.*, ferrous sulphate. Either crystalline or amorphous stone of high calcium variety is suitable. The smaller the particle size the greater the area presented, hence the more effective the bed. However, very small sizes tend to wash out at high flow rates employed. For practical purposes rate of application of waste to filter should not be less than 20 gal./sq. ft./min., as velocities produced by lower flows fail to keep the bed well expanded and will not eliminate gases formed, silica and other impurities remaining after dissolution of the stone at a sufficiently high rate. Rates of application higher than 100 gal./sq. ft./min. have been employed experimentally, but have disadvantage of requiring excessive free board and have tendency to wash out stone. Rates of application should range between 20 and 100 gal./sq. ft./min. Bed depths of from 1 to 4 ft. were found to be mechanically satisfactory. As neutralizing capacity was found to be in linear relationship with acidity of applied waste and bed depth, the following equation serves as a guide in determining most practical depth for given conditions of acidity and rate of application : $R = (68 - KA)d$, where R is rate of application of waste in gal./sq. ft./min ; d is depth of bed in ft. ; A is mineral acidity in 1000 p.p.m. $CaCO_3$; and K is constant for stone size. K is equal to 8 for No. 2 chick gravel (10/20 mesh stone).

Design considerations are given in brief. A. H. N.

801.* Blueprint of Refinery Processes. Anon. *Oil Gas J.*, 31.3.45, **43** (47), 169.—A brief outline, with flow-sheet, of 42 of the most important current refining processes. These include catalytic cracking (Cyclo-version, Fluid, Houdry, and Thermofor) ; hydroforming ; gas reversion ; thermal cracking ; alkylation (HF and H_2SO_4) ; sweetening (Lead Sulphide, Perco Copper, Copper chloride–oxygen, Solutizer and Tannin Solutizer) ; girbotol, phenolate ; thylox ; unisol ; desulphurization (Gray, Perco, and Phosphate) ; isomerization (U.O.P., Shell, and Liquid Phase) ; polymerization (phosphoric acid and hot sulphuric acid) ; Gray clay treating ; solvent extraction (Duo-sol, Furfural, and Phenol) ; dewaxing (M.E.K. and propane) ; propane deasphalting ; wax manufacturing ; dehydrogenation (Houdry Adiabatic, Perco, and U.O.P) ; isomate ; Fischer–Tropsch hydrocarbon synthesis ; hydrogen manufacture from gases and Thermofor clay-burning processes. C. L. G.

802. Adapting Old Equipment to New Uses. D. E. Evans and W. B. Meyer. *Refiner*, November 1944, **23** (11), 455–457.—Deals with converting a steel pressure vessel of 4 × 16 ft. dimensions to meet new and more severe operations in the production of 100-octane gasoline, after X-ray examination and stress-relief of the vessel.

A. H. N.

803.* High-Pressure Dehydration Unit Conforms to Refinery Piping Code. H. F. Dawe and H. N. Wade. *Refiner*, November 1944, **23** (11), 430–432.—Unit for dehydration of gas on the Tennessee Gas & Transmission Co. system is of special interest because it was designed in keeping with code requirements for oil and gas piping inside refinery limits. This unit also completes hydrate removal, part of the process at three cycling plants through which the charge for the new line passes. A flow diagram is given. A. H. N.

804.* Synthol Process. P. Ryan. *Oil Gas J.*, 31.3.45, **43** (47), 264.—Increasing consumption of crude petroleum reserves led to more attention being paid to utilization of other hydrocarbons—natural gas, oil shale, asphalt sands, coal, etc. The Synthol process has been developed for the manufacture of liquid hydrocarbons and other products from natural gas. The process consists of : purification of the natural gas, conversion to synthesis gas (CO and H_2), synthesis reaction in presence of selected catalyst and in conditions to give desired products, condensation of reaction products, separation of aqueous phase from oil and gas, stabilization and fractionation of liquid hydrocarbon products, and recovery of chemical products. It is claimed that the process will produce 75 O.N. motor gasoline for 5 cents per gallon from natural gas valued at 5 cents per 1000 cu. ft., besides diesel oil of 90–100 diesel index, butane, and a range of chemical products. Importance of the dual rôle in hydrocarbon and chemicals production is stressed, a combined plant having an estimated pay-off time of 3 years, compared to 8 years for the Synthol plant alone. Approximately 11,000 cu. ft. of natural gas are required to produce 1 brl. of liquid hydrocarbon products so that plant should be near large gas reserves, and convenient for transportation and markets. C. L. G.

805.* Fischer–Tropsch Synthesis and the Gas Industry. V. I. Komarewsky and C. H. Riesz. *Refiner*, November 1944, **23** (11), 415–422. (*Paper Presented before American Chemical Society.*)—Development of the Fischer–Tropsch process historically is given, followed by mechanism of the reaction and special difficulties encountered. The idea of the " complex action " catalyst—a catalyst which combines both hydrogenation and polymerization activities—is explained. Use of the process in the gas industry is discussed. A. H. N.

Metering and Control.

806.* Characteristics of Differential Type Flow Meter and Conditions Affecting its Operation. Part 2. L. K. Spink. *Refiner*, November 1944, **23** (11), 433–441.—Effects of different variables on the coefficient of discharge of differential type flow meters are studied quantitatively in detail. Effects of change in barometric pressure, of super-compressibility of steam and other gases, of viscosity, and of the position of pressure taps and other dimensional effects are analysed at length. A. H. N.

807.* Characteristics of the Differential Type Flow Meter and Conditions Affecting its Operation. Part 3. L. K. Spink. *Refiner*, December 1944, **23** (12), 488–492.—Installation problems of differential-type flow-meters are discussed. Practical hints to avoid errors due to trapping air or liquid or to corrosion by reactive fluids are given. For accurate measurement by differential-type meter, flow should not vary more than ± 20% unless the fluctuations are slow enough to permit a readable record of actual variations. Pulsating liquid flows such as those of single-acting reciprocating pumps should be made uniform by use of a cushion chamber between source of pulsation and orifice. A safe criterion for design of cushion chamber is a cushion volume and that instantaneous discharge of volume of one cylinder should not raise pressure sufficiently to increase differential across the orifice by more than 40%. On compressible fluids, pulsation error may be minimized by use of a high operating differential, a high ratio of orifice-to-pipe diameter, or by use of capacity adjacent to source of pulsation and resistance adjacent to orifice. On gas compressors, pulsations are usually less serious on suction side. Measurement at a point where pressure has undergone a drop greater than 50% of the absolute pressure is usually free from effects of pulsation. In handling pulsating gas flows, restrictions or cushion chambers in lead line to differential instrument are worse than useless. A well-designed damping unit is U-bend of a mercury float-type instrument which will give a readable and reasonably accurate reading if differential fluctuations do not exceed 40% of operating differential. If fluctuations are greater than this, while record may be readable, readings will not be reliable.
A. H. N.

808.* Automatic Electric Timer in Refinery Processing. J. J. Loustaunau. *Refiner*, December 1944, **23** (12), 461–468.—Basic principles and practical operation and use of automatic time-control apparatus are given. Precautions in use and maintenance and hints on design and details of mechanisms involved are discussed. A. H. N.

809. Measurement of Flow of Hydrocarbon Gases. H. T. Broeck. *Refiner*, March 1945, **24** (3), 92–94.—Equations are derived for calculating the coefficient of orifices used for measurement of flow of hydrocarbon gases. A. H. N.

810. Factors Affecting Measurement of Wet Gas. T. C. Shaw. *Refiner*, March 1945, **24** (3), 99–103.—Factors governing flow are analyzed. Influence of pulsation and way of evaluating errors introduced are discussed. A. H. N.

Safety Precautions.

811.* Determining Needed Relieving Capacity for Rupture Diaphragms. T. S. Murphy, Jr. *Chem. Met. Eng.*, December 1944, **51** (12), 99–103.—In a previous paper (*Chem. Met. Eng.*, November 1944) the author discusses principles of determining dimensions and capacities of rupture diaphragms on the assumption that rate at which protected vessels have to be relieved is known. In this paper the methods used to calculate or estimate such rates are given. Three questions universal to all protection systems to be used are answered: I. What will be source or sources of overpressure? II.

What will be likely maximum rate of volume increase from and at a given pressure (say, the rupture disc setting)? or, what rate of pressure increase may occur, to what maximum pressure if the increase is unrelieved, within the constant volume of the vessel or system? III. Finally, what size of rupture disc is required to discharge this volume or weight of fluid as fast as generated, or at a rate which will not permit a pressure rise above the maximum safe figure? Answer to third question is given in previous article. Answer to first two questions is given under six systems of sources of overpressure in a closed system: (A) A volume of gas or liquid flowing directly into vessel or system—as through piping. (B) Heat imparted to contents by an outside medium—such as by exposure fires, steam jackets or coils, atmospheric temperature, etc. (C) Exothermic reaction of contents. (D) Burning of contents. (E) Release of electrical or other heat-producing energy within vessel or system. (F) Reduction of volume by mechanical means, as by a piston. A. H. N.

812.* Safety With Hydrofluoric Acid Alkylation. A. W. Trusty. *Refiner*, December 1944, **23** (12), 469–471.—Physical, chemical, and some biological properties of gaseous anhydrous acid and its solution are given. First-aid instructions are given for various types of injuries to skin, eye, etc. Safety practices and precautions are discussed. A. H. N.

