

ABSTRACTS.

	PAGE		PAGE
OILFIELD EXPLORATION AND EXPLOITATION.		Chemical and Physical Refining	174 A
Geology	160 A	Special Processes	174 A
Geophysics and Geochemical		Metering and Control	175 A
Prospecting	161 A	PRODUCTS.	
Drilling	161 A	Chemistry and Physics	176 A
Production	161 A	Analysis and Testing	182 A
Oilfield Development	163 A	Crude Oils	184 A
TRANSPORT AND STORAGE	167 A	Gas	184 A
REFINERY OPERATIONS.		Engine Fuels	185 A
Refineries and Auxiliary Re-		Lubricants	186 A
finery Plant	168 A	Special Hydrocarbon Products	188 A
Distillation	169 A	Derived Chemical Products ...	190 A
Cracking	170 A	ENGINES AND AUTOMOTIVE	
Absorption and Adsorption ...	173 A	EQUIPMENT	191 A
Alkylation	173 A	MISCELLANEOUS	192 A
		BOOKS RECEIVED	194 A

AUTHOR INDEX.

The numbers refer to the Abstract Number.

Alden, R. C., 622.	Forziati, A. F., 612	Kratzer, J. C., 624
Amero, R. C., 577	Frey, F. E., 622	Krieg, A., 580
Armistead, G., 565-567, 617	Friedmann, W., 620	Kun, E., 560
Aston, J. G., 606	Friend, U. Z., 576	Kunkel, J. H., 575
Bockett, W. J., 582	Gadibusch, H. M., 623	Larson, C. M., 626
Berents, L. J., 568	Gaylor, P. J., 578	Love, F. H., 558
Bergstrom, F. W., 601	Gilbon, A., 538, 549	McLaren, C. B., 573
Bestul, A. B., 606	Gilbert, C. L., 633	Macmillan, D., 608
Bikerman, J. J., 602	Gilbert, T. H., 557	McReynolds, L. A., 622
Bloch, H. S., 590	George, J., 583-585	Mair, B. J., 612
Braggand, B. L., 564	Glushnev, V. E., 568	Mapstone, G. E., 573
Brickwedde, F. G., 604	Godwin, J. B., 572	Martin, H. Z., 570
Bruce, C. S., 619	Gohr, E. J., 570	Moorman, J. W., 569
Capell, R. G., 577	Green, D. H., 624	Morton, B. B., 561
Chernikin, V. I., 559	Haensel, V., 579	Murphree, E. V., 570
Cody, M. C., 551	Haller, H. L., 610, 611	Nevzglyadov, V. G., 563
Cook, W. A., 593	Harrington, P. J., 564	Nisbet, H. B., 621
Cox, H. R., 637	Henne, A. L., 598	Oberfell, G. G., 618
Crawford, C. L., 586	Hepp, H. T., 622	Ogorzaly, H. J., 570
Cristol, S. J., 611	Hickel, A. E., 614	Pace, E. L., 606
Cushing, M. L., 593	Hill, L. R., 569	Piacas, H., 590, 597
Dale, O. O., 540	Hill, M. A., 592	Pitzer, K. S., 605
Dashiell, J. W., 586	Hirschler, A. E., 595, 605	Pritzker, C. G., 627
Doussin, D. R., 507	Ipatieff, V. N., 597	Pryor, C. C., 545
Drake, N. L., 600	Ivanovsky, L., 620	Rasmussen, H. E., 599
Duck, J. T., 619	Ives, G. O., 554	Rhys, C. O., 564
Eastwood, S. C., 571	Jacobsen, E. W., 586	Ridden, H., 632
Eby, J. B., 547	Jensen, E. V., 591	Rideal, E. K., 583
Eckman, D. P., 581	Kelly, C. I., 629	Robertson, A., 583, 584
Ewing, J. S., 562	Kennedy, R. B., 572	Rodriguez, C., 620
Faulconer, W. B. M., 596	Kharnsch, M. S., 591	Rossini, F. D., 605, 612
Fawcett, F. S., 599	Khrisianoovich, S. A., 559	Rueggberg, W. H. C., 593
Fedosova, G., 625	Khudyakov, G. N., 587	Schieltz, N. C., 608
Pink, H. L., 606	Kilpatrick, J. E., 605	Schmerling, L., 588, 590, 594
Fleck, E. E., 610	Kite, W. C., 541	
Foley, L. L., 542	Knowlton, J. W., 608	
		Scott, R. B., 604
		Seibert, R. A., 601
		Shepherd, D. G., 638
		Shimp, H. G., 571
		Shoemaker, F. G., 623
		Simonsen, D. R., 596
		Simpson, T. P., 571
		Sneddon, R., 615
		Staley, F. R., 634
		Steiner, H., 589
		Steinitz, E. W., 628
		Stekoll, M., 544
		Streid, D. D., 636
		Sweeney, T. R., 600
		Szasz, G. J., 606
		Teeple, H. O., 576
		Thomas, J. E., 536, 537, 555
		Thomas, R. W., 618
		Thornton, D. P., 616
		Trebin, F. A., 559
		Tyson, C. W., 570
		Urry, W. H., 591
		Vermillion, G., 592
		Vogel, A. I., 609
		Vozzhinskaya, Z., 625
		Waalkes, T. P., 598
		Wagman, D. D., 605
		Washburn, E. R., 596
		Waters, J. F., 539
		Williams, D. B., 624
		Willson, C. O., 556
		Wood, W. H., 577
		Wredden, J. H., 630
		Zeitfuchs, E. H., 613
		Zherdeva, L. G., 625

OILFIELD EXPLORATION AND EXPLOITATION.

Geology.

533. Petroleum Reserves of the World. Anon. *Oil Gas J.*, 29.12.45, 44 (34), 172.—The world's petroleum reserves are shown graphically by countries for 1st January, 1944. The total is 50,000 million bbl, U.S.A. having 20,000 million, South America 6700 million, Europe 600 million, Russia 5900 million, the Middle East 15,700 million and the Far East 1070 million bbl.

U.S. domestic reserves represent 39% of the total, and U.S. foreign reserves are 19%; British Empire reserves are 2% of the total, and British foreign reserves amount to 20%. The U.S.S.R. has 11% of the reserves, while the Netherlands control 5%.

G. D. H.

534. Classification of the Petroleum Possibilities of the World. Anon. *Oil Gas J.*, 29.12.45, 44 (34), 174.—A small map of the world shows the areas which are most favourable as regards oil possibilities, those which are unfavourable, and those which may possibly have oil reserves.

G. D. H.

535. Venezuela's 1946 Exploratory Programme Biggest in History. Anon. *Oil Gas J.*, 29.12.45, 44 (34), 265.—The Venezuelan Oil Law demands that at least half of the concessionary acreage must be relinquished to the Government at the end of a three-year period from the date on which the concessions were granted. This is largely responsible for the intensive exploratory programmes undertaken in order to select acreage.

In 1945 27 seismograph parties, 9 gravity-meter parties and 14 geological parties operated.

Creole plans to drill 30 slim holes to an average depth of 5000 ft to evaluate geological and geophysical work on its Guarico concessions. Six geological tests have been drilled north of Jusepin, and tests have been drilled north and west of the discovery well, 1 Capacho, in northeast Anzoategui. A further test is 5 km south of Quiriquire.

Shell's 1945 exploration programme was greater than that of any other company in Venezuela. Structural drilling has been done in the Greater Oficina area. Geophysical work will be increased in 1946.

In the Guico area Socony has drilled 23 geological tests to an average depth of 2700 ft.

Tables give the types of exploration parties operated by the different companies in eastern and western Venezuela in 1945, while notes add some details.

G. D. H.

536. Exploration in Eastern Ecuador. J. E. Thomas. *Oil Wkly*, 7.1.46, 120 (6), 41 (*International Section*).—Shell's 25-million-acre concession in Eastern Ecuador stretches from a point 50 ml from Quito to 200 ml farther east. Field work began in 1939. The best geological exposures are in the foothill belt. Geological reconnaissance from the air, and detailed ground work supplemented by seismic work soon disclosed some structures. The first test location was made on the Vuano anticline. Vuano 1 is about 5 ml northeast of Arajuno. It has been abandoned after a series of unsuccessful completion attempts in both the Upper and Lower Cretaceous. The total depth is 5187 ft. Perforations were made at 5000–5035 ft, and at the base of the Hollin sand at 5175 ft. Both sets of perforations tested fresh water with some oil. Tests in the Napo limestone, after plugging back, also failed.

The Napo limestone and adjacent formations have seeps in this area.

No. 2 Vuano will be 6 ml north of No. 1, while No. 3 will be 12 ml southwest of the Arajuno landing strip.

The transport difficulties are described.

G. D. H.

537. Chile's "Farthest South" Exploration. J. E. Thomas. *Oil Wkly*, 7.1.46, 120 (6), 24 (*International Section*).—Two test wells are now being drilled by the Government of Chile near Punta Arenas.

Most of the exploratory work was geological on the Brunswick Peninsula; it was purely geophysical on the Isla Grande of Tierra del Fuego, which is covered by glacial drift. Numerous gas and some oil seeps have long been known in this area. Wells drilled on the Brunswick Peninsula and near Punta Arenas some 15 years ago gave

negative results, although several reported gas-shows and one had oil-showings at several horizons, from one of which 30 bbl of oil was recovered

Ten closed structures have been worked out since 1941. The Spring Hill well has passed 6800 ft, and may be carried to 11,000 ft. Production is hoped for in the Tertiary or Cretaceous. This is a purely seismic location. A little to the south a location has been made on the Little Spring Hill structure. 50 ml southeast is the location on the Seven Lakes structure.

On the Brunswick Peninsula the well on the Mina Rica structure has passed 1900 ft. This structure, together with Canelo, Rio Grande, Englefield, and Punta Prata, are geological finds. Supplementary geophysical work has been done on Rio Ganso, Rio Patos, and the Laguna Blanca structures.

Brief notes are given on the organization responsible for developing oil in Chile.

Geophysics and Geochemical Prospecting.

538. **Electronic Principles Used in the Discovery of Oil.** A. Gibbon. *Oil Wkly*, 14.1.46, 120 (7), 33.—F. S. Craver has devised an instrument which is stated to detect subsurface oil by recording electronic emanations on a series of sensitive screens. The locations of 145 oil-pools are said thereby to have been predicted before drilling the discovery wells.

The device is claimed to show the area of saturation, the approximate depth of one or more producing horizons, the relative recovery of oil per acre, and whether the oil is of high or low gravity.

Of 1569 wildcat prospects surveyed and later drilled, 1333 were correctly predicted as showing non-commercial saturation, and there were 5 errors, while 148 were correctly predicted to have commercial saturation, and there were 83 errors.

It is assumed that all substances give off emanations, and a screen has been constructed to record these emanations. The main emanations appear to diffuse almost vertically, while the secondary diffusion is in all directions. Depths are determinable only at the edge of the deposit.

The emanation intensities associated with commercial accumulations vary in different areas. Natural gas gives no recording, but a highly gas-saturated oil gives a higher recording than one with less gas.

G. D. H.

Drilling.

539. **Some Problems Encountered during Well Shooting Operations in the Nottinghamshire Oilfields.** J. F. Waters. *J. Inst. Petrol*, March 1946, 32 (267), 119-132.—The principal producing sandstones of the fields were millstone grit of very variable nature as far as porosity and permeability are concerned, and were shot to increase permeability. The paper describes the charges used and, in full detail, the timing mechanism adopted. The final form of the timing mechanism used incorporated a small cylindrical piece of lead under tension which flowed plastically to failure and caused a switch to close, thus exploding the charge.

A. H. N.

540. **Review of Oil-Well Cementing Practices in California.** O. O. Dale. *Petrol. World*, Feb. 1946, 43 (2), 41.—A general discussion of cementing by the older methods of mixing and the more modern bulk methods is given, together with a description of the two-plug method of cementing and of squeeze cementing. Mud compression under the high pressures used up to 3% is commonly met, and in rare occasions compressions of 20% are recorded. This compression is due to occluded gas in the mud or oil fluid which is used. Methods of measuring compression are outlined. The preparation of ordinary and of gel cement is reviewed. Cementing equipment and use of plastics are very briefly mentioned.

A. H. N.

Production.

541. **Well Spacing and Oil Recovery.** W. C. Kite. *Oil Wkly*, 11.3.46, 121 (2), 50.—Several graphs are presented showing the economical advantages of using close well spacings for oil recovery. Production figures show that increased well density results

in increased recovery. Within practical limits there is a definite mathematical relationship between spacing and recovery. An analysis of the various items of cost of producing oil in the Mid-Continent indicates that spacing of around 10 acres probably gets maximum profit/dollar expended. Studies of the relationship between spacing and actual recovery show that we may expect twice as much oil from a field if a pattern of 4 wells to a 40-acre tract is used instead of one well to 40 acres. If 4 wells are drilled on 80 acres the recovery should be about $2\frac{1}{2}$ times as much as only 1 well. Again, 4 wells on a 160-acre tract will produce 3 (to 3 plus) times as much as only 1 well on the 160 acres. It is claimed that wide spacing will do little to increase profits for deep drilling.

A. H. N.

542. Graph for Estimating Recoverable Oil by Volumetric Method. L. L. Foley. *Oil Wkly*, 25.2.46, 120 (13), 40.—A graph is presented for estimating the reservoir capacity from porosity data.

A. H. N.

543. Proper Flood Injection Pressures. Anon. *Oil Wkly*, 25.2.46, 120 (13), 38.—The phenomenon of a sudden critical pressure in flooding operations beyond which appears a rapid rise in the rate of flow is described and illustrated graphically. Two theories are put forward to explain what takes place. One school of thought holds that the overburden between the oil-sand and the surface is actually lifted or sheared above the sand, while the other thinks that a radial fracturing or shearing of the sand itself results. The former group is backed by the quite obvious fact that the overburden on any oil-sand weighs only so much/square inch on the sand top, dependent on the overburden density, and that when this weight/square inch is exceeded by water pressure in the sand plus a certain factor for the shearing action the overburden may be lifted. The latter group is based in the belief that a shearing of the sand takes place when the critical pressure is reached by the observation in field operations that wells in the same field with about the same amount and nature of overburden have widely variant critical pressures. Both groups are aware of the fact that many input wells have different critical pressures at various times during their life, and that no data are available for definitely predicting critical pressures in a certain well. The definition of critical pressure is lacking, but it usually approximates 1 lb/ft of well depth on the surface. For example a 900-ft well should have a critical pressure approximating 900 lbs on the surface. This figure is accurate enough to use in designing surface equipment and estimating corresponding input and recovery rates.

A. H. N.

544. Complete By-passing of Oil in Water-Flooding Operations. M. Stekoll. *Oil Wkly*, 11.3.46, 121 (2), 39.—Complete by-passing of breakthrough in water-flooding operations refers to a condition where the injected water does not force any oil to the producers and where the oil consequently is by-passed by this water. Data are presented on by-passing conditions in two fields of S.E. Kansas. In these two fields injection rate rather than pressure appears to determine by-passing action. Each injection well in these two fields is found to have a certain rate above which by-passing will consistently occur. In addition, the maximum rate of injection/foot of permeable sand for each field is fairly uniform. The by-passing or breakthrough rate in a sand determines economic well spacing, and is a major factor for consideration in water-flood development. The data as given in this paper are obtained from two fields in S.E. Kansas, one field producing from the Bartlesville sand and the other from the Wayside sand. The conditions as found in these two fields are not necessarily applicable to other areas. It is suggested that the pressure-intake curves as obtained from other areas be reviewed with the possibility of discovering whether or not rate is a significant factor in determining by-passing action. It is also suggested that the by-passing curves are most important for an efficient flooding operation, and that these curves should be obtained for injection wells to determine the maximum rate at which the field may be flooded and to prevent operation at an inefficiently high or low injection rate.

A. H. N.

545. Casinghead Gas Conservation. C. C. Pryor. *Oil Wkly*, 11.3.46, 121 (2), 56.—Humble Oil and Refining Co's intended policy for conserving casinghead vented gas are described. This policy includes the principles of: (1) completing and operating oil wells and oil reservoirs in such a manner as to result in a minimum production of casinghead gas and maximum efficient oil recovery; and (2) marketing, consuming, or

returning to the producing reservoir the produced casinghead gas wherever such disposition is economically feasible. Humble has made definite plans for conserving the vented casinghead gas in 11 fields amounting to 90,822,000 cu.ft/day. This figure represents 76.1% of the total 79,526,000 cu.ft/day of gas vented on Humble leases in District 3. The methods adopted in the different fields of the company are briefly described. A. H. N.

Oilfield Development.

546. World Crude-oil Production. Anon. *Oil Gas J.*, 29.12.45, 44 (34), 176.—A table gives the daily average production of the principal countries, starting in 1943 (Russia and the Axis-controlled areas are excluded).

Data are also given on the estimated postwar refinery crude runs in comparison with war-time runs, and estimated post-war production in comparison with war-time production (again the Russian areas are excluded). G. D. H.

547. Oilfields of England. J. B. Eby. *Oil Wkly*, 7.1.46, 120 (6), 3 (*International Section*).—Eakring and Duke's Wood are the most important of England's 5 oilfields. Both are on the same general structure. Kelham Hills is several miles to the southeast. These three provide the bulk of the annual output of 490,000 bbl.

England's first oil-well was at Hardstoft. From 1937 to 1939 seismic reflection work was carried out in the east Midlands area. Refraction work followed, and proved more satisfactory. The surface rocks are Triassic. Oil occurs in the Carboniferous in small, low-relief anticlines, on the gently dipping flank of the Pennine anticline.

Eakring has 54 wells, Duke's Wood 112, Kelham Hills 54, and Caunton 10. All the structures are faulted domes. Well depths range 1800–2680 ft. The oil-sands are sometimes lenticular. At Eakring the main production is from the Rough Rock. Porosities range 0–20%, and permeabilities 2–1000 md. Well spacing is one well to 2½–3 acres. Initial outputs have ranged 7–375 bbl/day. Gas/oil ratios are low, being 10–20 volumes of gas per volume of oil. The oils are considerably under-saturated, and production declines rapidly until the saturation pressure is reached. The later decline is slow. The original reservoir pressure at Eakring was 990 lb/sq. in. in at 1700 ft sub-sea level; the saturation pressure was 390 lb/sq. in. The initial pressure at Kelham Hills was 1200 lb/sq. in. at 2000 ft sub-sea level, and the saturation pressure 90 lb/sq. in. Each sand is under water drive.

The crude is very waxy, and wax and oil-water production cause trouble. Shooting has proved beneficial. The drilling and completion techniques are described. Tables give details about the producing horizons, wells, production, oil-water levels, the oil composition, and a list of wildcats.

The Formby shallow drilling in a seepage area has given some production. 45,000 bbl has been obtained from 12 pumping wells. The oil comes from the Trias, but seemingly has a deeper source. A deep well has reached 6380 ft without finding the source.

The Hardstoft well has been cleaned and treated with acid. During the war it gave 8700 bbl of oil, and it is still pumping a little oil with much water. G. D. H.

548. Nation's 25,840 Completions Fall Short of 1945 P.A.W. Goal. Anon. *Oil Wkly*, 21.1.46, 120 (8), 50.—In 1944 24,455 new wells were drilled in U.S.A.; the 1945 figure was 25,840. In 1945 Texas had 7410 new wells, 18.8% more than in 1944. Pennsylvania had 2929 new wells in 1945; the 1944 figure was 3060.

The 1945 completions included 13,737 oil wells, 2587 gas-wells, 7129 dry wells, 492 deepened wells, and 1895 input and disposal wells.

A table summarizes the December 1945 completions by States and districts, and gives similar figures for the whole of 1945. G. D. H.

549. Western Oklahoma's Prospects Bright. A. Gibbon. *Oil Wkly*, 21.1.45, 120 (8), 40.—With one or two exceptions active drilling in wildcat areas has been confined mostly to the eastern fringes of western Oklahoma. The possibilities of developing new oilfields along the western rim of the Nemaha Ridge are by no means exhausted. In the first 10 months of 1945 about 40 new oil- and gas-fields, new pays, and extensions

were found west of the Indian Meridian. The Wichita Mountains and the Nemaha Ridge have influenced nearly half of the new discoveries.

Exploration and development in Western Oklahoma will be influenced largely by the results of geological and geophysical studies in the Anadarko Basin.

In northwest Oklahoma and adjacent areas there is a regional monocline dipping south. The oil of the Texas Panhandle fields may have migrated from the Anadarko Basin. The geological picture in West Oklahoma is not clear, and at times the seismic work is uncertain. With few exceptions all the producing sands found in eastern Oklahoma are expected to occur in the West, and they will be thicker and more prolific, though deeper. The Pennsylvania sands are especially attractive, and the Ordovician sands may be well developed and deep.

Oil has been found in Cimarron County, in the Panhandle. Production is from the Cimarron sand at 4786-4790 ft. About a mile south and west the Cherokee sand has been found to be saturated at 4846-4861 ft.

Drilling in Beaver County may be influenced by the recent gas discovery in southwest Meade County, Kansas.

It is expected that when the geological pattern of Western Oklahoma is worked out lenticularity and stratigraphic traps will be found to hold much, if not most, of the oil found in the region. On the western edge of the Nemaha Ridge conditions are favourable for Hunton lime and stratigraphic traps.

The Marlow-Duncan area of northwest Stephens County has distillate production. The Lamont pool of Grant County yields oil and water from the Wilcox. Wells in Woods County have given fairly good shows in the Pennsylvanian. Ringwood provided Major County with its first commercial production. This area is in the heart of the Anadarko Basin, where producing sands are expected to be thick, and where the Pennsylvanian, Mississippian, and possibly the Ordovician will be tested.

A new gas-pay at 6786-6810 ft has been opened in the old Erick gas-pool of Beckham County. The original production was in the Permian at 2400 ft. The new pay is an arkosic limestone of the Lower Pennsylvanian. The Chitwood pool of Grady County was opened by a well giving 95 million cub. ft of gas and 250 bbl of distillate/day from the Lower Pennsylvanian at 10,879-10,889 ft.

A map shows the discoveries made in the first 10 months of 1945. G. D. H.

550. Triple-zone Completions in Eastern Venezuela. Anon. *Oil Gas J.*, 29.12.45, 44 (34), 227.—The Greater Oficina area has been under development for about eight years. It has several comparatively large fields, as well as smaller ones, none of which has been completely developed. Most wells have 2 to 6 distinct and separate productive sands. There have been as many as 30 distinct productive sands in one field. Most of the sands are thin, and often they are not extensive. At West Guara, however, the sands are thicker and more extensive. West Guara has 29 triple-zone completions, and East Guara 5. This technique saves steel. A single or a dual completion costs about \$65,000, while a triple completion costs \$70,000, and gives a further 400 bbl/day.

The technique of making a triple-zone completion is described. It seems likely that the obligatory use of small annuli will keep the well on flowing production longer than with a large annulus. G. D. H.

551. Demand for Venezuelan Oil in 1945 is Supplied Despite some Complications. M. C. Cody. *Oil Gas J.*, 29.12.45, 44 (34), 215.—In 1944 Venezuela produced 256,953,960 bbl of oil. The output in the first ten months of 1945 was 262,013,064 bbl. In the early part of November the output exceeded a million barrels per day, compared with a daily average of 770,617 bbl in the first quarter of 1945.

Venezuela can now supply medium and light, as well as heavy, crudes.

In the first ten months of 1945 Creole drilled 193 development wells, 90 being at Jusepin. Capacho 1 opened the Capacho field, but has been followed by 3 dry wells. Shell has drilled 6 Cretaceous producers at La Paz, raising the production from 14,000 to 28,000 bbl/day. In the Cabimas field Venezuela's deepest well is suspended at 13,034 ft. The Mara field has one producer.

The Guara field has been extended westwards, but the Santa Barbara field has proved disappointing in giving smaller wells than expected. The wildcat 8 Laguini,

in the Pueblo Viejo area, south of the Lagunillas field, was completed in May at 3050 ft, for 2390 brl/day.

Socony-Vacuum has drilled 13 producers at Guico during 1945. Consolidada drilled 52 producers in the Santa Barbara and Muri fields during the first ten months of 1945.

Texas completed Delta Amacuro 1 in the vicinity of Tucupita in May. Data on the findings of Nos. 3, 4, and 5 have not been revealed. S.A.P. Las Mercedes commenced drilling Grico 1 and Camaz 2, and has drilled 12 development wells in the Las Mercedes field. Venezuelan Atlantic is drilling 3 wildcats in the vicinity of Santa Barbara, Muri, and Mulata. Three other wildcats and 2 Morichito and 1 Punta Gorda in the same general area have been abandoned as dry holes. Avipa 1 in the Pirital area was completed as a small producer at 4818 ft.

Notes are given on the development and wildcat drilling activities of the various companies. Tables give their outputs by months during 1945, and monthly outputs are given for the more important fields. Maps show the locations of the wildcats drilled during 1945. G. D. H.

552. Deep Potentialities to be Tested at Amana, Venezuela. Anon. *Oil Gas J.*, 29.12.45, 44 (34), 293.—In 1939 production started from the TR and TRN fields (Temblador); in 1940 shipments began from the El Roble field, and in 1943 from the Amana (Mulata) field. In the first ten months of 1945 these properties averaged 35,216 brl/day, compared with 22,106 brl/day in 1944.

Two wells have been completed on the Pirital block by Atlantic under the Atlantic-Pantepec agreement. Avipa No. 1 was a 150 brl well, and Morichito No. 1 was abandoned because of mechanical difficulties. Punta Gorda No. 1 was abandoned below 6000 ft. Obligatory wells, 1 San Pedro and 1 Hueso, are to be taken to a minimum depth of 8000 ft, and Tonoro No. 1 is being drilled because of favourable indications and to make up footage requirements.

43 wells were completed in the first ten months of 1945 at Amana (Mulata), giving a total of 128 oil-wells, 6 gas-wells, and 8 dry holes. The aim is to maintain a potential of 30,000 brl/day. The cumulative output is 14,676,005 brl. Wells in the Mulata field range 4500–6500 ft in depth. The deeper productive possibilities of Amana are to be explored.

At El Roble the well depth averages 9000–10,000 ft. At the end of August the cumulative production was 9,836,877 brl. Special problems have been encountered in drilling, completing, and operating the wells.

Seven wells at Temblador were reopened for production in March 1945.

El Roble, according to the Dodge-Bennett report, had a developed reserve of 27,970,000 brl, with a further 103,500,000 brl of proven but undeveloped reserves, and prospective reserves of 393,530,000 brl, on the basis of engineering and geological data. Mulata's reserves are said to exceed the proven reserves at El Roble. The reserves of Tabasco, TR, and TRN are not considered to be extensive. G. D. H.

553. International will Increase Drilling in Peru, Chile, and Ecuador. Anon. *Oil Gas J.*, 29.12.45, 44 (34), 236.—The proven oil area of the La Brea-Parinas Estate covers 20,000 acres. 3500 wells have been drilled and 1200 abandoned. Many of the wells are over twenty years old, and now give less than 10 brl/day. At present 52% of the output is from flowing wells. There are 5 producing horizons, the Parinas now giving almost all of the flowing production, and being subject to complete pressure maintenance. An experimental water-flood has been initiated in one of the Verdun formation pools. The pools are naturally solution-gas drive pools. The Estate's output is declining in spite of increased drilling activity.

The output of the Do Marcs concession of Colombia is likewise declining. Galan No. 1 has been successfully completed, across the river from Shell's Casabe field, which gives heavy oil.

In Ecuador the International Ecuadorean Petroleum Co. has drilled 12 wildcats without making a commercial discovery.

Three of Peru's producing areas are quite old and have had relatively stable production for the past ten years. It is unlikely that any substantial additions to reserves will be made in these areas.

Notes are given on the petroleum industry in Peru and Colombia, from the point of view of Laws, personnel, etc. G. D. H.

554. The De Mares Concession of Colombia. G. O. Ives. *Oil Wkly*, 7.1.46, 120 (6), 30 (*International Section*).—In 1944 Colombia produced 22,387,508 bbl of oil, all from the De Mares and Barco concessions. The cumulative output was 346,763,808 bbl, 95% of this oil had come from the De Mares concession.

The first Colombian production was obtained in 1918 at Infantas on the De Mares concession. 200 bbl/day was obtained from the Eocene. The Infantas field is on a faulted anticline, with the productive area running for 7 ml slightly east of north and having a width of 1 ml. Two further producing sands were found in the Oligocene, but these are comparatively unimportant. 452 producers and 20 dry holes have been drilled; 10 have been abandoned, 1 is flowing, 275 are pumping, and the rest are closed in. There is a main overthrust on the eastern boundary of the field, and there are minor east-west cross-faults breaking up the producing area. The average thickness of the producing zone is about 400 ft.

In 1926 the La Cira field was found to the northwest. Its productive area is about 5200 acres. It also is an anticline with an overthrust on the east, but this thrust is towards the west. The same three producing zones occur. 809 wells have been drilled. 697 were producers. Production ranges 500–4500 ft in depth. The top sand occurs in parts only of the two structures. The two structures are operated together. The top zone gives 800 bbl/day, the second zone 2000 bbl/day, and the bottom zone 42,000 bbl/day.

The pipe-line outlet runs to Mamonal near Cartagena.

Several fault-blocks are being repressured with encouraging results.

Tropical's auxiliary activities are described, including the ways in which they care for their employees.