813. Short-Circuit Currents in Industrial Plants. D. L. Beeman. *Refiner*, March 1945, **24** (3), 118–119.—Dangers of using circuit breakers of too small rating for the type of hazard to be encountered are explained, and examples are given where such use resulted in loss and danger. A. H. N.

814.* Low-Pressure Carbon Dioxide Provides Protection Against Refinery-Fire Hazards. H. R. Harper. *Oil Gas J.*, April 28th, 1945, **43** (51), 134.—Carbon dioxide stored under relatively low pressures (300 lb. per sq. in.) in thin-walled thermally insulated pressure vessels of any desired capacity has many advantages over other fire-extinguishing materials. Percentage of "snow" formed in the discharge is greater when liquid carbon dioxide is at low temperature, and in addition to blanketing, there is the cooling effect of the particles of snow absorbing heat in subliming.

Several types of hazard can be allowed for. A system in one fuel-test building includes several types of application: total flooding, a combination of direct application and a total room flooding, and also direct application by hose reel. The system is automatic, with provision for stand-by manual-electric and manual operation. When a fire is detected by thermostats, the system is automatically put into operation; a pre-discharge alarm warns personnel to evacuate.

Following pre-discharge alarm period, 2000 lb. of carbon dioxide can be released in approximately 1½ minutes, 5 or 6 seconds only being required to bring the liquid carbon dioxide from storage unit to nozzle, but discharge can be made slower by lengthening discharge period and decreasing rate of flow from nozzles. G. A. C.

815.* How Carbon Dioxide Conquers Fire. H. V. Williamson. *Refiner*, November 1944, **23** (11), 447–450.—Principles involved in extinguishing fires by means of carbon dioxide blanketing are briefly described. Methods of applications and their limitations are given. A. H. N.

816. Discussion on "Industrial Fire Risks." *J. Instn. elec. Engrs*, 1945, **92**, Pt. 1, 135–138.—Additional information to that available in the original paper (W. F. Cooper and F. H. Mann, *J. Instn. elec. Engrs.* 1944, **91**, Pt. 1, 267–285; *J. Inst. Petrol.*, 1944, **30**, Abstract No. 1455). This includes useful tables of inflammability and explosibility of many powders and dusts and of some organic solvents. C. F. M.

PRODUCTS.

Chemistry and Physics.

817. Conversion of Oxygen Derivatives of Hydrocarbons into Butadiene. A. Egloff and S. Hula. *Chem. Reviews*, February 1945, **36** (1), 63.—A review of published information on preparation of butadiene from aliphatic and cyclic alcohols, hydrocarbon oxides, aldehydes, carboxylic acids and esters. German practice involves four-stage production of butadiene from ethane, via ethanol, 3-hydroxybutanol and 1 : 3-butanediol, whereas in U.S.A. and U.S.S.R. a single-stage process is used, starting from ethanol. Good yields are also obtainable from butanols, butenols, 1 : 3-butanediol, butanal, oleic acid, 2 : 3-butanediol diacetate, 4-methyl-*m*-dioxane, *cyclo*hexanol and 1 : 2-dihydroxybenzene. A copious bibliography is included. C. L. G.

818. Heats of Isomerization of the 18 Octanes. E. J. Prosen and E. D. Rossini. *Bur. Stand. J. Res. Wash.*, February 1945, **34** (2), 163.—Values have been determined of the heats of isomerization of the octanes (17 liquid, 1 solid) in the condensed state at 25° C., and for the gaseous state at 25° C and 0° K. These have been calculated from differences in heats of combustion, heats of vaporization, and decrease in heat content of the various isomers C. L. G.

819. Predicting Viscosity of Gases at High Pressure. E. W. Comings and B. J. Mayland. *Chem. Met. Eng.*, March 1945, **52** (3), 115–116.—A chart for deducing the viscosity of gases at high pressures from their viscosities at atmospheric pressure and the value of the critical pressures. Data are given for carbon dioxide, propane, ethane, ethylene, methane, and nitrogen for values of reduced pressures ranging from 0·2 to 10, and reduced temperatures ranging from 0·84 to 3·0. A. H. N.

820.* Viscosity of Propane-Oil Mixtures. R. W. Moulton and A. J. Mitchell, *Refiner*, December 1944, **23** (12), 481–484.—Viscosity of propane-oil mixtures was measured by a rolling-ball viscometer over temperature range −40° to 0° C. for propane to oil ratios from 1 : 1 to 5 : 1. Effect of temperature is greater at −40° C. than at 0° C. It was found that between propane to oil ratios of 1 : 1 to 3 : 1, viscosity decreases rapidly as ratio is increased. At higher propane to oil ratios the rate of decrease of viscosity with increase in propane is less. A. H. N.

Analysis and Testing.

821. Glass Helices for Packing Fractionating Columns. J. E. Still. *Chem. and Ind.*, 1945, 130–132.—Details of a new and quicker method of making single-turn glass helices. It requires only an ordinary small screw-cutting lathe with a few simple hand-made accessories. C. F. M.

822.* Melting, Setting and Solidifying Points of Waxes. A. H. Woodhead. *Petroleum*, April 1945, **8** (4), 71.—Deposition of solid matter occurs at certain definite temperatures when a molten wax slowly cools, the " melt " as a whole remaining fluid. These temperatures are defined as setting points. Wax solidifies at a temperature lower than the last setting point, defined as solidifying or congealing point. Increasing the complexity of wax composition results in greater differences between setting and solidifying points. A method has been devised, depending on this difference, and consisting of the use of a long 2 mm.-bore glass tube connected to a pipette-shaped vessel whereby consecutive determinations of melting, setting, and solidifying points may be made. The apparatus is immersed in water after introduction of about 0·1 gm. of wax, and phase changes determined by observation of movement of a short column of molten wax, caused by changes in pressure in the air vessel when cooled. Alternatively, artificial suction could be used. Results are repeatable to 0·5° C. A table shows results for a few commonly-known waxes. G. A. C.

823. Water Analysis Conversion Factors. Anon. *Refiner*, March 1945, **24** (3), 117.—A table is presented for multipliers by the use of which concentrations of ions may be converted into concentrations of salts composed of the ions concerned, and a metallic ion. For certain salts the effect of water of hydration is also included. A. H. N.

824.* Determination of Composition of Commercial *iso*Butane. S. W. Tooke and R. P. Roberts. *Oil Gas J.*, 7.4.45, **43** (48), 98.—A special distillation apparatus and test procedure has been developed for determination of composition of commercial *iso*butane and for other butane mixtures containing only propane, *iso*butane, normal butane, and pentane. The method depends on obtaining a true and accurately measured boiling-point curve for the sample by means of special distillation equipment using a precision thermometer. A special cooling-jacket eliminates inaccuracies caused by heat-flow from atmosphere to thermometer registering the vapour temperatures of the boiling sample. Distillation curve is obtained on a temperature-time basis. From curves provided, amount of butane is determined from end-point of the mixture, *iso*butane and propane from initial boiling point and 20% temperatures (corrected for pentane) and butane by difference. Test requires 45 minutes to complete, and is accurate to ± 0·25% for propane and pentane and ± 1·0% for *iso*butane and normal butane. G. A. C.

Gas.

825.* Science in Natural Gas. J. E. Pew and F. H. Dotterweich. *Refiner*, December 1944, **23** (12), 472–476. (*Paper Presented before the Texas Academy of Science.*)—Use of natural gas as raw material for production of several synthetic products is discussed. Use of carbon black in processing synthetic rubber in the form of a slurry appears to promise a reduction in cost of synthetic rubber. Electrically-conductive rubbers have possibilities for preventing icing on aircraft and dissipating electrostatic dangers. Use of natural gas in producing liquid fuel, plastics, etc., is reviewed. A. H. N.

Engine Fuels.

826. Manufacture of Aviation Gasoline. N. Mayer. *Refiner*, March 1945, **24** (3), 120–124. (Translated from *Ooel und Kohle*, July 1940, **29**, by E. J. Barth.)—Deals with use of anti-knock compounds—with interesting comparison to use of digitalis for regulating and increasing energy output in the blood stream—and with the significance of sulphur in aviation fuel. Catalytic dehydrogenation and the use of *iso*-octane, *iso*pentane, and other hydrocarbons are discussed. General characteristics of aviation fuels are summarized. A. H. N.

Lubricants.

827.* Detergency or Dispersancy in Heavy Duty Engine Oils. C. W. George. *Refiner*, December 1944, **23** (12), 504–508. (*Paper Presented before Society of Automotive Engineers.*)—This study shows " dispersant " oils more apt than " detergent " oils as descriptive of the lubricants fortified with additives for use in internal-combustion engines. While no great harm can come from the inaccuracy of terms, emphasis should be placed on the fact that the purpose of the heavy-duty oil is to keep the engine clean for maximum periods of operation. It follows that the oil should be used for limiting fouling rather than for cleaning the engine, as use for latter purpose in a dirty engine may result disastrously in cleaning engine and collecting all dirt in pipes and other restrictions. This problem is particularly serious with the owner-driver who uses different oils at random. A. H. N.

828.* Additives for Lubricants. M. W. Webber. *Petroleum*, April 1945, **8** (4), 76.—Use of additives, defined as substances which impart or enhance desirable properties of a lubricant and eliminate or minimize deleterious ones, are of proved value. An oil, after having been subject to very drastic refining, has only one quarter the oxidation resistance of the distillate oil. Highly paraffinic, solvent refined oils are corrosive to hard bearing alloys, especially at high temperatures. Severe refining adversely affects friction—and wear—reducing properties of oils. Drastic refining reduces the number of hours' running before ring-sticking occurs. Use of additives inhibits oxidation and corrosion, imparts detergent properties to the oil, improves oiliness, increases load capacity, depresses pour point, and improves viscosity index. Severe refining results in removal of naturally occurring inhibitors and in production of long-chain paraffin hydrocarbons. Cyclic hydrocarbons are far more resistant to spontaneous ignition than straight-chain hydrocarbons. In oils of asphaltic type liability to oxidation is due to unsaturated groups in both cyclic and open-chain compounds. Oxidation of a lubricating oil also leads to polymerization. Oxidation inhibitors include hydroxy compounds, *e.g.*, phenols and naphthols, nitrogen compounds of the amine type, sulphur, chlorine, and phosphorus compounds, and many organo-metallic compounds. It is not possible to produce a single inhibitor which will work equally well with all oils, but many bodies which inhibit oxidation will also give protection from corrosion. G. A. C.

829.* Additive for Lubricants (2). M. W. Webber. *Petroleum*, May 1945, **8** (5), 85.—Lubricating oils containing detergent additives possess special sludge-dispersing properties in internal-combustion engines. Most detergent additives are complex organo-metallic compounds, whose efficiency is due to both solvent and peptizing action. Use of such additives ensures clean engine parts and freedom from sticking piston-rings and valve-stems, and from choked oil-ways. It is imperative that period between draining and replenishing the crankcase oil should not be prolonged, and care must be taken in introducing detergent oils into engines previously run on straight oils. Full-scale engine tests are essential for evaluation of detergent oils, although laboratory tests are of some value. Some additives tend to accelerate corrosion and reduce oxidation stability. " Oiliness " is of great importance in conditions of boundary lubrication, and laboratory machines can evaluate additives designed to improve this property. Efficiency of extreme pressure additives seems due to chemical action which form compounds acting as anti-welding or anti-seizing agents. Most E.P. additives are oil-soluble organic compounds containing sulphur chlorine or phosphorus. Compounds should be stable and non-corrosive in storage conditions.

Extreme-pressure lubricants are tested in laboratory machines, but these machines do not rate in the same order a representative series of lubricants, due to varying test conditions.

Extreme-pressure additives are also used in cutting oils, and in drawing and pressing lubricants. Additives are used to improve viscosity indices, and to lower the pour point or cold test of oils in grease manufacture and in preparation of penetrating oils. Colloidal graphite is an additive of great merit, both in boundary lubrication and as a high-temperature lubricant. G. A. C.

830.* Lubrication Vade Mecum. E. W. Steinitz. *Petroleum*, April 1945, **8** (4), 64.—Part II (i) of the Lubrication Vade Mecum gives Lubrication Charts I–V, based on classification of machinery and uses, as follows: Chart I (power generation and prime movers); Chart II (general technical equipment); Chart III (mining and related industries); Chart IV (pulp, paper and stationery manufacture, printing); Chart V (food and allied industries). Lubricant specified for a given machine can be determined by noting the " Lubricant Code Number " of this machine in Part II and referring to the corresponding entry in Part I. G. A. C.

831.* Lubrication Vade Mecum 2 (2) Lubrication Charts VI–IX. E. W. Steinitz. *Petroleum*, May 1945, **8** (5), 92.—Continuing the lubrication charts based on classification of machinery and uses, Chart VI refers to Textile and Foundry Industries, VII to the Metal Industry, VIII to Clocks, Optical Instruments, Mechanical Appliances, whilst IX concerns the Chemical Industry. The lubricant specified for a given machine can be ascertained by locating this machine in Part II, noting the " Lubricant Code Number " and turning to the corresponding entry in Part I. G. A. C.

832. Alternating Loads on Sleeve Bearings. J. Dick. *Phil. Mag.*, December 1944, **35** (251), 841–848.—Derives the equations for the case where the locus of the centre of the shaft is an ellipse, and then the differences between the truly sinusoidal load and this case evaluated and found for many practical purposes to be sufficiently small to justify conclusions drawn from the elliptical locus being applied to the oscillating case. These conclusions are summarized. A. H. N.

Bitumen, Asphalt and Tar.

833.* Bitumen and the Bitumen Industry With Special Reference to Asphaltic Bitumen. 1. Historical and Technical Survey. J. S. Jackson. *Petroleum*, May 1945, **8** (5), 82.—Early uses of bitumen are reviewed. Excavations in Mesopotamia have disclosed that bitumen was used in the waterproofing of tanks, drains, and baths. Bitumen was obtained from natural pools and seepages, the water pressed out, and the material then exposed to the sun. Bitumen with a melting point of about 100° F. was mixed with sand or loam to prepare mortars and mastics. Brick river embankments were constructed with the mortars and further waterproofed with mastics. The fall of Babylon marked the end of the bitumen industry until modern times.

Main materials of the bitumen industry now are asphaltic bitumen produced from selected petroleum crudes, rock and lake asphalts, coal-tar and coal-tar pitch. The latter products were the first to be used extensively in road construction and for industrial applications. From about 1850 lake asphalt from Trinidad was used for manufacture of drains, reservoirs, and for insulating purposes. Trinidad lake asphalt is also softened by addition of a suitable flux and used in all forms of road construction, roofing, and flooring mastics. Mexican crude oils were found particularly suitable for production of bitumen, and later, liquid asphaltic bitumens—" cutbacks "—were developed for application at lower temperatures and for coating stone aggregates. Relatively unstable bitumen emulsions are used for surface dressings, very stable emulsions having many other industrial applications. Bitumen mastics are used in various waterproof constructions, and " blown " bitumen, which possesses rubbery properties, is used for coating roofing felts, iron pipes, and electric cables. Notes are given on the difference between British and American nomenclature. G. A. C.

Special Hydrocarbon Products.

834.* Residual films of D.D.T. E. A. Parkin and A. A. Green. *Nature*, 2.6.45, **155** (3944), 668.—When absorptive type wallboards are sprayed with solutions of D.D.T., the highest toxicity to flies is obtained from a given quantity of D.D.T. by applying it at a high concentration. It is suggested that this is due to the tendency of D.D.T., particularly the crude product, to form supersaturated or super-cooled solutions, this tendency being greater in Pool burning oil than in acetone. If spray residue is undisturbed it remains relatively non-toxic, but surface disturbance, as occurs on the introduction of flies, or by a brush, induces formation of minute crystals of D.D.T. C. L. G.

835.* Anti Malarial Oils. C. L. Gilbert. *Petroleum*, April 1945, **8** (4), 62; May 1945, **8** (5), 90.—Development of use of petroleum oils for treatment of water surfaces to control mosquito larvae is outlined and the composition, properties, mode of action, and testing of such oils reviewed. Anti-malarial oils consist basically of gas oil, or a blend of petroleum products of equivalent viscosity and may contain refinery by-products, used oils or special additives. Two most important requirements are spreading characteristics (spreading pressure and film stability) and toxicity. Spreading characteristics are controlled by substances present only to a very small extent in the oils, and are affected by such factors as exposure of oil film to light, presence of polar bodies, etc. Toxicity cannot be related directly to chemical composition, although aromatic hydrocarbons tend to be more toxic than paraffinic. It is believed to result from penetration of the oil into the trachea of the larvae, this either causing death rapidly or preventing the larvae from developing into pupae. C. L. G.

836. Properties of Petroleum Oils in Relation to Toxicity to Potato Tuber Moth Larvae. W. Ebeling. *J. Econ. Ent.*, February 1945, **38** (1), 26.—Tests have been carried out on the toxicity to potato-tuber moth larvae of (*a*) solutions of various insecticides in light-medium spray oil and (*b*) light, light-medium, and heavy spray oils and kerosine without insecticides. The insecticides in group (*a*) tests were placed in the following order of effectiveness: 1% dinitro*cyclo*hexylphenol; 1% Lethane 440; 0·625% Derris extractives; 1% nicotine; 1% Thanite; 0·1% Pyrethrins, and 4% D.D.T. In tests (*b*) carried out at 70° F. and 86° F. the median lethal period (M.L.P.) for 50% of the test insects was much lower with kerosine than with spray oils, the heaviest grade of spray oil giving longest M.L.P. Viscosity and distillation ranges of spray oils are not significant. Kerosine vapours probably have an effect on the nervous system of the insect, since if they are completely immersed (instead of just wetted) no difference is found between kerosine and spray oil. In further tests paraffinic and naphthenic oils of similar unsulphonated residue content gave similar toxicities, but oils of lower unsulphonated residue content were more toxic than those of higher U.R. The latter finding was confirmed on house fly larvae. It is suggested that variable results

reported for relation between toxicity to insects or eggs and composition of petroleum oils, may be due to physical nature or oxygen permeability of the oil film.
C. L. G.