In August Tropical completed Galan 1 on the east bank of the Magdalena. This well is said to have a potential of 1500 bbl/day, and is shut in. The oil resembles that of Shell's Casabe field on the Yondo concession, directly across the river. It is on the same structure as Casabe.
G. D. H.

555. Bolivia's Oil Situation. J. E. Thomas, *Oil Wkly*, 7.1.46, 120 (6), 45 (*International Section*).—In 1937 Bolivia made the oil industry a State monopoly. The early exploration had been in southern Bolivia by the Standard Oil Co. (N.J.). The developed fields are in the extreme south, adjacent to the Argentine fields of the Salta district. The largest field, Bermejo, extends into Argentina, where it is called Agua Blanca. Sanandita and Camiri are the other active fields. Three other fields are marked by single shut-in wells (Caigua, Camatindi, and Buena Vista). A well at Saipuru was plugged because of a lack of market.

Bolivia is land-locked, sparsely populated, and without substantial industry. Domestic markets for oil are small; any substantial production would require a pipe-line across northern Paraguay to give an outlet.

Camiri and Sanandita have small skimming plants of 630–750 bbl/day capacity. Most of the Bermejo crude moves to Argentina. In 1944 the average daily outputs of Bermejo, Sanandita, and Camiri were, respectively, 321, 280, and 257 bbl. In 1945 the output has increased, and in September the corresponding figures were 618, 310, and 412 bbl. Camiri has 5 or 6 wells, Sanandita about 15, and Bermejo 12. A 30-well programme has been planned for Camiri.

There are numerous structures and oil seepages extending northwest to the Peruvian frontier. They lie in a narrow belt—the Sub-Andean Trough. All the seepages seem to be related to very steep folds, usually overthrust. Production is from the Devonian, Permo-Carboniferous, and Tertiary. The Devonian is commonly considered to be the source. Rich looks favourably on the area east and southeast of this belt, and extending eastwards almost to the Brazilian border and south into Paraguay. He expects stratigraphic traps on the eastern flank of this great geosyncline. Drilling is about to be begun in north Paraguay, and this may throw light on these prospects.

Some production and refining statistics are given.

G. D. H.

556. The Middle East—its Present and Future. G. O. Willson. *Oil Gas J.*, 29.12.45, 44 (34), 183.—General conditions in the Middle East are described, and the operating companies are listed. Proven reserves are estimated at 16,000 million bbl, and indicated reserves at 29,250 million bbl. Except in Kuwait production is from limestone reservoirs. Kuwait produces from Upper Cretaceous sands, Kirkuk and the fields of

southwest Iran are characterized by extensive jointing which permits uniform drainage with very few wells. The Kirkuk structure is 65 ml long and 2½–3 ml wide. It produces 90,000 bbl/day from 10 wells in an area of 8 sq ml at one end of the structure.

In these limestone fields observation wells are drilled to follow the behaviour of the oil–water and gas–oil levels.

Masjid-i-Sulaiman has produced over 750 million bbl of crude, and still gives 75,000 bbl/day. The residue after topping the crude is now returned to the formation.

Refinery capacity of the Middle East totals 635,000 bbl/day, Abadan providing 385,000 bbl/day. All the crudes have a relatively high sulphur content. During the war the refineries have been operated to give the largest possible yields of asphalt, residual, fuel oils, diesel oils, and other intermediate products. At Abadan large quantities of 110-octane gasoline were produced. Reforming operations exceeded 100,000 bbl/day.

A pipeline outlet is required for the Abqaiq field of Saudi Arabia. A 16-in line is planned to parallel the 12-in lines from Kirkuk to Haifa and Tripoli.

Tables summarize the Middle East field operations, list the refineries, and give the characteristics of the crudes.

G. D. H.

TRANSPORT AND STORAGE.

557. Soil Corrosion and Pipe Protection. T. H. Gilbert. *Petrol. Engr.*, Nov. 1945, 17 (2), 82.—A general discussion is presented on the subject of buried pipelines, their corrosion in the soil, and the various methods employed to shield them from deterioration.

Most soil corrosion is believed to be electrical in character and corrosion on buried metal pipelines is accompanied by an electric current leaving the pipe and flowing into the soil. The main causes bringing about electrical discharge are considered to be:—

(a) Stray currents from direct current railways or tramways running near the pipelines;

(b) Natural differences in soil potential may cause currents to flow in the pipe. These currents may be very small and travel only a fraction of an inch, or they may travel for several miles;

(c) Galvanic potentials due to small differences in potential between adjacent particles of iron or mill scale, or between a brass or copper fitting and iron;

(d) Concentration cells due to differences in potential in the soil resulting from variations in the concentrations of gases or salts.

The testing of soil for corrosive properties is discussed and the various available methods are compared. The question of pipeline protection by the use of various coating agents such as asphalt, coal tar, and petroleum waxes in solid form and applied hot is included, and these are compared with the efficiency of various wrapping materials. Methods of electrical inspection of pipeline coatings are also discussed.

Finally, the question of cathodic protection is covered, and full details of the best methods of ensuring this are given.

Numerous diagrams and sketches are included, and a short bibliography is appended.

T. M. B. M.

558. Reconditioning Pipeline under Pressure. F. H. Love. *Petrol. Engr.*, Nov. 1945, 17 (2), 186.—A description of the reconditioning of part of a 10-in pipeline after ten years service in the counties of Reagan, Upton, and Crockett, Texas. The work was carried out by a contracting firm for the Shell Pipe Line Co. The earth covering the buried line is first removed by a conventional ditching machine equipped with a shoe fitting the pipe contour. After uncovering the line, 6 × 4-in. metal straps were welded to the top side of each welded joint for reinforcing. In rocky regions any rock remaining is removed by a tractor-driven plough which has a shoe that fits the top half of the line and rooters which dislodge the rock. The line is then raised from the trench by two sideboom tractors, and supported on skids above the ditch. Three travelling cleaners are used next; the first has cutting knives and removes most of the old coating, the line is then inspected and repairs noted, and reinforcing straps are welded on the bottom side of each welded joint. The second cleaner then removes the

remaining coating and most of the scale, and then washes the pipe with a cleaning fluid. The third machine cleans the line with steel brushes and applies a primer paint. A travelling-type coating and wrapping machine then applies a coal-tar enamel, and spirally wraps the line with asbestos felt. The ditch is padded with earth in rocky regions, and the line lowered and covered with a 24-in. earth layer. Seven photographs are shown of the machines in operation. W. H. C.

559. Isothermal Flow of Gases in Pipes. S. A. Khristianovich, F. A. Trebin, and V. I. Chernikin. *Bull. Acad. Sci. U.R.S.S., Cl. Sci. Tech.*, 1945, 845-856.—The increasing use of large-diameter gas transmission lines, employing high pressures, with a consequent high Reynolds number of the gas passing through, has shown the need for an expression, denoting the flow of gas under such conditions, that shall be more accurate than that of Weymouth (*Trans. Am. Soc. Mech. Eng.*, 1912, 34, 1090) largely employed hitherto. The expression derived, expressing the gas flow gravimetrically (kg/sec), takes into account the deviation of hydrocarbon gases from Boyle's law and also irregularities in the pipe structure. The gas throughput, and required distance between pumping stations, yielded by the new formula, are less than the corresponding figures obtained by use of the Weymouth calculation. V. B.

REFINERY OPERATIONS.

Refineries and Auxiliary Refinery Plant.

560. Motor Voltage Considerations in Oil Refineries. E. Kun. *Refiner*, Feb. 1946, 25 (2), 65-66.—An economical evaluation of the voltage to be used in refineries, in American practice and terms, is made. Higher voltages are preferred for high horsepower motors. A. H. N.

561. Development Work to Prevent Corrosion. B. B. Morton. *Petrol. Engr*, Nov. 1945, 17 (2), 134.—The planning of development work to prevent corrosion is discussed, and a curve indicative of progress in development work is given showing the relationships time/percentage of progress towards an objective, and is applied in the cases considered. It shows that the evidence of progress occurs some time after the project is launched. This point is considered important to those who must show returns from expensive ventures. The search for superior sucker-rod materials is described. Linings for refinery vessels and plant are discussed, and the necessity for carefully planned economic study is stressed. A test spool for insertion at plant points is described and illustrated. Emphasis is placed on the insulation of test circles against steel, particularly where operations are at temperatures at which water may condense, so as to avoid electrical couples. Brief mention is made of the effects of crudes containing sulphur and naphthenic acids. Preliminary spool tests showed that normal stainless steels were destroyed at a rate higher than for carbon steel, and indicated that a molybdenum variety of 18-Cr, 8-Ni alloy, or Inconel containing 80-Ni, 13-Cr, would have to be used, the Inconel is available as seamless steel tubes. Monel is used for HF, and Hastelloy B (Mo-Ni) for HCl. W. H. C.

562. Stainless and Heat-Resisting Steels. J. S. Ewing. *Petrol. Engr*, Feb. 1946, 17, (5), 124.—Stainless and heat-resisting steels are reviewed from the aspects of their application in the petroleum industry. Broadly, increase of resistance to corrosion of chromium steel alloys is given by alloys containing 6-8%, 12%, and 23% chromium; and resistance to oxidation or scaling at high temperatures depends mainly on the chromium content, although the addition of nickel, and in some cases small amounts of silicon, titanium, and columbium, will provide greater protection against this type of action. For still tubes, transfer lines, vapour lines, heat-exchanger tubes which require strength at elevated temperatures, the alloy must be also ductile for fabrication purposes; 18-8 stainless steel with small amounts of molybdenum, titanium, or columbium are normally suitable; for very severe operating conditions steels with 25% chromium and 20% nickel must be used. Corrosion of refinery equipment is discussed from the aspects of types of processes, deleterious materials in the crudes or products, or elemental gases liberated therefrom, or turbulence through pipes and of

hot-end applications. As no general recommendations can be made for the various applications, types of corrosion and heat resisting steels are discussed under the following sections: bubble caps, bubble trays, liners, valve pumps, weld overlays, miscellaneous hot- and cold-end applications, in which the types of steel alloys suitable for the conditions of operation are discussed.

W. H. C.

563. Turbulent Movement of Liquids in Round Pipes. V. G. Nevzglyadov, *Bull. Acad. Sci. U.R.S.S., Cl. Sci. Tech.*, 1945, 857-874.—The paper is a theoretical and mathematical consideration of the stationary flow of an incompressible viscous liquid in a smooth-walled straight pipe of circular cross-section.

V. B.

Distillation.

564. No Peace for Fractionators. P. J. Harrington, B. L. Braggand, and C. O. Rhys. *Oil Gas J.*, 24.11.45, 44 (29), 135.—Fractionating tower studies by the Standard Oil Co. are described and extensively discussed. They were commenced owing to difficulties arising in two crude-oil pipe-stills at the Bayway refinery in 1941. The main columns were 12½ and 16½ ft in diameter, the units being designed for processing 28,000 b/d East Texas crude to 20% bottoms and 32,000 b/d, West Texas crude to 30% residue, and required reflux and pump-round flow rates up to 115,000 g/hr of hot liquids across the plates. Gaps of 5 to 25° F, based on the 95 and 5% points of adjacent cuts, were expected. The hydraulics of the tower plates were investigated, and are described. From these and other studies, including moving pictures, valuable information was obtained in respect of normal and abnormal flow across the plates which lead to the means for their correction. Very simple changes were possible which permitted increase of throughput up to 45,000 b/d with gaps of 20-35° F continuous cuts, with 100% efficiency. The difficulties encountered are fully described. Briefly they amounted to a resistance to the flow over the plates causing the phenomena termed "dumping," which is due to (a) too long a liquid path, (b) low cap-pressure drop, (c) excessive resistance to liquid flow across the plates.

Dumping differs from flooding. A dumping tower may give no evidence of the phenomena, especially if no large sidestream is taken off, and may even give tolerably good fractionation. The many methods of correcting the cap plates to eliminate dumping are described. At a later date, in another large pipe-still, newly installed, a new trouble was found. At high throughputs a cyclic surging was heard which the early studies could not solve. To investigate this, pyrex observation plates were fitted in the sections, and scales were fixed inside to observe liquid levels and spray heights; moving pictures were also taken. The investigation and results are described, and a diagram shows the counter-current vapour cross flow over plates and the liquid hold-up on the plate inlet side, responsible for the surging. In this case, by blanking caps so as to eliminate counter-current cross flow and arranging the caps so as to reduce spray heights, the plates were made capable of operating without surging at a throughput greater than designed capacity. The knowledge gained was used in designing new stills for processing 30,000 b/d to 16% residue, which when installed could be operated at 50,000 b/d for 18% bottoms, with adjacent cuts of 10-15° F better than the design figure. Some details are given of investigations in respect of isobutane towers, 10-ft-diameter 50 single-pass plate column designed for 7500 b/d of alkylates and butanes, producing 5000 b/d of 80% isobutane overhead, with about 1% of isobutane left in the butanes bottoms. Reflux meters indicated 25-30,000 b/d. but heat and material balances proved that much of the pumpback was being carried over from the tower as liquid. Despite this, the tower ran smoothly and had an over-all plate efficiency as usually defined of 80%. The studies revealed the tower to be badly flooded. High liquid-flow rates had caused gradients across the plates which upset vapour flow and resulted in counter-current vapour cross-flow as outlined above. In this case, however, due partly to a considerable number of transverse plate support beams, vapour cross-flow velocity was so high over much of the plate as to entrain liquid spray upstream. Surging did not occur, as in the re-run still, the build-up of liquid was only limited by filled down-comers. In the 27-in plate spacing it was observed that liquid heights were 12 in over weirs and 25 in on the liquid inlet side, yet smooth operation and fair fractionation were obtained. When the modifications previously described were made,

and also by increasing downcomer to plate clearances, the isobutano tower was able to handle 45,000 b/d of vapour and liquid load with a plate efficiency of at least 106%. Tower-charge hydraulics are briefly reviewed.

W. H. C.

Cracking.

565. Modern Refining Processes. 2. Catalytic Cracking for Production of Motor Gasoline. G. A. Armistead. *Oil Gas J.*, 2.3.46, 44 (43), 60.—Catalytic cracking is a new and expensive process, and has to face heavy competition from older processes making similar products.

Its primary advantages over thermal cracking are generally recognized to be: 1. High-quality level of the cracked motor gasoline; 2. Reduced degradation of feed to gas and residuals; 3. Adaptability to high sulphur feed-stocks; 4. Increased gasoline yields from heavy feed-stocks.

The three widely used processes are the Fluid, Thermoform and Houdry, while one Cycloversion unit is in use.

These processes are described and illustrated by schematic flow diagrams.

The general limitations of catalytic cracking units may be classified as: (a) reaction; (b) carbon burning; (c) preparation equipment; (d) fractionation; and (e) sulphur content of fuel limitations. Each of these factors is considered in detail and its importance evaluated.

It is concluded that carbon burning is the most important limitation to all types of catalytic cracking and will continue to be the major bottleneck.