837. A.L. 63. R. S. Cahn. *Chem. and Ind.*, 1945, 132–133.—Some details are given of the evolution of A.L. 63 the anti-louse powder used by the British Forces. A.L. 63 Mark I contained 50% of finely-divided naphthalene, derris root sufficient to give 1% of rotenone, 2% of high-boiling tar acid, and the residue china clay. Mark II was of similar composition, but contained Lonchocarpus extract in place of derris root. Mark III (now in use) contains D.D.T.
C. F. M.

838.* Manufacture, Blends, and Uses of Sulphated Oils. 2. Blends with Mineral Oil. S. Glicher. *Petroleum*, April 1945, 8 (4), 66.—Sulphated fatty oils are much better emulsifying agents for mineral than for fatty oils; and highly sulphated fish oils, such as cod, herring, whale, and sperm are miscible with relatively large proportions of mineral oil. Resulting blends are suitable for preparation of cutting oils, which should have high specific heat, low viscosity, good lubricating properties, and heat conductivity, be stable, non-corrosive, and non-inflammable. The fluid should be neutral. Blends of highly sulphated cod oils with mineral oil, sometimes used as cutting oils, are mainly employed for fat-liquoring purposes in sole-leather industry, as also are dilute aqueous emulsions of similar blends in this and the fur industries. Sulphated fatty oils blends with pine-oil, *cyclo*hexanol, cresol, etc., are used in water as disinfecting, wetting, and cleaning fluids. Sulphated oleic acid possessing greater wetting and detergent powers than most other fatty acids is used extensively in these industries, especially in leather processes. Combination of sulphated fatty oils or acids with mineral oil is effected by thorough mixing, and pH values later adjusted.
G. A. C.

Derived Chemical Products.

839. Petroleum: Source of Raw Material for Chemical Industry. J. H. Boyd, Jr., *Chem. Eng. News*, 1945, **23**, 345.—In addition to carbon black, hydrogen, ethylene, and acetylene many new hydrocarbons are becoming available from petroleum. These may be separated by fractionation, superfractionation, azeotropic distillation, extractive distillation, solvent extraction, crystallization or adsorption. The problem of availability is complicated by the differences in crudes, equipment available, market conditions, and the purity demanded. The latter condition being imposed by the chemical industry, this industry will have to bear the cost of any special purification required. Seventeen hydrocarbons are now being produced commercially, all but three being of high purity. Some are synthesized, and many more will be available after the war if required.
S. J. L.

840. Neutral Products of Oxidation of Petroleum Hydrocarbons by Oxygen of the Air. S. S. Nametkin and V. K. Zvorykina. *Nat. Petrol. News, Technical Edition*, 4.10.44, **36** (40), R. 702.—Oxidation of different oil distillates, particularly paraffin wax and gatch—*i.e.*, wax that has not been passed through the sweating chambers—by means of air has received much attention in Russia. Construction of two semi-plants for the purpose naturally called for closer study of the subject. Oxidation of paraffin wax produces higher monobasic fatty acids; vaseline oil from the Emba crude oils gave acids belonging to the class of naphthenic acids, which is in agreement with the nature of the Emba crudes. Simultaneously with production of fatty acids, hydroxy acids and neutral by-products are also obtained by action of air on petroleum products.

Investigation was made on products from receivers when oxidizing paraffin and "gatch" at the Mendeleev Institute, Moscow. This material was a dark yellow oil, with an acid reaction which was treated as follows: the material was neutralized with NaOH and treated with concentrated sodium bisulphite solution. The aldehyde-bisulphite compounds were washed with ether to separate the oily matter, and the oil-free bisulphites decomposed with NaOH, the aldehydes being separated by steam distillation, drying, and repeated fractionation. Aldehydes corresponding to the series: caproic, heptoic, caprylic, nonylic and capric, aldehydes, $C_5H_{11}CHO$ to $C_9Hl_{19}CHO$, were identified, the total amounting to 7·7% of the initial product.

Oil remaining after the separation of the aldehyde bisulphites was hydrolysed with 2N–NaOH, washed, and then distilled to 200° C. and distillation completed under 15 mm. pressure. The distillate was refractionated three times, eleven fractions being taken. Separation of alcohols from the accompanying oil in each fraction was obtained by esterification with boric acid in benzene, the ester being obtained as a residue after distillation to remove benzene and water and distillation at 10 mm. pressure to remove the oil. The residue (ester) was hydrolysed with 2N–NaOH and the alcohols separated from the aqueous layer, dried with KOH, and fractionated into 5–10° C. fraction. A total of 12·3% of alcohols was isolated corresponding to hexyl, heptyl, octyl, nonyl, decyl, undecyl, and dodecyl, $C_6H_{13}OH$ to $C_{12}H_{25}OH$. Properties of the alcohols obtained are in agreement with those given in literature references. Confirmation was obtained by oxidizing to the respective acids and the analysis of the silver salts, the boiling points of the alcohols, acids and melting points of the amides, etc.

W. H. C.

841. Soil Treatment with Special Reference to Fumigation with D–D Mixture. W. Carter. *J. Econ. Ent.*, February 1945, **38** (1), 35.—Tests were made in Hawaii on control of organisms in pineapple-growing land using D–D mixture (1·3-dichloropropene and 1·2-dichloropropane) and other soil fumigants. The value of chloropicrin for this purpose had been established in earlier tests ; the present series, which commenced in 1940, were based on D–D mixture, chloropicrin, allyl alcohol, allyl chloride, methallyl alcohol, and methallyl chloride, injected into the soil at 150 lb./acre. By 1943 considerably better growth was apparent in plots treated with D–D mixture and chloropicrin, in one dry area the crop being increased from 3·01 tons per acre to 18·16 and 16·76 tons, respectively.

D–D mixture added to irrigation water in an emulsion of diesel oil (200 lb. D–D per acre) has also given good control of nematodes in soil under agricultural cultivation, and reduced weed-growth. Method of application suggested is from a small pump ahead of the disc plough. As an insecticide, D–D mixture has been shown to control weevils, termites, and Lyctes beetle. Tests on the various isomers present in D–D mixture have shown that 1·3-dichloropropene is the most toxic (to rice weevils), but that other chlorinated compounds present have a synergist effect. Delayed response from fumigation with D–D mixture is attributed to greatly improved root system developed in the young plant, rather than to persistent action on nematodes over a period of years. Its relative cheapness and ease of handling compared with chloropicrin, offers possibilities for improvements to agriculture in general. C. L. G.

842. Socony-Vac Reports Cheaper Thiophene Process. Anon. *Nat. Pet. News*, 1945, **37** (5), 34.—Formerly priced at $54 per pound, thiophene can now be produced from petroleum so cheaply as to be used in place of phenol for plastics production. The pharmaceutical and dyestuffs industries will also benefit. A laboratory pilot plant is now in operation. S. J. L.

843. British Carbon Black. Anon. *Chem. Trade J.*, 8.6.45, **116** (3029), 628.—In *Gas Journal* for 30th May, is given a description of a plant in the U.K. erected in 1942 for production of carbon black by gasification of pitch of melting point (K. & S.) 36° C. The pitch is carbonized in a chequerwork generator, producing 105 therms of 330 B.Th.U gas per ton. The gas stream carries with it the major portion of the fixed carbon in a flocculent state, from which it is recovered in primary and secondary cyclones and by an " Elexprecipitator." After cooling, the carbon black is weighed and filled into bags. It is of very fine particle size, and is chiefly used as a filler for rubber. Remaining carbon, washed from the gas stream, is used as boiler fuel.

C. L. G.

844. Industrial Alcohol. A. E. Williams. *Chem. Age*, **52**, 325.—An account of methods by which manufacture of alcohol for solvent and fuel purposes may be effected most economically. Amongst cheaper raw materials available are potato haulm, straw, wood, peat, and sulphite liquor. Haulms from 100 tons of potatoes will yield 450 gal. of alcohol, whilst 1 ton of sawdust or wood meal will yield about 45 gal. of 95% alcohol. Wet peat may give 1·2% of alcohol, and waste sulphite liquor from the wood-pulp process can produce 1%. Fermentation efficiency may be increased in general ways—

e.g., by adding 1% sodium fluoride, and phosphate at pH 5·0. Recovery of alcohol and by-product alcohols requires careful pH control before and during distillation. Hiag System for dehydrating the alcohol with anhydrous sodium and potassium acetates is described at length, and a flowsheet of plant built by Blairs, Ltd., is shown. Synthesis of alcohol from ethylene in the U.S.A. and from acetylene is described. Acetaldehyde, produced from acetylene, may be reduced to ethyl alcohol with nickel catalysts. It is concluded that Great Britain's cheapest source of alcohol is such material as straw and potato haulm. S. J. L.

Coal, Shale and Peat.

845.* Shale Oil Industry in Estonia. P. Kents. *World Petroleum*, 1945, **16** (1), 44.—Describes geological structure of the seams which hold estimated shale oil reserves of 30 billion barrels. The shale is of an unusual type called kukersite, ignites easily, and can replace coal. During pyrolysis, decomposition commences at 170–180° C., and owing to fusion at 300° C., special type retorts have to be used. 20–36% by weight of shale is converted into crude oil—*i.e.*, 48–86 gal. per ton of shale. Typical analyses are given. The permanent gases produced are used for heating the retorts. In composition, kukersite oil is between natural crude oil and low-temperature coal tars, the products being gasoline, impregnation oils, bitumen, etc., kerosine, diesel oil, motor naphtha, asphalt, lubricating oils and insecticides. Three different types of retort are in use, of which the best is the Estonian Tunnel retort, due to mechanization and low labour costs. Its capacity is 500 brl. per day. Figures are shown for plant, production, and labour costs, and the price of refined products is given. S. J. L.

846.* Thermal Solution Peat Conversion. Anon. *Petroleum*, April 1945, **8** (4), 67.—Thermal solution processes have been studied in the Soviet Union to utilize extensive peat deposits and surplus mazout to yield a complex of light volatiles and a heavy boiler fuel. Five samples of peat of diverse origin were treated with tetraline, anthracene oil, mazout, and other solvents at about 400° C. A combination of thermal solution of peat with hydrogenation of the peat solution yields benzine and kerosine; and with mazout as solvent, another process yields gases, benzine, ligroin, kerosine, and a heavy liquid residue. A ton of dry peat processed with 1½ tons of mazout will yield 280 kg. crude benzine, 167 kg. kerosine, and 54 kg. boiler fuel. G. A. C.

Miscellaneous Products.

847.* Textile Wetting and Foaming Agents from Petroleum. E. Profft. *Refiner*, December 1944, **23** (12), 502–503. (Translated from *Fette und Seifen*, 1942, **49** (12), 868, by E. J. Barth.)—Surface active materials are classified into: (1) anion-active; (2) cation active; (3) anion-cation active. This grouping depends on whether group responsible for surface-activity (*e.g.*, an alkyl chain derivative) resides in anionic, cationic or both parts of the complex molecule. Greatest proportion of well-known textile aids are anion-active; such as sodium oleate, sodium cetyl sulphate, sodium sulpho-vicinoleate, etc. The paper deals with cation active substances, and with salts of higher aliphatic bases. In getting products from petroleum, the raw material is first chlorinated to required degree and reacted with ammonia to give surface active products. Four compounds from paraffin wax and kerosine are studied.

A. H. N.

848.* Manufacture, Blends and Uses of Sulphated Oils. 3. Blended Oils. S. Glicher. *Petroleum*, May 1945, **8** (5), 95.—Sulphated oils are often blended for fat-liquoring purposes, with or without the addition of raw oils, to produce a milky, and thus less penetrative emulsion with water. Turkey-red oil is frequently adulterated with cheaper vegetable oils, such as ground-nut or cotton-seed oils. Sulphated fish oils are blended with raw or sulphated unrefined fish oils, or with mineral oils. Sulphated oils of the same type should be blended, and blends should remain clear and stable and form stable aqueous emulsions.

Among textile assistants, turkey-red oil finds use in softening of cotton goods and as a dyeing assistant. Textile assistants can be classified into sulphated fatty alcohols, fatty acid amides, sulphated aromatic compounds, quaternary ammonium compounds, and non-ionized surface active agents.

Sulphated fatty alcohols are esters of the $R{\cdot}CH_2{\cdot}O{\cdot}SO_3H$ type. The sodium salts of the acid sulphates of lauryl, cetyl, and oleyl alcohols are useful detergent wetting and lathering agents; and sulphated secondary alcohols yield preparations of very great wetting power. Diesters of the sodium sulpho-succinic acid have excellent properties. Fatty acid amides of the type $R{\cdot}CO{\cdot}NH{\cdot}C_2H_4{\cdot}SO_3Na$ possess pronounced detergent powers and good stability. Sulphated aromatic compounds are valuable low-temperature wetting agents, but have little detergent power. Quaternary ammonium compounds are good softening agents, due to the active cationic group; and polyglycerols esterified with a fatty acid are non-ionized surface active agents unaffected by hard water, mineral acids, or alkalies. G. A. C.

849.* Insect Epicuticle. R. Dennell. *Nature*, 5.5.45. **155** (3940), 545.—It has been previously shown (see *J. Inst. Petrol.*, 1944, Abs. Nos. 1021 and 1025) that the desiccation of insects by inert dusts may be due to adsorption of the epicuticle wax film, which becomes discontinuous, or to abrasion of the wax film and subsequent loss of water. Sarcophaga larvae are, however, affected neither by adsorption nor abrasion and it is suggested that in their case, as also in the case of the cockroach Periplaneta, the outer epicuticle consists of a very stable lipo-protein complex. Variation in manner of association of the lipoid substances with the insect epicuticle may therefore affect the behaviour of inert dusts. C. L. G.

850. Dispersants for Aerosols. L. D. Goodhue, J. H. Fales, and E. R. McGovern. *Soap*, April 1945, **21** (4), 123.—Freon 12 (dichlorodifluoromethane) is the most satisfactory dispersant for insecticidal aerosols, being non-toxic, non-inflammable, inert, odourless, and of suitable vapour pressure. It is not, however, a good solvent for all insecticides. Tests have been carried out to determine suitability of other dispersants, but none is completely satisfactory. Methyl chloride has possibilities for outdoor application, being a good solvent, but is toxic and inflammable, while methylene chloride is insufficiently volatile, but could replace up to 20% of the Freon. A similar replacement could be made with a mixture of equal parts of butane and propane, giving a cheaper, non-inflammable product. Propane alone, as the dispersant, was found to give a higher kill than butane, probably owing to its higher vapour pressure. Dimethyl ether can replace 25% of the Freon, but is expensive. Freon 22 (chlorodifluoromethane) gives a similar kill to Freon 12, whereas Freon 31 (chlorofluoromethane) produces a coarse aerosol of low toxicity. Carbon dioxide has possibilities, owing to its cheapness, but is not a good solvent for pyrethrum, and its vapour pressure is very high. C. L. G.

851. Test Performance of GR–S Compounds. E. N. Davis. *Nat. Petrol. News, Technical Section*, 4.10.44, **36** (40), R. 710.—Limitations of products of this type of synthetic rubber in a few industrial usages are presented.

Fire hazards in manufacturing and compounding of GR–S synthetic rubbers are briefly discussed. Knowledge of properties and compounding characteristics of Buna-S is not so complete as that of natural rubber, but some characteristics are quite different. Crude GR–S does not break down and become plastic as easily as natural rubber does when milled; it is estimated that it takes 10–20% longer to process. Adhesion of the plies in fabricating products, prior to vulcanization, from natural rubber mixtures is extremely good, but with GR–S products adhesion is a greater difficulty—*i.e.*, it lacks "building tack." The definite points of difference between compounded natural rubber and compounded GR–S are illustrated by, and discussed in respect of, cotton-jacketed rubber-lined hose and insulated wire covering. Tensile strength of pure natural rubber with a small amount of curing ingredients is around 3000 p.s.i.; compounding materials greatly reduce this figure. For this reason a high-grade product containing plenty of rubber should have a high tensile strength and a high ultimate elongation for tyre and hose manufacture. Pure GR–S compounds, however, have a tensile strength of only about 400 p.s.i., but compounding materials give it tensile strength, *e.g.*, carbon black is especially effective and mixed with GR–S affords a tensile strength of up to 3000 p.s.i., but with some loss of flexibility. Textile strengths and ultimate elongation tests on natural rubber compounds and GR–S compounds, in respect to ageing, are surveyed and discussed; in general the latter is the superior product. Although carbon black is exceptionally good for GR–S compounding for tyres and hose manufacture, its presence in insulating covering for wire greatly lowers insulating resistance, so that it cannot be used for this purpose. Insulating resistance of GR–S compounds is considerably lower than that of natural rubber compounds, but is sufficiently high that only minute electrical leakage is shown by calculation.

At present, GR–S compounds for tyres, hose linings, or wire coverings have not the equivalent qualities that natural rubber compounds possess, but with increasing knowledge and from the uncompleted investigations in hand great improvements are anticipated. W. H. C.

852.* Preparation of Drying Oils from Petroleum. F. Christman. *Refiner*, November 1944, **23** (11), 458. (Translated from *Fette und Seifen*, **49**, 524 (1942), by E. J. Barth.)—Production of highly unsaturated oils from high-molecular-weight hydrogen-rich oils is outlined. Hydrocarbons rich in hydrogen suitable for this purpose are hard or soft paraffins, ceresin, ozokerite, montan wax, crude vaseline, paraffinic residues or lubricants rich in hydrogen, or other heavy fractions from petroleum or lignite tars which have been solvent-treated to remove hydrogen-poor portions of these oils. Oils made by hydrogenating carbon monoxide, at low or high pressures, are especially suitable and are highly paraffinic, or can also be olefinic in character; oils made by polymerization of cracked gases also are suitable as well as the so-called voltol oils. Oils originating from coal hydrogenation, and regular hydrogenated petroleum oils are likewise suitable. To obtain unsaturated high-molecular-weight hydrocarbons the above raw stocks are cracked (dehydrogenated) at over 350° C., preferably in presence of splitting-catalysts, such as bleaching-clay previously treated with hydrofluoric acid, or colloidal clays, or the metals of the sixth group. Dehydrogenation also could be accomplished by sulphur- or oxygen-containing gases. A preferred procedure for obtaining the desirable unsaturateds is to treat above raw stocks with halogen, sulphur, or oxygen, preferably in presence of catalysts, such as iodine or antimony trichloride, and to split these elements out later in the form of their hydrogen derivatives, such as HCl, H_2S, or H_2O. The splitting is best done between 100° and 350° C. in presence of mild condensation catalysts, such as bleaching clay, boric or oxalic acid, or complex Ansolvo-acids or their salts; halogen halide is also a condensation agent. Olefins can be mixed with diolefins or triolefins and the whole condensed at 30–70° C. in presence of a solvent. Method of condensation and reagents to be used are given in brief. A. H. N.