The characteristics of the motor gasoline produced by these processes are somewhat similar with O.N. varying from 77 to 84 A.S.T.M. and lead susceptibility reflecting the unsaturated quality of the product. High sulphur content of the feed-stock has a depressing effect on O.N. and T.E.L. susceptibility of the cracked product.

D. L. S.

566. Modern Refining Process (2). Factors Affecting Quality of Motor Gasoline from Catalytic Cracking of Gas Oils. G. A. Armistead. *Oil Gas J.*, 9.3.46, 44 (44), 76.—Factors are discussed, such as boiling range, aniline number, sulphur content of feed-stock, which materially affect the quality of motor fuels produced by catalytic cracking. Under similar conditions the A.S.T.M. octane ratings may vary from 79 to 82, depending on the charge-stock properties. While the effect of boiling range is less positive than characterization factor, the heavier feed-stocks under the same cracking conditions give products more unsaturated, which tend towards higher C.F.R.-R. octane numbers and reduced lead susceptibility.

The sulphur content of the feed-stock largely controls that of the gasoline, with consequent effect on clear octane and lead susceptibility. When acid treated to remove substantially all the sulphur, some catalytically cracked gasoline in the range of 0.10–0.20% sulphur show very little increase in the clear C.F.R.-M. octane number, although lead susceptibility is considerably improved.

Catalyst type and activity are important factors, synthetic silica-alumina catalysts produce less carbon and more saturated products with higher content of isoparaffin and aromatics than natural-type catalyst under comparable conditions. The activity of a catalyst after prolonged use may have an appreciable effect on quality of motor gasoline.

Operating conditions considerably influence the quality of the liquid products from catalytic cracking, more severe conditions tend to produce a higher-quality gasoline and a more aromatic cycle-oil fraction, but there are definite limitations to the use of high temperatures of this purpose. The increase of C.F.R.-R. clear octane number with temperature is rapid, and leaded octane numbers increase similarly. The effect of temperature on motor octane is much less. Tables illustrate the effect on quality of numerical increase in variables, and give factors affecting quality of catalytically cracked motor gasoline.

G. A. C.

567. Modern Refining Processes. 3. The Coking of Hydrocarbon Oils. G. A. Armistead. *Oil Gas J.*, 16.3.46, 44 (45), 103.—The coking processes and their utility in the refining industry are reviewed. Thermal coking processes fall into two classes: one for ultimate gasoline yield in which the gas oil evolved is completely cracked, and

the second for partial gasoline yield in which stock is coked and the gas oil produced subsequently cracked in a separate operation.

The de Florez process is an example of the former operation; the feed, ranging from gas oil to heavy cracked tars, is introduced into the primary fractionator, where some distillation takes place, the residue being collected in the tower base for introduction to the coke-drum. Heater feed is passed through the heater under pressures ranging up to 500 lb at temperatures up to 1100° F, the discharge and the primary fractionator bottoms entering the coke-chamber, where the vapours pass overhead, the residual liquid at 800–875° F going to coke. Two or more coking chambers are used alternately, at 25–150 lb pressure. The products are motor gasoline, gas, and coke, conversion per pass to gasoline ranging up to 25%. With very low-gravity feed-stock the process is not economic, the gasoline yield increasing with rising gravity. In the delayed coking process virgin residual feed is coked to partial yields of gasoline with production of gas oil for feed to thermal, or catalytic cracking. In this process the feed is passed through a heating coil, raised to 900–950° F, and discharged into the coking chamber operating at 5–50 lb. pressure and 775–850° F. temperature, where the vapours pass into the fractionator, the unvaporized portion being coked; two or more coking chambers being used alternating. Gas-oil yields increase with increasing A.P.I. gravity, whilst yields of gasoline, coke and gas decrease. The quality of coke produced is important, lighter stocks tend to produce a harder and more compact coke. Topped crudes yields coke of about 7–10% volatile combustible matter and a density of approximately 1.0; and variations in operating conditions yield cokes of differing characteristics.

Coke is removed by either the cable or hydraulic systems. In the former 4000 ft of $\frac{7}{8}$ -in. stranded steel cable, coiled in the chamber from top to bottom, is pulled through the bottom mainway, dislodging the 125 tons of coke as it comes. The hydraulic method is in more general use, and consists essentially of cutting out the coke mass by high-velocity water streams, the removal speed being high, 150 tons being cut out in about 2 hr. A third method involves use of a rotating drill which dislodges the main body of coke by impact and scraping of swinging weights. The process is competitive with viscosity-breaking and cracking with higher yields.

G. A. C.

568. Vapour Phase Oxidizing Cracking of Oil Products, Part II. L. J. Berents and V. E. Glushnev. *Nat. Petrol. News (Tech. Sect.)*, 5.12.45, **37** (49), R 1014.—Further evidence is given to support the statement that decomposition of the feed material proceeds the more vigorously the higher the O₂ content of the charge within the limits studied. It is postulated that O₂ initiates the decomposition of the hydrocarbon chain, and that peroxidic substances formed as a first stage serve as the source of activation and initiation of new chains.

Experiments of oxidizing cracking of gas oil have been carried out in a reaction tube of 5000-ml capacity. Results indicate that the highest yield of aromatics exceeding 11% was obtained at 530–550° C. Gasolines with substantial aromatic content can be obtained, and cracking at 520–550° C yielded 16.6% with an end-point of 150° C and containing 60–65% benzene, toluene, and xylene, while if the end-point be extended to 225° C, 22–25% gasoline can be obtained with a content of low molecular aromatics of 47–50° C. The remainder of this gasoline will consist of unsaturated *cyclo*-olefins with 5 and 6 C atoms and dienes.

In the cracking of Surakhany mazut the highest yield of 200° C end point gasoline was 16.8%, with a charging rate of 88.7 gm/hr and temperature of 620° C. The effect of variation in the temperature on the composition of the gasoline has been studied. In none of the experiments was there any appreciable coke deposition.

A theory as to the mechanism of oxidizing cracking is advanced.

D. L. S.

569. Turn-arounds in Fluid Catalytic Cracking Units. L. R. Hill and J. W. Moorman. *Petrol. Engr.*, Feb. 1946, **17** (5), 98.—Extensive information on off-stream periods of fluid catalytic cracking units has been collected by the Kellogg Co in respect of their plants. The data have provided a comprehensive outline of the effects of corrosion, erosion, and mechanical wear of equipment, and are of importance for providing: (1) essential information for efficient operation of units; (2) additional mechanical design information so that improved equipment would result; (3) further information on processing in general, and are useful for determining optimum conditions for any

particular unit. Through the information gained, better design features have been incorporated in succeeding plants, so that to-day fluid catalytic cracking units have stream efficiencies of more than 90% with maintenance costs of less than 4% per year of the investment cost. It is obvious that the stream efficiency factor, *i.e.*, the number of operating days per run, divided by the total number of days run, plus the days required for the turn-around, is a very important consideration in the economics of an operating plant. Before a turn-around is made, a programme of planning and organization is drawn up to enable the turn-around to be made in the shortest time. Full details of such a scheme are given. All key points in the system should be inspected during the shut-down, whether or not experience indicates the necessity. These include: slide valves, principle catalyst carrier lines, tubular equipment through which the catalyst flows, fractionating system, slurry pumps.

Experience has shown that detailed inspection of other equipment and lines is practically unnecessary. A summary is given under the following sections which indicates the conditions of such equipment, and which is useful as a guide: cyclones, regenerators, slide valves, exchangers, fractionators, catalyst piping, expansion joints, feed heaters, waste-heat boilers, and reactors. Details are given and discussed of typical stream efficiencies, distribution of shut-down causes, and typical craft distribution for turn-arounds, turn-around man-hour requirements for both aviation gasoline and motor gasoline producing units. A brief outline is given of the method of starting up after the unit is again ready.

W. H. C.

570. High-Capacity Operations on Fluid Cracking Units. E. V. Murphree, E. J. Gohr, H. Z. Martin, H. Z. Ogorzaly, and C. W. Tyson. *Nat. Petrol. News (Tech. Sect.)*, 5.12.45, 37 (49), R. 972.—Methods were developed during the war to improve the output of fluid catalytic cracking plants operating with the maximum amount of carbon burning in the regenerator.

Within the limitations imposed by the carbon-burning capacity, output of such a plant can be increased: (1) by improving carbon conversion relationships; (2) by altering conditions to obtain a greater carbon-burning rate.

Two methods of achieving (1) have been applied: (a) improvement of stripper efficiency to reduce hydrocarbon carry-over to the regenerator; (b) reduction in the ratio of catalyst to oil feed by raising the regenerator temperatures. It was determined that these temperatures could be raised from 1050–1075° F to 1100–1150° F.

Fresh feed-charge capacity was increased 15–20% by reason of the reduction in carbon yield at the lower catalyst/oil ratio and by the use of a larger proportion of oxygen in regeneration a higher carbon-burning capacity resulted.

The article is furnished with representative plant data to illustrate the results obtained.

D. L. S.

571. Liquid-Charge Technique in T.C.C. Processing. T. P. Simpson, S. C. Eastwood, and H. G. Shimp. *Nat. Petrol. News (Tech. Sect.)*, 5.12.45, 37 (49), R. 977.—The catalyst-flow system for liquid-charge technique in T.C.C. processing is essentially the same as for vapour-phase operation, although the rate of catalyst circulation may be somewhat higher. The reactor used is the concurrent solid bed downflow type with provision for introducing the feed at the top and removing the cracked products from the bottom. The charge may consist of total liquid or mixed liquid/vapour, while the catalyst is the same as is used in the present conventional vapour-phase operations.

Experimental work has shown that the catalytic reaction starts and proceeds extremely rapidly the instant the spray meets the catalyst, and it has been demonstrated that in the cracking of a 25% Mid-Continent crude residuum, 70% of the ultimate gasoline formation has occurred at a point representing only 12% of the total path through the reaction zone.

Yields of motor gasoline of 45–60% vol., of distillate fuel 20–30% vol., and of heavy fuel 10–20% vol. are typical. The gasolines have excellent volatility, octane numbers 77–82 with good lead response, while light distillate fuels with low pour points are obtainable.

Catalyst-to-oil ratios of the order of 1.8–4.0 vol. have proved to be adequate, and, to minimize coke laydown, the Conradson carbon of the feed should not exceed 4% wt. Deasphalting should be carried out if the Conradson carbon is too high, and this will improve gasoline yields, besides reducing coke formation.

D. L. S.

572. T.C.C. Unit Turn-around Procedure. J. B. Godwin and R. B. Kennedy. *Petrol. Engr*, Nov. 1945, 17 (2), 93.—Little has hitherto been published describing the practical aspects of servicing and maintaining the various types of equipment employed in Thermoform catalytic cracking. This article discusses fully the means adopted by the Beaumont refinery of the Magnolia Petroleum Co. to provide efficient utilization of time, labour, and materials to restore the equipment to prompt operation.

A complete account is also included on the procedure adopted for shutting down the plant and preparing the equipment for the maintenance crews. T. M. B. M.

573. Corrosion Problems in the Cracking of Shale Oil. G. E. Mapstone and C. B. McLaren. *Refiner*, Feb. 1946, 25 (2), 49-52.—On cracking, the tar bases in crude shale oil give rise to small amounts of hydrogen cyanide. In the presence of water and ammonia, part of the hydrogen cyanide is hydrolyzed to formic acid, the remainder combining with the iron products of corrosion to form prussian blue. The formic acid causes corrosion in the upper section of the pressure distillate stabilizer, while in other sections of the plant the presence of tar bases inhibits this form of corrosion. Installation of a countercurrent caustic-soda wash between the distillate receiver and the stabilizer effects satisfactory removal of the acidic corrosive materials. A. H. N.

Absorption and Adsorption.

574. Diethylene Glycol Plant Dehydrates Gas to Exact Specification. Anon. *Refiner*, Feb. 1946, 25 (2), 67-68.—A brief description of a plant using diethylene glycol for dehydration of gas is described. A flow sheet is presented and the process outlined.

A. H. N.

Alkylation.

575. Results of Alkylation Plant Modification. J. H. Kunkel. *Petrol Engr*, Nov. 1945, 17 (2), 168.—The increased production through modification to the Bayway refinery catalytic cracking plant, which has no alkylation facilities (see Abstr. 1329-1945), has necessitated modification of the Baltimore refinery's alkylation plant to accommodate the increased supply received from Bayway. The alkylating unit at Baltimore was designed to process 4190 bbl/day of butenes only, consuming 50 ton/day of acid, for the production of 2130 bbl/day of deparaffinized aviation alkylate, having an A.S.T.M. Motor method octane value of 93, with F.B.P. of 350° F, 120 bbl/day of heavy alkylate; and 40 bbl/day isobutane. The modifications required are described by which the plant was enabled to alkylate 11,500 bbl/day, consisting of 9000 bbl/day of C₄ and 2500 bbl/day of C₅ hydrocarbons, to give 4055 bbl/day of aviation alkylate of A.S.T.M. Motor method octane number 88.7 with a 370° F end point; 630 bbl/day of heavy alkylate; and 900 bbl/day of isopentane; the acid consumption being 320 tons/day. Briefly the alterations required additional pumping facilities, more heat-exchangers, larger condensing capacity, and fractionating column revision. The feed-nozzles on the isobutane tower were placed nearer the top to improve stripping, and to improve fractionation the down-spout clearances to the plates were increased and the bubble-cap blanking was revised. The tower pressure control was changed and re-positioned to permit a lower cooling temperature in the condensers and to reduce dezincification of the condenser tubes. A larger feed line to the re-run tower was put in to reduce the load on the stripper in the base of the tower. To ease the load on the re-run column and to facilitate blending of the final gasoline product, which contains large amounts of isopentanes, an off-site deparaffinizer in the refinery's thermal cracking unit was tied in with the plant between the butane tower and the re-run tower. In this revision of flow, butane-tower bottoms enter the deparaffinizer for a close-cut separation of the C₅s. The deparaffinizer's overhead isopentanes is condensed and goes to storage for blending, and the tower bottoms, deparaffinized total alkylate, are charged to the re-run tower preheater. The reactor temperature is maintained at 58° F instead of 35-40° F as in the original plant. W. H. C.

576. Corrosion by Hydrofluoric Acid. U.Z. Friend and H. O. Teeple. *Oil Gas J.*, 1946, 44 (45), 87.—The results of laboratory and plant corrosion tests in hydrofluoric acid of various concentrations are recorded.

In the alkylation process hydrofluoric acid or fluorides initially enter the system in the anhydrous form, but water may be picked up from feed materials or leakage, and corrosion by dilute solutions is set up.

Laboratory corrosion tests were made in metal containers, Monel, nickel, or lead for the dilute solutions and Monel or steel for the concentrated solutions; the test specimens being completely immersed and not in contact with the container or other metals.