853. Polystyrene. Part III. S. Booth. *Brit. Plastics*, May 1945, **17** (192), 200.—Methods of manipulation and processing polystyrene are discussed. It can be easily extruded on screw or hydraulic machines at 130–150° C., but owing to its rubbery nature and long relaxation time, it should be uniformly heated and the polymer grains homogeneous and uniform in size. For thick sections the low heat conductivity and high coefficient of expansion tend to cause voids, so that extrusion into a heated mould is preferred. Compression moulding at 135–150° C. is comparatively simple. Polystyrene is particularly suitable for injection moulding at 140–150° C., but streamline flow should be avoided, owing to effect of molecular orientation on strength of narrow sections. Early troubles from surface crazing have been attributed to traces of monomeric impurities, and have been eliminated by ensuring that the polymer contains $\not>1\%$ of matter volatile at 150° C. under vacuum when heated for 2–3 hours. For the production of threads and foils the necessary molecular orientation to give flexibility and shock resistance is obtained by rapid cooling when stretched. It is thus only possible to produce thin orientated threads (diam. 0·001 to 0·1 in.). Flexible foil is obtained by stretching sideways an extruded tube, subsequently cutting it into sections. Two newer American methods of processing, extrusion blowing, and moulding from fine spun fibres appear to be suited to polystyrene. Casting is used for special purposes—*e.g.*, optical lenses—but necessary dissipation of heat of polymerization requires uneconomically long polymerization times at low temperatures. Polystyrene is readily machined if adequate cooling and chip removal is carried out. Compounding with plasticizers presents no difficulty, but is seldom necessary, owing to its flow properties at working temperatures. Polystyrene cannot be used at over

75° C., but improved heat-resisting grades have been produced by incorporation of chlorinated diphenyls or filling with, *e.g.*, silica, while the newer polydichlorostyrene (styramic HT) has a heat distortion temperature 30° C. higher than that of polystyrene.
C. L. G.

854. Properties and Uses of Polythene. Part III. E. L. Midwinter. *Brit. Plastics*, May 1945, **17** (192), 208.—The precautions necessary in processing polythene by different methods are discussed. Its tendency to oxidize at over 120° C., with consequent change in power factor and fluidity, can be reduced during milling by rolling with an open nip, or by addition of anti-oxidants. The latter should also be added during preheating before extrusion, the optimum preheating temperatures being 125° C., 140° C., and 150° C. for alkathene 20, 7, and 2, respectively. During extrusion, control of temperature rise from feed to die is most important. Cold feeding of alkathene granules eliminates oxidation which takes place during preheating. For the covering of cables, owing to the low viscosity at extrusion temperatures the core must be drawn off the die, the polythene coating requiring drawing down, since polythene swells as it leaves the die. Voids caused by surfacing hardening on cooling may be prevented by gradual temperature reduction. Films are readily obtained by extrusion through a narrow orifice on to cooling rolls. Moulding by compression (for sheets and simple shapes), injection (for complicated design), and extrusion (for larger articles) can be satisfactorily carried out if the necessary attention is given to temperature control. Hot melt coating of paper with microcrystalline or amorphous waxes containing 20–30% of the softer grades of alkathene, provides useful water-resistant packaging material, and the hot calendering of fabrics with alkathene containing 2–3% of some elastomers provides material for protective clothing. Hollow articles can be produced by filling moulds with cold polythene, melting and draining, and simple rings, caps, etc., by dipping formers into melted mixtures of, *e.g.*, 85% alkathene 200 and 15% bitumen. Powder spraying, or coating with solutions of polythene, provides resistant tenacious surfaces. For large and complicated articles, fabrication may be carried out by jointing sheets or tubes by hot gas welding, using nitrogen at 200° C. Alkathene sheets may also be manipulated at 105° C. by bending and shaping over formers or blowing with air, and are easily machined, an air blast being recommended for cooling and swarf removal. C. L. G.

855. Synthesis of Fatty Acids and Fats. Anon. *Chem. Trade J.*, 1945, **116**, 400.—Lectures by Prof. Langenbeck in Germany indicate a new method of producing edible fats. Self-condensation of formaldehyde, discovered in 1861, was studied in the presence of organic catalysts. The reaction, however, was found to be autocatalytic, and it is believed that glycolaldehyde and dioxyacetone are the autocatalysts responsible. Chemical reduction will then produce glycol and glycerol for fat production. Fatty acids can be produced by condensation of acetaldehyde and crotonaldehyde in presence of piperidine salts and under weakly acid conditions, followed by hydrogenation and oxidation of resulting unsaturated aldehydes. This phase of the work is still in experimental stages due to undesirable side-reactions taking place.
S. J. L.

MISCELLANEOUS.

856.* Close Co-operation within Industry has made Possible its War-time Achievements. H. D. Ralph. *Oil Gas J.*, 31.3.45, **43** (47), 288.—A broad review of achievements of the petroleum industry in producing the products required for the war. Thus, manufacture of 100 octane gasoline has been increased from 40,000 brl. to 600,000 brl. per day, involving the construction of 189 major refining installations costing approximately $760,000,000. Military requirements of more than 36,000,000 gallons per day of motor gasoline have been met, in addition to enormous quantities of other products. Two entirely new industries, toluene and butadiene manufacture, have been created. In all, refinery production is now some 800,000 brl. per day above pre-war minimum. Lists of domestic and foreign 100 octane units completed and under construction, toluene, butadiene and butyl plants are given. C. L. G.

BOOKS RECEIVED.

Chemical Engineering Laboratory Equipment : Design, Construction, Operating. By O. T. Zimmerman and Irvin Lavine. Pp. 530. U.S.A. : Industrial Research Service, Dover, New Hampshire. 1943. Price 34*s*.

Based on reports submitted by 21 leading teachers of chemical engineering, this book is an outgrowth of *Unit Operations Laboratory Equipment* and has been modernized and expanded to be of value in industrial research and development. Sections cover equipment used in : flow of fluids ; flow of heat ; evaporating ; drying ; distillation ; gas absorption ; filtration ; and crushing and grinding.

Chemicals of Commerce. By F. D. Snell and C. T. Snell. Pp. 542. Chapman & Hall, Ltd., London. 1939. Price 28*s*.

A brief description of the properties, preparation and use of many hundreds of chemicals used in industry. Fifteen chapters cover the compounds of the metals and twenty-two chapters deal with the various classes of organic compounds. The latter include synthetic products of the aliphatic and aromatic series and also natural plant products, and proteins.

Merchant Ship Construction : Especially Written for The Merchant Navy. By H. J. Pursey. Pp. 209. Brown, Son & Ferguson, Ltd., Glasgow. 1942. Price 21*s*.

The various parts of a ship are described shortly but clearly and illustrated with perspective sketches. Includes a large section on Oil Tankers. Others cover general parts of ships ; shipyard practice ; survey of ships and testing of materials ; and definitions.

Spectroscopy and Combustion Theory. By A. G. Gaydon. Pp. viii + 190. Chapman & Hall, Ltd., London. 1942. Price 17*s*. 6*d*. net.

A monograph in which the author has collected and discusses the results of recent research on the application of spectroscopy to the various types and phases of combustion. Infra-red, ultra-violet and visible spectra and slow, normal and explosive combustion are dealt with.

Synthetic Resins and Allied Plastics. (*Second Edition.*) Edited by R. S. Morell with contributions from ten contributors. Pp. xii + 580. Oxford University Press, London. 1943. Price 35*s*.

The book contains thirteen chapters covering the production and properties of each of the main classes of synthetic and natural plastics and resins. Four chapters deal with identification and testing and discussion of the mechanism of polymerization.

The High-Speed Compression-Ignition Engine. By C. B. Dicksee. Pp. 331. Blackie & Son, Ltd., London. 1942. Price 20*s*.

Deals in detail with the principles governing the operating of c.i. engines of speeds required for road transport. Chapters cover : laws of gases ; idealized cycles of operation ; chemistry of combustion ; losses and limitations of the practical engine ; air charge before admission of fuel ; the process of combustion ; air movement ; types of combustion chamber ; and some practical results.

INSTITUTE NOTES

JULY, 1945.

PERSONAL NOTE

Mr. I. S. Rutherford, formerly Chairman of the Roumanian Branch, has arrived in the U.K., following his release from a concentration camp where he has been interned since 1941.

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.

Membership.

BALLARD, Hori Hale, Technical Representative, C. C. Wakefield & Co., Ltd. (*G. H. Thornley ; E. A. Evans.*)

BRAIN, Leslie Maitland, Junior Asst. Superintendent, Anglo-American Oil Co., Ltd. (*F. Tipler ; G. M. Davies.*)

CHAPMAN, James Leonard, Asst. Superintendent, Anlgo-American Oil Co., Ltd. (*G. M. Davies ; F. Tipler.*)

CHETWIN, Victor Baxter, Works Chemist, Produce Merchants, Ltd. (*H. W. Chetwin ; E. R. Redgrove.*)

CHOPPEN, Edward Frank, Acting Asst. Superintendent, Anglo-American Oil Co., Ltd. (*C. Chilvers ; F. Tipler.*)

GREEN, Thomas William, Designing Engineer, Petroleum Board. (*A. Harland ; R. St. A. Griffiths.*)

HUNT, Kenneth Charles, Technical Manager, Intava Limited. (*S. J. M. Auld ; H. C. Tett*).

OWEN, Dewi Rhys, Technical Assistant, Shell Refining & Marketing Co., Ltd. (*E. LeQ. Herbert ; J. W. Vincent.*)

PERRY, Reginald James Salter, Technical Secretary, National Lubricating Oil & Grease Federation. (*E. R. Redgrove ; W. Kay.*)

SMITH, Alfred, Works Manager, London & Thames Haven Oil Wharves, Ltd. (*E. A. Hunting ; A. J. Wright.*)

WHEELER, James Richard, Senior Examiner, A.I.D. Test House (*J. Mason ; I. W. Evans.*)

WIGGIN, Harold, Works Manager, The Valor Co., Ltd. (*W. E. J. Broom ; A. Osborn.*)

WOOLDRIDGE, Alfred Wilford, Divisional Sales Manager, Anglo-American Oil Co., Ltd. (*C. Chilvers ; G. M. Davies.*)

Transfers.

ARTER, Kenneth Troward, Senior Engineer, Esso European Laboratories. (*W. E. J. Broom ; A. Osborn.*) (*Member to Fellow.*)

BANGERT, Norman Roy, Assistant Chemist, Shell Refining & Marketing Co., Ltd. (*H. E. Priston ; J. Parrish*). (*Associate Member to Member.*)

COLLIER, Alan, Chief Chemist, Low Temperature Carbonisation Ltd. (*G. S. Pound ; W. F. Murray*). (*Associate Member to Member.*)

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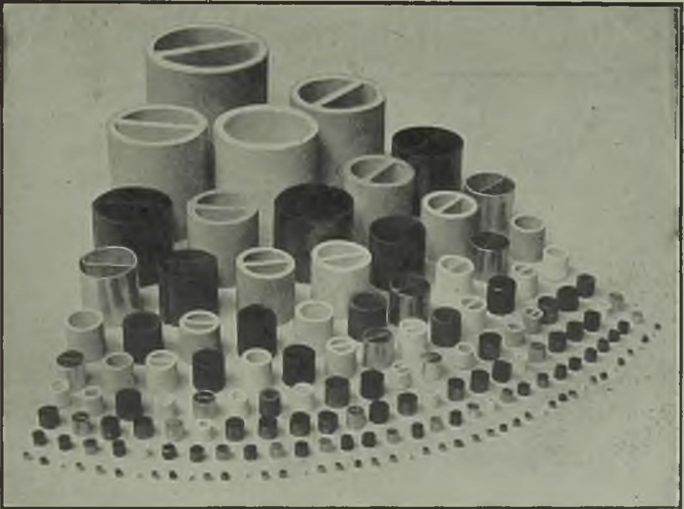

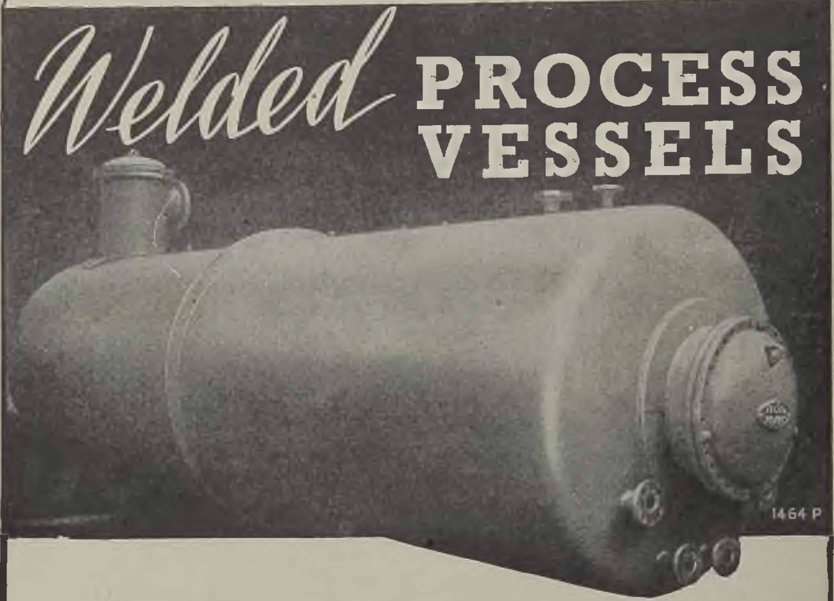
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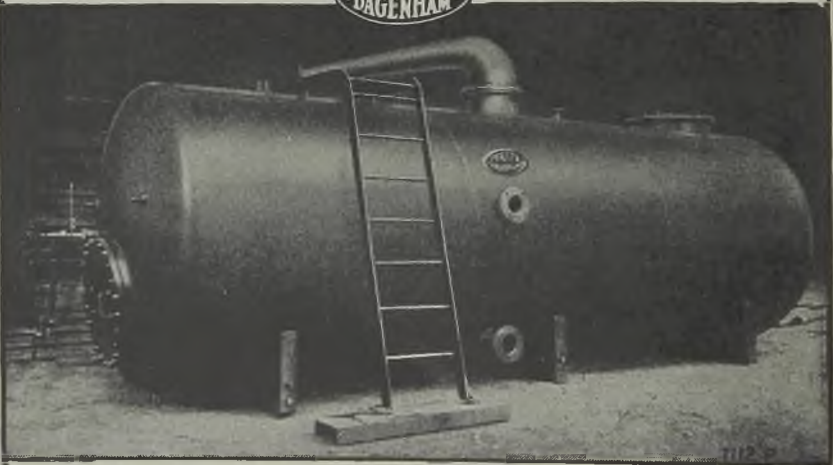
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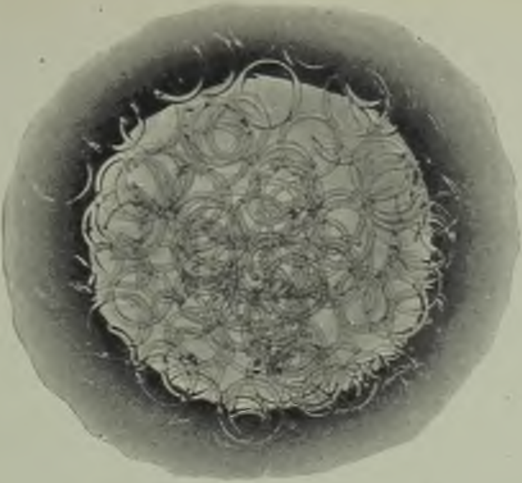


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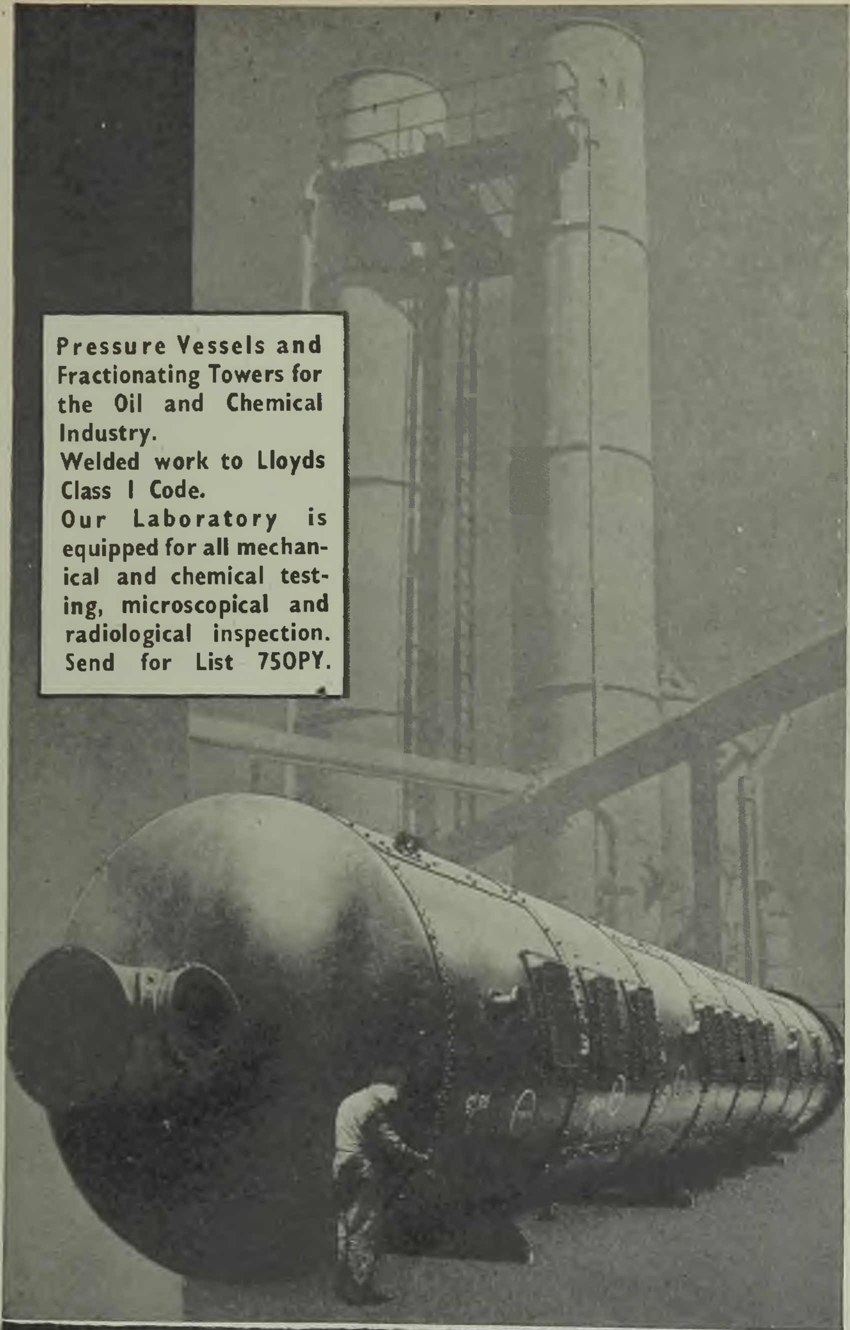