Corrosion tests were also made in various parts of the regeneration equipment of alkylation plants, such as the top of the acid-regeneration column and in the inlet and outlet ends of its preheater. Tests were also made in hydrofluoric acid solutions in operating equipment in plants using this acid for other purposes, *e.g.*, in the acid pickling solutions used for the pickling of cast iron. From the data given in tables, general conclusions as to the performance of common metals and alloys in hydrofluoric acid have been drawn.

Monel metal is usefully resistant to all concentrations of the acid, including anhydrous acid over a considerable range of temperature. Its corrosion rate may be increased by a high degree of aeration of the solution, and by the continuous presence of oxidizing salts such as cupric or ferric salts. Monel is not subject to stress-corrosion cracking in hydrofluoric acid, but it is in strong fluosilicic acid solutions containing 22% H_2SiF_6 . This may be prevented by stress-relieving Monel vessels. The corrosion rates for "K," "H," and "S" Monels are similar to those for Monel itself. Copper and high-copper alloys, such as red brass, silicon bronze, and admiralty brass, are equal in their performance in hydrofluoric acid; in dilute solutions corrosion rates are considerably increased by aeration or oxidizing salts. The upper temperature limit appears to be 175° F. Copper-nickel alloys are next to Monel in general performance. Carbon steel is resistant to concentrations above 75–80% up to about 150° F, so that it can be used in most of the equipment except that involved in acid regeneration, and sufficiently large clearances should be allowed in plug-valves for scale formation. Nickel, Inconel, Hastelloy alloys, austenitic stainless steels, and other alloys are also studied, and corrosion rates in inches per year for all materials tested are given in 9 tables.

G. A. C.

Chemical and Physical Refining.

577. Fullers Earth as a Binder for Catalysts and Adsorbents. R. G. Capell, R. C. Amero, and W. H. Wood. *Refiner*, Feb. 1946, 25 (2), 69–71.—The characteristics of fuller's earth in general, and of "Florigel" in particular, as binders are discussed. It is concluded that Florigel is eminently suitable because: (1) when mixed with water and catalytic or adsorptive materials, it forms a plastic mass which may be readily mixed, pugged and extruded, pressed or pelleted; (2) it gives increased mechanical strength to a wide variety of soft non-plastic materials; (3) it is irreversible with respect to water—that is, it does not "mud-up" or break down after heating at 700° F or higher, and therefore preserves its binding action in contact with water or steam; (4) it is a porous, insoluble mineral, and therefore does not "bind-off" or detract from the surface area of the material being bound; (5) it is an adsorbent and a catalyst in its own right, and active in decolorization, polymerization, desulphurization, and dehydration reactions; (6) it is stable at high temperature.

A. H. N.

Special Processes.

578. Patent Trends in Petroleum Refining. P. J. Gaylor. *Nat. Petrol. News (Tech. Sect.)*, 5.12.45, 37 (49), R. 986.—*Nitro-Hydrocarbons and Derivatives*. The patents dealing with the preparation of nitro-hydrocarbons by the reaction of N_2O_4 with the lower paraffins and olefins are discussed. Thus 1:2-dinitro-ethane, melting point 39–40° C and boiling at 135° C/5 mm, is produced by reacting ethylene and N_2O_4 at –10° C and atmospheric pressure. The percentage of ethylene in the mixture must be kept within definite limits to avoid danger of explosion.

iso-Butylene also reacts to form 1:2-dinitro-2-methylpropane.

A number of these patents is held by the I.C.I., Ltd.

Bead Catalysts. Socony Vacuum's patents on "T.C.C. synthetic beads" involve the dropping of hydrosol catalyst globules into a fluid immiscible with water (such as

oil) in which the globules assume a spheroidal shape. Gelling takes place at the interface between the sol and the medium

One of the peculiar features attributed to these gel pellets is their transparency, present only when silica is predominant. They are extremely hard, and are thus capable of resisting losses by attrition and shock due to handling.

Vinyl Acetylene. This is the raw material for neoprene, and can be produced by the controlled polymerization of acetylene. A patent has been taken out by Phillips Petroleum for the recovery of this material from a C_4 stream from certain thermal cracking and catalytic dehydrogenation processes.

An azeotropic exists between vinyl acetylene and butenes 2 which is of minimum boiling point, and can thus be separated by distillation. A number of solvents have been found which selectively absorb vinyl acetylene from the other C_4 hydrocarbons and render it possible to obtain it in purity of 95%.

In the production of butadiene by pyrolysis of hydrocarbons the C_4 fraction is usually extracted with ammoniacal cuprous acetate solution, in which the diolefin is selectively absorbed. Acetylenes are also absorbed forming acetylides, but these can be separated, since they are very soluble in high ammonia or high amine solutions.

Acrolein Compounds. The oxidation of olefins to acroleins by the use of tellurite and selenite catalysts is the basis of a new patent. D. L. S.

579. New Version of Fischer-Tropsch Reaction gives 90% Yields of iso-Paraffins. V. Haensel. *Nat. Petrol. News. (Tech. Sect.)*, 5.12.45, 37 (49), R. 955.—This is the report of an Oil Mission team to Germany, and deals with work carried out at the Kaiser Wilhelm Institut für Kohlenforschung, Muelheim Ruhr. By modifying the composition of the synthesis gas for the Fischer-Tropsch reaction so as to obtain a 20% excess of CO over H_2 , it is possible to produce a product containing an excess of iso-paraffins.

The reaction first produces higher alcohols (primarily isobutanol), which are then dehydrated, and the resulting olefins hydrogenated to the iso-paraffins. One step synthesis was achieved by combining all three reactions into one stage.

A number of catalysts have been developed which are suitable for this reaction, mainly consisting of the oxides of zinc, thorium, or aluminium, or mixtures of these. The reaction is carried out at 450° C and 300 atm pressure, and the throughput is 5-10 times higher than that used in the regular process. D. L. S.

Metering and Control.

580. Selection and Application of Refinery Instruments. Part 2. Temperature.

A. Krieg. *Petrol. Engr*, Feb. 1946, 17 (5), 74.—The three basic types of instruments used in temperature measurement or control are: (a) thermometer or thermal bulb type; (b) potentiometer pyrometer or thermocouple type; (c) resistance thermometer or resistance bulb type. In section (a) thermal bulb types are classified as: liquid expansion; vapour tension; gas filled; mercury filled. In section (b) potentiometer pyrometers are described under the headings: electrochemical potentiometer; electronic potentiometer; electronic photo-tube potentiometers. In section (c) resistance thermometers are described and discussed under two arrangements for circuit balancing—viz., mechanically balanced and electronically balanced thermometers. The instruments indicated in the sub-sections are described and discussed in respect of their characteristics, range of scale, accuracy, permissible length of tubing (for type (a)), suitability for various types of plant. Process variables are outlined and discussed from the aspects of capacity lag, transfer lag, and distance lag. Sections on thermal potential and furnace outlet control are also given. W. H. C.

581. Effect of Measurement Dead Time in Control of Certain Processes. D. P. Eckman.

Petrol. Engr, Feb. 1946, 17 (5), 59.—One of the most important factors in automatic control of processes is the manner in which the controller mechanism responds to changes in the measured variable. This measuring lag forms an extensive part of the input-output controller relationship. Investigations of the factors of measurement of dead time and dead zone in automatic control instruments have been made with a view to aiding the application of theoretical and empirical data to control problems.

The measuring lag of a temperature controller is composed of: (1) the lag of the primary element; and (2) the lag of the controller detecting mechanism. For the purpose of these studies, two classes of self-balancing potentiometer controllers are discussed: (a) a periodic action, and (b) a continuous action, potentiometer. In the periodic type instrument, when an unbalance of voltages is produced by a change in measured temperature the detecting mechanism determines the amount of unbalance and drives a voltage divider or slide wire to balance against the new value of measured voltage. The continuous type of action potentiometer uses a continuous uninterrupted drive (usually electronic) to obtain the balance measured against standard voltages. The use of continuous action in potentiometer balancing eliminates any lag due to a re-balancing mechanism, and avoids periodicity, whereby a small dead time may elapse before changes in controller temperature can be detected. In order to determine the effects of dead time in the measuring system, the following tests are described and discussed: (a) two-position control, by which all extraneous factors may be eliminated from the tests on automatic control; (b) proportional reset control. A controller may be applied to a process, and the deviation during a recovery from a load change may be expected to show differences depending on the magnitude of the dead zone. The dead zone is usually defined as the greatest range of scale values within which changes in the value of the controlled variable are not detected. The results given show the importance of measuring lag and measurement dead zone in automatic control. It is desirable to maintain measurement dead time as small as possible, for it increases the quality of control, especially on those processes where all other lags are small. By keeping dead zone small, a reduction of dead time is obtained which increases quality of control.

W. H. C.

582. Rotameters. W. J. Beckett. *Refiner*, Feb. 1946, 25 (2), 91-93.—The principles of construction and use of rotameters are given in this paper, which forms a part of Southern California Meter Association Meter Course.

A. H. N.

PRODUCTS.

Chemistry and Physics.

583. The Oxidation of Liquid Hydrocarbons. I. The Chain Formation of Hydroperoxides and their Decomposition. P. George, E. K. Rideal, and A. Robertson. *Proc. Roy. Soc. A.*, 14.3.46, 185, 288.—The course of the low-temperature liquid-phase oxidation of hydrocarbons through hydroperoxide formation and subsequent decomposition has been confirmed. The function of a heavy metal catalyst is to increase both the rate of formation and decomposition of this hydroperoxide. The dependence of the stationary concentration of hydroperoxide on the oxidation rate and the catalyst concentration indicated that the hydroperoxide decomposition is unimolecular with the reaction velocity constant directly proportional to the catalyst concentration. This has been confirmed by independent decomposition experiments. It is suggested that the reaction involves the breakdown of a "heavy metal catalyst-hydroperoxide" complex.

From a study of the oxidation rates of hydrocarbons, alcohols, and ketones, and the oxidation of mixtures, it was found that alcohols are the most resistant to oxidative attack, and, furthermore, inhibit the catalysed oxidation of long-chain paraffins. The oxidation cannot therefore proceed through alcohols as primary intermediates, and the hydroxylation theory is thus inapplicable to these liquid-phase oxidations. It is suggested that the sequence hydrocarbon-hydroperoxide-ketone represents the major course for the reaction in the early stages of the oxidation.

From the variation of the inhibited rate with time, a theoretical treatment has enabled the chain length of the uninhibited oxidation to be determined. For instance, at 120° C the chain length is 142 ± 10 . The "activation energy" of the chain length is -13.3 ± 2 k cal.: thus at 20° C the chain length would have a value of 48,000. From this activation energy and that of the overall reaction, the activation energy of the chain initiation reaction has been found to be 28.2 ± 2.5 k cal.

In the heavy-metal catalyzed oxidation the rate is independent of the catalyst concentration above a certain value. This may be explained by the hypothesis that the

heavy-metal catalyst both starts and stops reaction chains responsible for hydroperoxide formation. The phenomena of positive and negative catalysis follow, according to relative efficiency of the heavy-metal catalyst in these two reactions.

T. M. B. M.

584. The Oxidation of Liquid Hydrocarbons. II. The Energy-Chain Mechanism for the Thermal Oxidation of Tetralin. P. George and A. Robertson. *Proc. Roy. Soc. A*, 14.3.46, 185, 309.—The liquid-phase oxidation of hydrocarbons, where the point of the oxidative attack is a $>CH_2$ group, has been shown to proceed at a rate independent of the oxygen pressure and proportional to the square of the hydrocarbon concentration. This arises from a primary chain reaction which gives a hydroperoxide as the primary intermediate. Degenerate chain branching, resulting from the decomposition of the hydroperoxide, is responsible for a slow exponential increase in the reaction rate with time: it is less marked the higher the temperature.

At the reaction temperatures employed (65–120° C) the hydroperoxide is the predominant oxidation product, and the major kinetic problem has been to determine the nature of the primary reaction chain. An examination of the kinetic characteristics of the inhibited oxidation has shown that the normal chain termination is a unimolecular reaction of the chain carrier, and further, that the chains are initiated in a unimolecular reaction of the hydrocarbon. These conclusions enable a unique choice to be made in favour of an energy-chain mechanism.

In this case the process of inhibition must not only be regarded as an additional means of terminating the reaction chain, but as a competition between the hydrocarbons and the inhibitor for the chain carrier in which the reaction with the inhibitor is greatly favoured.

T. M. B. M.

585. The Oxidation of Liquid Hydrocarbons. III. The Oxidation of Tetralin in the Presence of Benzoyl Peroxide as a Free Radical Chain Reaction. P. George. *Proc. Roy. Soc. A*, 14.3.46, 185, 337.—The product of the benzoyl peroxide sensitized oxidation of tetralin is the hydroperoxide as it is in the thermal and heavy metal catalysed oxidations. There is clear evidence that the reaction has a chain mechanism. As the concentration of benzoyl peroxide is increased the oxidation rate rises to a constant value, which shows that the peroxide both initiates and terminates the reaction chains. The oxidation rate is proportional to the first power of the tetralin concentration, and is characterized by a complex less than first-order variation with the oxygen pressure over the entire range of peroxide concentrations. This arises from a chain termination reaction with oxygen, a new feature in liquid-phase oxidations, and one which is not present in the thermal oxidation. In view of the accepted free radical character of the benzoyl peroxide decomposition, this oxygen termination reaction is thought to be characteristic of a free radical chain oxidation. A suggested mechanism gives an expression for the rate identical with that obtained from the kinetic investigation.

By using low peroxide concentrations it has been found that the thermal energy chains and the induced free radical chains proceed simultaneously.

Decomposition experiments have shown that in oxidizing systems benzoyl peroxide decomposes faster than in solvents in the absence of oxygen. Using this and other kinetic data, the oxidation chain length has been found to be approximately 230.

T. M. B. M.

586. Compressibility of Liquid Hydrocarbons. E. W. Jacobsen, E. E. Ambrosius, J. W. Dashiell, and C. L. Crawford. *Oil Gas J.*, 23.3.46, 44 (46), 109.—The relation of compressibility to A.P.I. gravity for 19 purified hydrocarbons and oils is considered, and compressibility factors for these are given at several temperatures between 30° and 130° F. A list of references to the literature is appended.

T. M. B. M.

587. Combustion of Liquids from a Free Surface. G. N. Khudyakov, *Bull. Acad. Sci. U.R.S.S., Cl. Sci. Tech.*, 1945, 1115–1126.—A study was made of the combustion of various liquids, including petroleum products, from the open surface of a quartz vessel (62 mm diam). Once established, the combustion rate remains constant. Measurement of temperature distribution in the liquid beneath the burning surface indicates that there is no appreciable diffusion of heat down into the bulk of the liquid. The

velocity of combustion is increased by pre-heating of the liquid. The thermal potential of the evaporating surface is a constant, which is characteristic for each substance; for the liquids examined it varied from 8580 (ethyl acetate) to 22,920 (green oil) cal./m²/hour. Petroleum products lay in the range 10–12,000 cal./m²/hour. V. B.

588. The Mechanism of the Alkylation of Paraffins. L. Schmerling. *J. Amer. chem. Soc.*, 1945, **67**, 1778–1783.—Evidence is presented in support of a chain mechanism for the alkylation of iso-paraffins with olefines.

It is suggested that the *t*-alkyl ester first formed from the iso-paraffin, by addition to the olefine, yields an ester of higher molecular weight, which then reacts with the iso-paraffin to give the observed paraffin product and a new molecule of the *t*-alkyl ester, which then reacts with olefine as in the second step, and thus the cycle is repeated.

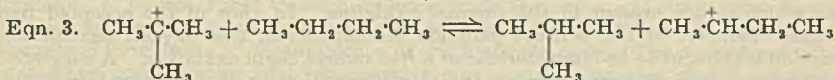
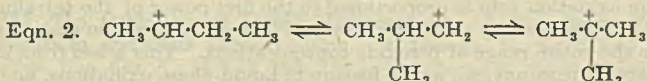
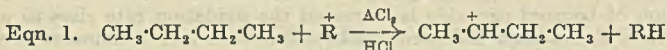
J. H. P.

589. The Catalytic Dehydrocyclization of Paraffins. H. Steiner. *J. Amer. chem. Soc.*, 1945, **67**, 2052–2054.—Experiments on the poisoning of the catalysts used in this reaction and particularly the conclusions drawn regarding the mechanism of the catalytic action are discussed.

It is held that the reaction proceeds by two stages; the dehydrogenation of the paraffin to olefine being followed by the cyclization of the olefine to an aromatic. Both stages are affected by the poisoning of the catalyst. Where the poisoning is due to accumulation of polymer, the two reactions are affected to much the same extent. When water and particularly ethylene is the poison, the dehydrogenation reaction rate is repressed even more than that of the cyclization stage but the decline is still parallel. The author argues, in contradiction to other workers, that the close relationship revealed by the parallel effect of poisons on both reaction rates shows that they proceed on identical centres of the catalyst surface.

J. H. P.

590. The Mechanism of Paraffin Isomerization. H. S. Bloch, H. Pines and L. Schmerling. *J. Amer. chem. Soc.*, 1946, **68**, 153.—A sequence of reactions is proposed for the isomerization of paraffin hydrocarbons in the presence of an aluminium halide catalyst:—



The chain initiating ion $\overset{+}{\text{R}}$, which need be present in small amounts only, may be produced in several ways—*e.g.*, by the addition of hydrogen chloride or hydrogen aluminium chloride to an olefine present in the paraffin as impurity, or which is added as such. The rearrangement of the *s*-butyl carbonium ion (Eqn. 2.) is analogous to that of olefines in the presence of acidic substances, whilst the reaction of Eqn. 3 and of Eqn. 1 is similar to the hydrogen-halogen interchange which occurs between iso-paraffins and *s*- or *t*-alkyl chlorides in the presence of aluminium chloride. Higher temperatures or otherwise more severe reaction conditions are necessary for the isomerization of *n*-paraffins than for the alkylation of iso-paraffins. The proposed mechanism is also applicable to the isomerization of cyclo-paraffins.

J. H. P.

591. Addition of Carbon Tetrabromide and Bromoform to Olefines. M. S. Kharasch, E. V. Jensen, and W. H. Urry. *J. Amer. chem. Soc.*, 1946, **68**, 154–155.—The addition reaction between carbon tetrabromide and an olefine is initiated either by diacylperoxides or visual light, and mono-addition products normally result. The reaction with bromoform is extremely slow in the absence of the peroxide.

J. H. P.

592. Catalytic Alkylation of Chlorobenzenes. G. Vermillion and M. A. Hill. *J. Amer. chem. Soc.*, 1946, **68**, 190–191.—The reaction of cumene with monochlorobenzene

catalysed by aluminium trichloride was studied as a new method of alkylating halobenzenes. The para isomer is present among the chlorocumenes thus prepared.

J. H. P.

593. Condensation of Aliphatic Alcohols with Aryl Hydrocarbons in the Presence of Chlorosulphonic Acid. W. H. C. Rueggeberg, M. L. Cushing and W. A. Cook. *J. Amer. chem. Soc.*, 1946, **68**, 191-192.—Alkylated benzenes may be prepared by the slow addition of 1 mole. chlorosulphonic acid to a mixture of 1 mole. of the alcohol and 3 moles. of the aromatic hydrocarbon at about 10°. Secondary and tertiary alcohols react smoothly, but primary alcohols in general do not. The mechanism of the reaction is discussed.

J. H. P.

594. Exchange of Hydrogen and Chlorine between *Bicyclo*-(2 : 2 : 1)-Heptane and *t*-Butyl Chloride. L. Schmerling. *J. Amer. chem. Soc.*, 1946, **68**, 195-196.—When *bicyclo*-(2 : 2 : 1)-heptane is contacted with *t*-butyl chloride at 0° in the presence of aluminium chloride, 2-chloro*bicyclo*-(2 : 2 : 1)-heptane results, and not 1-chloro*bicyclo*-(2 : 2 : 1)-heptane, as would be expected.

J. H. P.

595. Freezing Points and Polymorphism of the Eight C₉H₁₂ Alkylbenzenes. A. E. Hirschler and W. B. M. Faulconer. *J. Amer. chem. Soc.*, 1946, **68**, 210-213.—Each of the eight isomeric C₉H₁₂ alkylbenzenes has been prepared and the physical properties investigated.

J. H. P.

596. The Ternary System: *t*-Butyl Alcohol, Benzene, and Water at 25°. D. R. Simonsen and E. R. Washburn. *J. Amer. chem. Soc.*, 1946, **68**, 235-237.—The ternary system tertiary butyl alcohol, water, benzene has been studied, and the solubility curve, refractive index, specific gravity, and relative viscosities recorded and compared with those of the corresponding alcohol, water, benzene system.

J. H. P.

597. Reaction of Methylcyclopentane with Olefines in the Presence of Sulphuric Acid and Hydrogen Fluoride Catalysts. H. Pines and V. N. Ipatieff. *J. Amer. Chem. Soc.*, 1945, **67**, 1631-1638.—The reaction apparently involves the following: the addition of methylcyclopentane to olefines accompanied by ring expansion and migration of alkyl groups within the ring; hydrogen disproportionation; isomerization of straight-chain olefines to iso-olefines followed by hydrogenation; reaction of partly dehydrogenated naphthene with *cyclo*-olefines or saturated cyclic hydrocarbons to form polycyclic olefines or polycyclic saturated hydrocarbons; depolymerization and/or depolyalkylation.

J. H. P.

598. The Addition of Fluorine to Double Bonds. A. L. Henne and T. P. Waalkes. *J. Amer. chem. Soc.*, 1945, **67**, 1639-1640.—Fluorine released by the spontaneous decomposition of lead tetrafluoride produced in the presence of excess of an olefins from lead dioxide and hydrogen fluoride may be taken up at an olefinic double bond.

The possibilities of the reaction in furthering the synthesis of symmetrical compounds such as CHClFCHClF are discussed.

J. H. P.

599. Physical Properties of Thiophene, F. S. Fawcett and H. E. Rasmussen. *J. Amer. chem. Soc.*, 1945, **67**, 1705-1709.—The following properties of thiophene have been determined on a sample freed from benzene and other impurities: f.p., b.p. over the range 500-900 mm., n_D , d_4 , and η at 20°, 25°, and 30°, specific dispersion at 20°, and some derived constants. For the system thiophene-benzene the n_D^{20} , d_4^{20} , η_{20} , and f.p. were determined as a function of the composition.

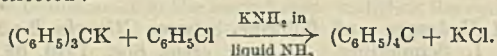
The purification of the thiophene is described, both physical and chemical methods being employed. Analyses were made using a mass spectrometer, which method permits of the detection of as little as 1 part of benzene in 7000 parts of thiophene (and vice versa).

J. H. P.

600. The Reaction of Phenanthrene with Ethyl Diazoacetate. N. L. Drake and T. R. Sweeney. *J. Org. Chem.*, 1946, **11**, 67-74.—The addition of ethyl diazoacetate to an ethylenic linkage yields a pyrazoline carboxylic ester, which evolves nitrogen at elevated temperatures and forms a derivative of ethyl cyclopropanecarboxylate. The reaction has been extended to aromatic hydrocarbons such as benzene, naphthalene, mesitylene,

durene, and, in the present work, to phenanthrene. If the nature of the aromatic precludes addition to a non-substituted carbon atom, a rearrangement product of the bicyclic ester is obtained, and not the bicyclic ester itself. The product in the case of phenanthrene is ethyl dibenznorcaradienecarboxylate, the structure of which is proved; the properties of the acid are described. C. N. T.

601. Phenylation of Some Hydrocarbons with a Phenyl Halide Activated by an Alkali Amide. R. A. Seibert and F. W. Bergstrom. *J. Org. Chem.*, 1945, 10, 544-550.—A number of factors influencing the following type of reaction, reported by Wright and Bergstrom (*J. Org. Chem.*, 1936, 1, 179), have been studied, although no improvement in the yield was effected:—



The mechanism of the catalytic effect of alkali amides is unknown, but a number of possibilities have been suggested. Potassium amide, although having approximately the same catalytic effect as sodium amide, gives slightly better yields of tetraphenylmethane owing to its greater solubility in liquid ammonia. Chlorobenzene appears to be the best halide for the reaction: the fluoro-compound does not react under the conditions used, the bromo-compound has a rather high freezing point, whilst the iodo-compound gives rise to extensive tar formation.

Many hydrocarbons having two or three groups attached to a methano carbon atom, and which are capable of forming salts with the alkali amides, can be catalytically phenylated in accordance with the general procedure. For example, diphenylmethyl-potassium is phenylated to tri- and tetra-phenylmethane, 9-fluorylpotassium to 9-phenylfluorene and 9:9-diphenylfluorene, and 9-phenyl-1:2-benzofluorylpotassium to 9:9-diphenyl-1:2-benzofluorene. Attempts to replace the K of $(C_6H_5)_3CK$ with aryl groups other than phenyl have so far met with failure.

Potassium amide reacts with bromobenzene in cyclohexylamine to form cyclohexylaniline and a substance which appears to be cyclohexyldiphenylamine.

C. N. T.

602. Fundamentals of Consistency and Viscosity. Part 3. J. J. Bikerman. *Refiner*, Feb. 1946, 25 (2), 72-78.—In this concluding part thixotropy and the effect of temperature on consistency are discussed. Different incidental methods of testing for consistency are described at the end of the paper. A. H. N.

603. Molecular Weights of Viscous Hydrocarbon Oils: Correlation of Density with Viscosities. A. E. Hirschler. *J. Inst. Petrol.*, March 1946, 32 (267), 133-161.—Molecular weights of lubricant fractions have been correlated with kinematic viscosities at 100° and 210° F., using a modified Keith and Roess chart; and with the density at 25° C. and viscosity at 210° F. By combining these two charts a correlation between these four physical constants is developed whereby any two may be used to estimate values of the other two. Based on this chart, a simple equation has been developed for calculating the molecular weight from viscosity data, applicable to oils with viscosity indices between -50 and 120. Using published data on lubricant fractions, and synthetic hydrocarbons in the lubricant range, these correlations are evaluated and compared with previously proposed correlations of molecular weights with viscosity data; the accuracy of the latter is shown to be quite dependent on the viscosity-temperature behaviour of the oils. The data on synthetic hydrocarbons indicate that the viscosity-density correlations are much more sensitive to composition than the viscosity correlation; the latter is therefore recommended when two viscosities are available. Consideration of a large number of lubricant fractions indicate that the average composition is sufficiently uniform that the viscosity-density correlations will give satisfactory results in most cases; very naphthenic samples should, however, not be evaluated on the viscosity-density charts, unless they are especially prepared for this class of oils. The correlation may be used to estimate vis_{100} , vis_{210} , or density, given two of the three constants; the accuracy possible for oils of different origins is indicated. A. H. N.

604. Thermodynamic Properties of Solid and Liquid Ethylbenzene from 0° to 300° K. R. B. Scott and F. G. Brickwedde. *Bur. Stand. J. Res. Wash.*, Dec. 1945, 35, 501.—

The following properties of a sample of high-purity ethylbenzene were measured: (1) specific heat of solid and liquid from 15° to 300° K; (2) triple-point temperature (-95.005 ± 0.010 ° C for pure ethylbenzene); (3) heat of fusion (86.47 int. j g^{-1}); (4) heat of vaporization at 294° K (400.15 int. j g^{-1}); and (5) vapour pressure from 273° to 296° K. With these experimental data, the enthalpy and entropy of the solid and of the liquid in the range 0° to 300° K were calculated.

T. M. B. M.

605. Heats, Equilibrium Constants, and Free Energies of Formation of the Acetylene Hydrocarbons through the Pentynes to 1500° K. D. D. Wagman, J. E. Kilpatrick, K. S. Pitzer, and F. D. Rossini. *Bur. Stand. J. Res. Wash.*, Dec. 1945, **35**, 467.—Values are presented for the following thermodynamic properties for acetylene, propyne (methylacetylene), 1-butyne (ethylacetylene), 2-butyne (dimethylacetylene), 1-pentyne (*n*-propylacetylene), 2-pentyne (methyl ethylacetylene), and 3-methyl-1-butyne (isopropylacetylene), in the gaseous state, to 1500° K: the heat-content function, $(H^0 - H^0_0)/T$; the free-energy function, $(F^0 - H^0_0)/T$; the entropy, S^0 ; the heat content, $H^0 - H^0_0$; the heat capacity, C^0_P ; the heat of formation from the elements, ΔH_f^0 ; the free energy of formation from the elements, ΔF_f^0 ; and the logarithm of the equilibrium constant of formation from the elements, $\log 10 K_f$.

Equilibrium constants and concentrations of components are given in tabular and graphical form for the isomerization of the two butynes and if the three pentyne as a function of temperature to 1500° K. Equilibrium constants are also given in tabular and graphical form for the dehydrogenation of ethane to ethylene to acetylene, of propane to propylene to propyne, of *n*-butane to 1-butene to 1-butyne, and of *n*-pentane to 1-pentene to 1-pentyne.

T. M. B. M.

606. The Heat Capacity and Entropy, Heats of Fusion and Vaporization and the Vapour Pressure of Butene -1. The Zero Entropy of the Glass; the Entropy of the Gas from Molecular Data. J. G. Aston, H. L. Fink, A. B. Bestul, E. L. Pace, and G. J. Szasz. *J. Amer. chem. Soc.*, 1946, **68**, 52-57.—Butene-1 has been crystallized for the first time and thermal data obtained down to 11.5° K. The calorimetric entropy of the ideal gas has been used in conjunction with assumed molecular data, to calculate two alternative values of the barrier hindering the mutual relative rotation of the ethyl and vinyl groups.