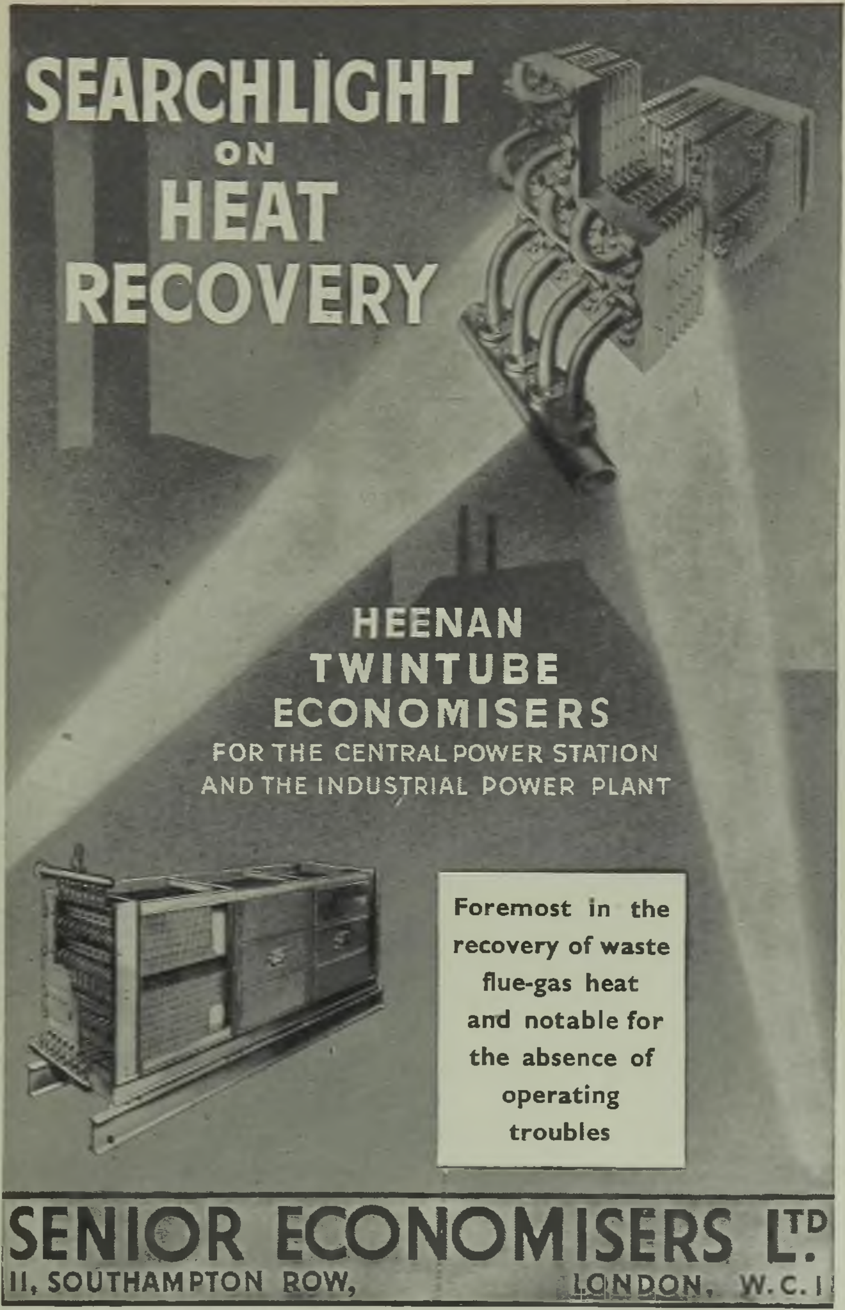

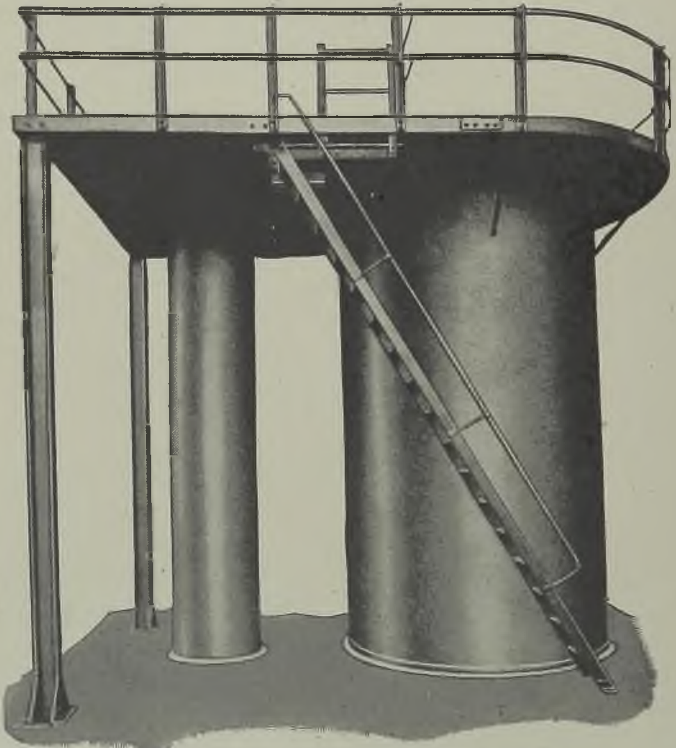

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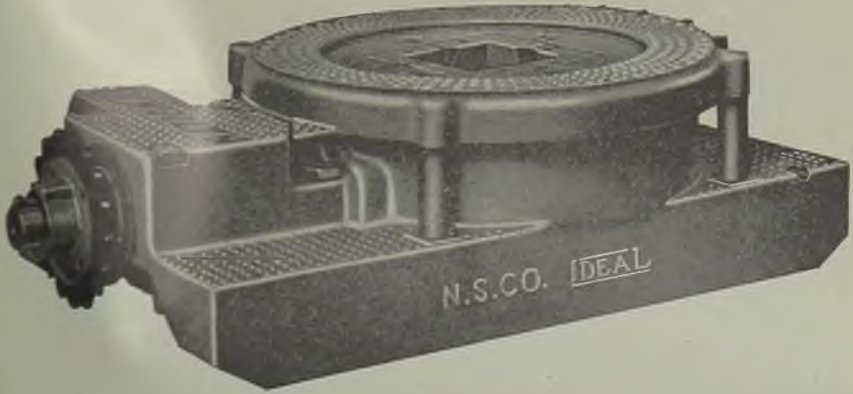

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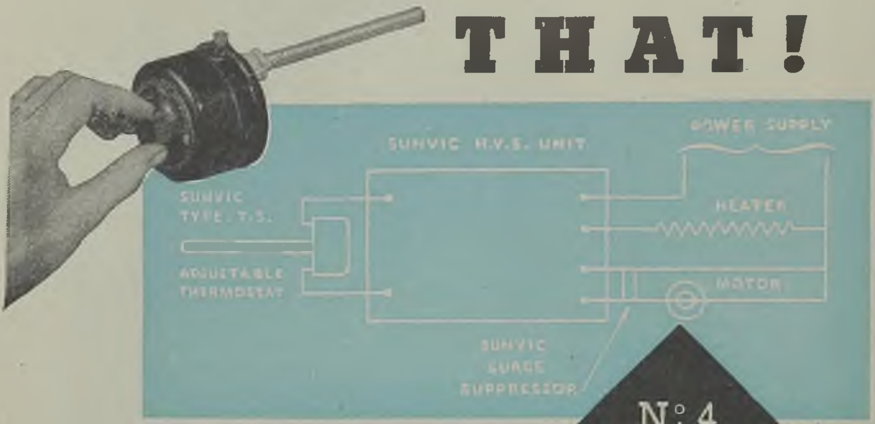
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