J. H. P.

607. The Heat Capacities, Heats of Transition, Heats of Fusion and Entropies of cyclopentane, Methylcyclopentane and Methylcyclohexane. D. R. Douslin and H. M. Huffman. *J. Amer. chem. Soc.*, 1946, **68**, 173-176.—Heat capacity data on cyclopentane, methylcyclopentane and methylcyclohexane have been obtained over the range 12 to 300° K. Melting points and transition temperatures, heats of fusion and transition determined and entropy values for the liquid state at 298.16° K were calculated

J. H. P.

608. Physical Chemical Properties of the 2:3-Butanediols. J. W. Knowlton, N. C. Schieltz, and D. Macmillan. *J. Amer. chem. Soc.*, 1946, **68**, 208-209.—The diastereoisomeric 2:3-butane diols have been obtained in a high degree of purity and their physical properties investigated.

J. H. P.

609. Physical Properties and Chemical Constitution. Part IX. Aliphatic Hydrocarbons. A. I. Vogel. *J. chem. Soc.*, Feb. 1946, 133.—New experimental data for the parachors and refractivities of the normal hydrocarbons (*n*-pentane to *n*-hexadecane) and certain branched-chain hydrocarbons are presented. The data for the normal paraffins give for CH_2 , P 39.98, R_G 4.618, R_D 4.643, R_F 4.687, R_G' 4.731, and Mn_D^{20} 20.63. By combining these figures with those deduced in Part VIII (*J. chem. Soc.*, 1943, 638), the following figures for CH_2 , H, and C (in CH_2) have been obtained:

	P.	R_G .	R_D .	R_F .	R_G' .	Mn_D^{20} .
CH_2	40.02	4.624	4.647	4.695	4.735	20.59
H	15.7	1.026	1.028	1.043	1.040	-2.46
C (in CH_2)	8.6	2.572	2.591	2.601	2.655	25.71

T. M. B. M.

610. Stability of D.D.T. and Related Compounds. E. E. Fleck and H. L. Haller. *J. Amer. chem. Soc.*, 1946, **68**, 142-143.—The action of catalysts such as iron, chromium, anhydrous ferric chloride, and aluminium chlorides in eliminating hydrogen chloride from D.D.T. is discussed. The decomposition is inhibited by certain solvents and other impurities present in the technical grade. Their removal on further purification of the material may lead to an apparent instability of the D.D.T., since contamination with traces of catalytic material may easily result in air-drying and other operations. An explanation is thus offered for the belief that pure D.D.T. is less stable towards heat than is the technical grade. J. H. P.

611. Bromine Analogs of D.D.T. S. J. Cristol and H. L. Haller, *J. Amer. chem. Soc.*, 1946, **68**, 140-141.—The preparation of 1-tribromo-2:2-bis-(*p*-chlorophenyl)-ethane (I) and 1-tribromo-2:2-bis-(*p*-bromophenyl)-ethane (II) by the sulphuric acid-catalysed condensation of bromal with the appropriate halobenzene is described. Compound (I) is fairly stable, and has m.p. 146-147° C. Compound (II) is very unstable. Both (I) and (II) eliminate hydrogen bromide in alcoholic alkalies to form the corresponding olefines, the oxidation of which to the *pp'*-dihalobenzophenones locates the position of the ring halogen atoms. Dinitro-derivatives of (I) and (II) have also been prepared. J. H. P.

Analysis and Testing.

612. Assembly and Calibration of a Density Balance for Liquid Hydrocarbons. A. F. Forziati, B. J. Mair, and F. D. Rossini. *Bur. Stand. J. Res. Wash.*, Dec. 1945, **35**, 513.—The assembly and calibration are described of a density balance for rapidly measuring the densities of liquid hydrocarbons on samples as small as 9 ml in volume. The reproducibility of the measurements is ± 0.00002 to ± 0.00003 g/ml, and the overall uncertainty is estimated to be about ± 0.00005 g/ml. T. M. B. M.

613. Kinematic Viscometer for Opaque and Very Viscous Liquids. E. H. Zeitfuchs. *Oil Gas J.*, 12.1.46, **44** (36), 99.—An instrument has been developed for determining the viscosities of very viscous, opaque liquids, especially useful in the range of 1000-75,000 cs. It consists of an enlarged glass bulb from which extend capillary tubes above and below. Drainage effects, which limit accuracy, have been minimized by the use of a horizontal tubular reservoir; and a siphon makes loading convenient and precise. About 1 ml of sample is introduced through the enlarged bulb, and the apparatus manipulated so that the time of passage of the meniscus of the sample between two marks on the small vertical bulb is noted. The kinematic viscosity is calculated from a given formula. Tests with various petroleum liquids of known viscosities have established that the diameter of the horizontal tube is such that neither "drainage" nor surface tension differences had an appreciable effect on accuracy of results.

Dimensions of the instruments are determined by the range of viscosities to be determined, final adjustments to exact values of constants are made by changing the volume of the lower bulb slightly or by locating graduation lines during calibration. Calibration is made with liquids of known kinematic viscosity, the flow time in any given viscometer being limited to between 100 and 600 sec. G. A. C.

614. Evaluation and Manufacturing Methods of Ball- and Roller-Bearing Greases. A. E. Hickel. *Refiner*, Feb. 1946, **25** (2), 61-64.—The Annular Bearing Engineers Committee (ABEC) bearing test is critically discussed, and its deficiencies on long-period use of the bearing are indicated. The different effects of temperature on different greases are outlined. Results of different bearing greases made in a simple testing machine equipped with SKF ball bearings are shown photographically. These bearings were held in a sleeve-type housing, and could be operated at various temperatures, speeds, and pressures. An automatic rheostat controlled the box which enclosed the bearing machine, and each bearing housing was equipped with a thermocouple for reading temperatures on a potentiometer. The bearing and box temperatures were taken every half-hour. The speed was 966 r.p.m., or equivalent to 75 miles/hr and

the load was 100 p.s.i. Photographs show the conditions of the grease and bearings after 10,000, 13,000, and 25,000 mile-runs. Results of tests on greases manufactured by different methods and having different constituents are presented. A. H. N.

615. Petroleum Research Goes Electronic. R. Sneddon. *Petrol Engr*, Nov. 1945, 17 (2), 59.—A description of physical methods of test involving electronic applications is given, together with their suitability for analysis and control in the petroleum industry.

The electronic microscope uses an electron beam to illuminate the specimen, which eventually is made visible on a fluorescent screen; magnifications of about fifty times greater than those with the highest power light microscope can be obtained. It is thought that this instrument will be of use in helping to solve problems depending on minute structural differences in such mechanisms as isomerization, polymerization, catalysis, etc.

The mass spectrometer depends on the deflection, by means of a magnetic field, of ionized particles of the molecules of a mixture, according to their mass. By amplification the streams of ions are measured by a series of galvanometers, and the deflection recorded photographically as a spectrum. The mass spectrometer lends itself admirably to the detection of impurities, differentiation of isomers, and most gaseous hydrocarbons, and should therefore be of great value to the petroleum industry.

The omission spectroscope depends on the fact that when a substance is burned, the character of the light evolved can be used to determine its composition, and is at present primarily adapted to the identification of metals and alloys. When quantitative results are needed, the optical density of the significant spectrum lines are measured on a densitometer and compared with those of known samples of similar composition. In the control of refining processes this instrument is used for the examination of catalysts for traces of metals.

X-ray diffraction is mainly used for the study of crystalline substances, but has been found of great value in the identification of inorganic deposits on engine parts, as well as determination of molecular weights and the study of lubrication and lubricants.

Infra-red absorption. The sensitivity of this medium is largely due to the fact that in the spectrum of electro-magnetic frequencies the range from 1-30 microns (the infra-red area) corresponds closely to the vibration frequencies of atoms or groups of atoms in the hydrocarbon molecule. This instrument quickly identifies hydrocarbons in the gaseous, liquid, or solid form in mixtures, and is therefore valuable for qualitative and quantitative analysis of hydrocarbons when the number of components is limited to about ten. The study of junctional groups within molecules, as well as the identification of the molecules themselves, is also an important application of the instrument. T. M. B. M.

616. Neutralization Number Test for Additive Oils is Subject to Misinterpretation. D. P. Thornton. *Nat. Petrol. News, Tech. Sect.*, 7.11.45, 37 (45), R. 885.—A summary is presented of the five papers representing the views of industrial, turbine, and automotive engineers, received in response to a questionnaire made by the A.S.T.M. Subcommittee on Neutralization Number and Saponification.

On the industrial side, neutralization numbers are commonly used in checking used non-additive oils for deterioration. Half the replies show that oil is renewed when a maximum limit has been reached, the limits range from 0.20 to 2.0, the majority favouring a narrower range of 0.7-1. The other half of the users are divided between those who use the rate of increase in neutralization number and those who use both a maximum limit and the rate of increase, as indicating the degree of oil deterioration. In the case of additive oils, users do not appear to be well versed in the use and behaviour of this type in service, but apparently they realize that unusual neutralization numbers for additive type oils are not important, provided these oils are superior to non-additive oils for some services.

The viewpoint of the turbine industry shows that neutralization numbers are generally used as a factor in determining when an uninhibited oil should be sweetened or discarded. When inhibited oils are used, the neutralization number is not considered satisfactory, as the changes are only very slight. Interfacial tension tests are definite, and predict breakdown long before there is a change in the neutralization number; where interfacial tension apparatus is not available, the saponification value is a good

substitute, as there is a direct correlation between the two. Other tests also considered more satisfactory than neutralization numbers are described, particularly foaming and sludging tendencies. The best perhaps is the present turbine-oil-stability test, modified to include appearance of the oil and catalyst coils, in addition to the neutralization and saponification numbers. This is described and fully discussed. When rust and oxidation inhibited oils are observed during this test remarkable differences become apparent which are not shown by the neutralization number.

In the automotive industry greater confusion in interpreting neutralization number appears to exist than in the other two groups. Two aspects are apparent, and are discussed: those of the mechanical and those of the service engineers. To the former interested solely in design and manufacture, neutralization number is of no value; its value to the service engineer becomes apparent later. Lack of correlation between neutralization number of the oil in service and the condition of the engine further confuses engineers. This is discussed in relation to the tabulated data of used oil analyses and condition of engine parts. It is shown that the test value of an oil is of interest to service engineers provided that information concerning type and composition of the base oils and addition agents is available. Tabulations: analyses of two different oils operated in the same type of gasoline-engine equipment under the same type of normal road operation and analysis of six oils run in G.M. 71 diesel engine, are discussed from the same aspect. Such data are available in following the changes that take place in service, provided knowledge of the type of oil and additive involved is available.

It would appear that, in general, industry is not very familiar with the service behaviour of additive type oils, and there is a danger that, through misunderstandings, neutralization number specifications may become sufficiently restrictive to constitute a barrier to adequate development of these heavy-duty oils. It has been demonstrated that neutralization number is an inadequate criterion for predicting the useful life of oils containing additives, especially oxidation inhibitors.

W. H. C.

Crude Oils.

617. The Desalting of Petroleum Oils. G. Armistead, Jr. *Oil Gas J.*, 23.3.46, 44 (46), 81.—A discussion is presented on the difficulties occasioned in refinery processing by the presence of salt in crude oil, and on the means employed for desalting.

The presence of salt in crude oil causes deposits in two places in refining units: (a) where water is being evaporated from the crude, causing salt deposits, and (b) where cracking conditions prevail, depositing salt on tube walls, etc., with or without coke. Hydrolysis of salts such as magnesium chloride, releasing hydrochloric acid, occurs at ordinary distillation temperatures, and the acid must be neutralized to prevent corrosion.

Four methods for salt removal are given: (a) water flashing; (b) water washing and settling; (c) water washing and electrical precipitation; and (d) propane deasphalting (a modification of the process employed for lubricating oils). Each of these methods is described and diagrams of the plant used are included. A list of references to the literature is appended.

T. M. B. M.

Gas.

618. Liquefied Petroleum Gas Sales in 1945 up to 21.4 per cent over 1944. G. G. Oberfell and R. W. Thomas. *Oil Gas J.*, 12.1.46, 44 (36), 64.—Sales in 1945 of liquid gas exceeded 1 billion gal, an increase of 21.4% over 1944, domestic usage accounting for over half a billion gal. Distributors have erected new bulk stations, and new equipment has been ordered to meet the expected increased demand. Over a quarter of a billion gal was used as industrial fuel, a 4.8% increase over 1944. Utility companies have increased their gas-producing capacity by installing liquefied petroleum gas facilities, this accounting for 60 million gal, an increase of 25.6% over 1944. For the production of chemicals, 220 million gal of C_3 and C_4 hydrocarbons were used, an increase of 48.8%, and large quantities have gone into motor fuel.

The Liquefied Petroleum Gas Assoc has continued active in promoting safety

regulations. It is estimated that the quantity of C_3 and C_4 hydrocarbons produced represents only 10% of amount available.

Recent developments have been used for flame cultivation (weed destruction) and controlled atmosphere annealing with radiant-tube furnaces.
G. A. C.

Engine Fuels.

619. Utilization of Non-petroleum Fuels in Automotive Engines. J. T. Duck and C. S. Bruce. *Bur. Stand. J. Res. Wash.*, Dec. 1945, **35**, 439.—A number of substitute fuels and blends were tested to determine their relative efficiency in the operation of common types of engines. The tests showed that the maximum power developed with alcohol and with some of the other fuels was slightly greater than with gasoline. The specific fuel consumption with the various fuels was approximately in inverse proportion to the heat of combustion of the fuel used. Analysis showed that the mixture distribution was less uniform with the substitute fuels than with gasoline. Tests made with low-proof alcohols showed that an engine can be operated on blends as low as 70 proof, but it is ordinarily impractical to use a blend much below 190 proof because of the excessive volume required.
T. M. B. M.

620. Sulphur Compounds from Panuco Gasoline II. W. Friedmann and C. Rodriguez. *Refiner*, Feb., 1946, **25** (2), 53-60.—The treatment of a particular gasoline sludge with different reagents to isolate the sulphur compounds from it is given in full, comparing results with those of previous investigators. Thus treatment with mercuric chloride isolated the compounds, all cyclic sulphides, after repeated crystallization, treatment with sodium sulphide or hydrochloric acid and steam distillation, drying, and rectification. The properties of the compounds and the chemistry of the complexes met are detailed.

Sulphur compounds of sulphuric acid and phosphoric acid treatment of sludges are also discussed. The use of perchloric acid is finally studied. The potential value of the sludge as raw material for the organic chemical industry is indicated.

A. H. N.

621. The Blending Octane Numbers of 2 : 5-Dimethylfuran. H. B. Nisbet. *J. Inst. Petrol.*, March 1946, **32** (267), 162-186.—Following a review of the theory of knocking combustions and the influence of the chemical nature of the fuel thereon, inductive reasoning suggests that 2 : 5-dimethylfuran should have high-blending octane numbers in admixture with basis fuels of low octane number. The results of engine tests confirm this.
A. H. N.

622. The Story of Diisopropyl. R. C. Alden, F. E. Frey, H. T. Hepp, and L. A. McReynolds. *Oil Gas J.*, 9.2.46, **44** (40), 70.—Diisopropyl (2 : 3-dimethylbutane) is a hexane of high octane number with medium-high volatility, boiling point 136.4° F, and Reid vapour pressure of 7.35 lb.

It occurs naturally in crude oil in small amounts, and was first manufactured on a large commercial scale by Phillips Petroleum Co. in August 1944. Ethane and propane are subjected to low-pressure cracking to produce ethylene, and *n*-butane is isomerized to isobutane. The ethylene and isobutane are then reacted together in the presence of an aluminium chloride catalyst to yield diisopropyl. In the absence of catalysts and at high temperatures and pressures neohexane is formed instead.

The chemistry of the process is discussed and equations are given indicating the probable course of the reaction. The effects of reaction variables, feed composition, etc., are dealt with in some detail.

Diisopropyl concentrates containing upwards of 93% of the hydrocarbon are readily obtained by fractionation of the alkylates. The pure hexane with 4 ml. T.E.L. has an A.S.T.M. aviation rating of 113.2 octane number, while its weighted blending value (plus 4.0 ml T.E.L.) varies from 117.0 to 112.6, with average value of 114.3.

The supercharged rich-mixture blending rating of diisopropyl with 4.0 ml T.E.L. varies from 200.9 to 167.0% of its power obtained with S reference fuel, the average value being 182.7.
D. L. S.

623. Effect of Fuel Properties on Diesel-Engine Performance. F. G. Shoemaker and H. M. Gadibusch. *Oil Gas J.*, 12.1.46, 44 (36), 74.—Correlation of chemical and physical properties of a gas oil with actual engine performance is not always possible, thus ignition quality is rated by engine-test methods. The transformation of the heat content of the fuel into mechanical power takes place in three distinct phases, as shown by indicator diagrams. A period of ignition delay is followed by one of rapid pressure rise, and finally remainder of injected fuel continues to burn at a slower speed for some time until polytropic expansion begins. Ease of vaporization and ignition influences the delay period. Investigations of the effects of fuel composition are complicated by natural fuels being composed of many molecularly different components, and on account of the intrinsic relation of their physical properties to their chemical composition.

Prevailing cylinder pressure was determined in a multicylinder two-cycle diesel engine, full-load performance details being obtained by conventional methods, using twelve fuels of various compositions. Less time is required to ignite and burn the fuel at high engine speeds, and fuels of different cetane rating show ignition delay in their respective order at the various speeds, with the exception of the 46-cetane fuel, whose curve coincides with that of the 51-cetane fuel at all but the top speed, these two fuels having materially higher aromatic content. In the second phase of combustion only the 22-cetane fuel reaches maximum cylinder pressure earlier than the other four tested. In the final combustion period the higher-cetane fuels burn faster than even the 57-cetane fuel at 2100 and 800 r.p.m.

Four fuels were used to investigate influence of vaporizing characteristics, and among other results it is shown that ignition delay of all fuels of the volatility group is practically alike, and within the range of the corresponding fuels of the cetane group, identical results being obtained in the part load range down to 50% load. Thus for combustion, power, and economy, fuel variations within a wide range of properties have no significant effect on this type of direct injection engine under normal conditions. A figure shows the variation of motoring compression pressure as a function of engine speed, and other diagrams indicate that the speed of compression-ignition engines is not limited by the combustion process. Automotive type of service such as city coach operation demands employment of special fuel. Tests on cold starting show that a fuel of 80-cetane is required to start a compression ignition engine without special preheating, at about 0° F, and it is important to rate ignition quality of fuels also in the low-temperature range.

G. A. C.

Lubricants.

624. New Synthetic Lubricants. J. C. Kratzer, D. H. Green, and D. B. Williams. *Refiner*, Feb. 1946, 25 (2), 79-90.—Paper presented before Society of Automotive Engineers. The purpose of this paper is to describe in some detail the characteristics of two series of synthetic lubricants having certain unusual properties. Until recently these compounds were subject to an order of secrecy issued by the Commissioner of Patents. Both series of lubricants are currently being produced on a commercial scale by Carbide and Carbon Chemicals Corp'n. One series of synthetic lubricants, which is essentially insoluble in water, is designated by the symbol "LB" followed by a number representing the viscosity at 100° F. in S.U. secs. The other series, the members of which are soluble in water at room temperature, is designated by the symbol "50-HB," similarly followed by a number designating the Saybolt viscosity at 100° F. These new synthetic lubricants are a development of American science and industry. They are not related to the synthetic lubricants developed in Germany. Those were primarily developed to substitute for natural petroleum products which were unavailable to the Germans during the war period. They exhibit properties which are superior to these German products, and they differ from them chemically. The new synthetic lubricants described in this paper are synthesized from natural or other hydrocarbon gases as raw materials. They contain no petroleum oils. They are inherently more expensive to produce than the best petroleum lubricants now sold. This factor will probably limit the market for these products except where their special properties justify increased cost. Both the LB series (water-insoluble) and the 50-HB series (water-soluble) of synthetic lubricants are being manufactured and sold by Carbide and Carbon Chemicals Corp'n. under the trade-mark "Ucon" for a wide variety of industrial applications.

A. H. N.

625. Viscosity of Lubricating Oils at Low Temperatures (3). L. G. Zherdeva, Z. Vozzhinskaya, and O. Fedoseeva. *Petroleum*, Apr. 1946, 9 (4), 76.—On cooling a viscous oil to -15°C . the crystallization of paraffin wax with the formation of a crystalline lattice causes anomalous viscosity long before the pour point.

Such structural viscosity depends on all the usual factors, including thermal history. Marked cooling exerts an influence on the viscous properties of the molecules.

Synthetic lubricants have exceptional mobility at low temperatures consequent upon their structure, but the introduction of an aromatic ring into such an oil lowers its mobility.

Inferior mobility of petroleum oils is primarily due to content of free paraffins; and an increase of pressure of 1000 kg/cm^2 causes an increase in the viscosity of oils by 4–10 times, the viscosity/temperature coefficient of oils deteriorates with increasing pressure.

The addition of synthetic oils to low-grade petroleum oils improves the fluidity characteristics of the latter.

G. A. C.

626. Charts show Viscosity and Oxidation changes in Used Crankcase Oils. C. M. Larson. *Nat. Petrol. News. Tech. Sec.*, 7.11.45, 37 (45), R. 891.—By the use of a viscosity comparator instrument, reading Saybolt seconds direct at 100°F ., a simple means is afforded for checking viscosity changes of used lubricating oils. Charts are given for ascertaining: (1) the dilution of; and (2) extent of oxidation of lubricating oils used in: (a) gasoline; and (b) diesel engines. They are based on changes in viscosity of (1) a loss through dilution, caused by blow-by or fuel leakage, and shown as percentage dilution by the gasoline or diesel fuel; and (2) an increase, through oxidation caused by excessive crankcase temperatures over extended periods of usage and expressed as percentage viscosity increase.

The gasoline-engine oil chart is also used for determining whether the engine is operating too cold or too hot—if too cold, dilution results; if too hot, oxidation results. Examples for using the charts are given.

W. H. C.

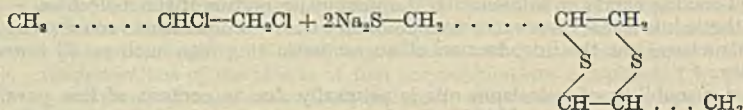
627. Sulphur and Sulphur Chloride Organic Reaction Products as "Lube" Oil Additives—2. C. G. Pritzker. *Nat. Petrol. News. Tech. Sect.*, 7.11.45, 37 (45), R. 871.—108 U.S. patents from 1926 to 1945 are surveyed and the patent history is reviewed from 1872. Lard-oil substitutes are discussed. The subject naturally covers the use of many types of sulphur and sulphur compounds, reacted with various kinds of oils. In many patents the method of preparing the improved lubricating oil or additive, and sometimes the reaction equation and/or formula of the product and their uses are given. Some interesting recent specifications are:—

James in U.S.P. 2,209,976/1940 stabilizes mineral oils by adding sulphur chloride and alkylamine reaction products; sulphur is not suitable for stabilizing transformer, turbine, or technical white oils, but Story (2,211,798) states the following are suitable for such oils: alkyl disulphides, arylalkyl disulphides such as diethyl, di-*n*-butyl, diisomyl, dibenzyl, diphenyl ethyl, diphenyl *n*-propyl, benzothiazole, and tetramethyl thiuram disulphides.

The use of silent electric discharge is specified in two patents. Pier (2,258,806, 1941) so treats hard paraffin wax plus 30% ceresin and 0.5% sulphur, afterwards distilling off the unreacted. The product contains 0.3% sulphur; Wiezevich (2,178,769/1939) so treats mineral oil plus 0.1–2% sulphur, to increase the efficiency of the voltolized product as an oxidation inhibitor.

Three patents react iso-olefins in various ways; Morway (2,364,382/1945) reacts high-mol.-weight polymer—*e.g.*, isobutylene—with SCl or S_2Cl_2 and obtains an E.P. additive; Plummer (2,227,691/1941) reacts isobutylene polymer with sulphur at $375\text{--}400^{\circ}\text{F}$. for 60–120 minutes so that only 0.05% is added, or if SCl_2 is used the initial temperature should be $100\text{--}110^{\circ}\text{F}$. for 30 minutes, and finally at 300°F . for 1 hour, and obtains a synthetic lubricant which prevents scoring and scuffing in the cylinders and parts; Barnard (2,227,692) adds isobutylene polymers to a naphthenic or coastal cut and adds 0.005–0.5% sulphur, or uses a high-sulphur mineral oil. The additive produced inhibits carbon deposition and prevents ring-sticking; Townes (2,364,830) obtains an i.c. lubricant with E.P. properties by reacting depolymerized rubber polymer with SCl_2 so that both S and Cl enter the product. Smith (2,378,803/1945) acidifies an oil before reacting it with sulphur; the product must be neutralized. By this method

lower temperatures are required and the product is not darkened. Smith (2,377,654) by adding potassium oleate to sulphurized sperm oil, inhibits it against foaming. Farrington (2,346,156/7) by a condensation reaction obtains a long chain (>20 carbon atoms) multibridge thioalkyl compound; by reacting inorganic sulphides with a long-chain halogenated hydrocarbon, the following reaction takes place.



These so-called paraffin-wax polythiodimers are from four to eight times as effective as cetyl ethyl sulphide, and more than three times as effective as a conventional dialkyl disulphide, when used as lubricant for *i.e.* engines and hard metal bearings, and are non-corrosive in the presence of refined lubricants under severe operating conditions. W. H. C.

628. *Lubrication Vade Mecum Addendum* (4). E. W. Steinitz. *Petroleum*, Apr. 1946, 9 (4), 75.—This further part of the addendum to the *Lubrication Vade Mecum* includes notes on lubricants for steam hammers, hydraulic presses, accumulators, testing machines, rolling and Mannesmann mills, clocks, optical instruments and mechanical appliances such as speedometers and typewriters. G. A. C.

629. *Secrets of German Lubricating Oil Technology in War-Time. Highlights of C.I.O.S. and B.I.O.S. Reports to Date.* C. I. Kelly. *Petrol. Times*, 2.3.46, 50 (1268), 207. Part I. Lubricating Oils: Production and General Policy.—This is a review of a number of the reports issued by C.I.O.S. on the information gained as to the state of German oil technology at the close of the war.

Owing to the cessation of all oil imports from overseas from the first day of the war, Germany had to depend largely on indigenous crudes. Production of crudes amounted to 1,920,000 tons/year exclusive of Roumanian (alleged 6,000,000 tons/year) and Hungarian sources, whose products were supplied direct to the Services in the Eastern areas.

Statistics show that production of synthetic lubricating oil amounted to rather less than 10% of the total lubricating-oil production. It must be noted, however, that ultimately the Germans depended for aircraft lubricants almost entirely on the products of their synthetic plants. Synthetic lubricating-oil stocks were much more viscous than "conventional" bright stocks, and this allowed the incorporation of a comparatively large volume of low-viscosity neutrals in aircraft oils.

Precision bombing ultimately reduced output of these plants to such an extent that attempts were made to rebuild underground, and at the conclusion of hostilities several of these projects were almost completed.

The necessity for increased lubricating-oil production encouraged the development of recovery processes and the utilization of "waste products."

Thus extracts from Edelcanu refining were used as rubber extenders, constituents of printing inks, putty substitutes, etc., while Duosol extracts were distilled to produce a distillate lubricating oil and an asphalt residue.

Spent fuller's earth was extracted with gasoline to dissolve out the oil which was subsequently recovered, while the earth after extraction was used as a filler and plasticizer for synthetic rubber.

Used aero-engine oils were recovered by removing diluent and solid particles and incorporating to the extent of 10% in the charging stock fed to the Duosol plants. Used oils from the Army and Navy were also recovered, the Army oils mainly by small firms, the Navy oil by the Kriegsmarine. D. L. S.

Special Hydrocarbon Products.

630. *Crystallography of Waxes and Related Substances.* L. Ivanovszky and J. H. Wredden. *Petroleum*, Apr. 1946, 9 (4), 82.—In this first of a series on waxes and related substances crystals from wax solutions, and their transitions, are discussed.

Commercial paraffin wax, m. pt. 60° C, was dissolved in carbon tetrachloride, alcohol

added, and the heated solution allowed to cool, the precipitation of wax crystals slowly occurring.

After 24 hours this precipitate consisted of large plates about $\frac{1}{2}$ in in length, with crenated edges and no definite angles. The solution contained microcrystals, from which a structure-less film of wax formed, trapping beneath needle-shaped microcrystals of 5–20 μ length and $2\frac{1}{2}$ –5 μ diameter. The crystals disappeared over night, giving place to minute globules of wax about 1 μ diameter. After a week the wax solution exhibited an agglomeration of quadrangular plates with needles still in the liquid. Periodic examination of a slide from solution which had been standing eight weeks showed no change until nearly twelve hours had elapsed, when the needle crystals apparently unrolled to form irregularly shaped plates. Microphotographs illustrated this transition, showing needles formed plates of same length, only the breadth increasing.

G. A. C.

631. Mineral Oil and Dowty Liquid Springing. Anon. *Petrol. Times*, 2.3.46, 50 (1268), 225.—The Dowty liquid spring operates at pressures up to 100,000 lb/sq. in. and utilizes liquid compression.

Light mineral oils have proved the most suitable fluids for this purpose, and a liquid which can be compressed by 20% of its original volume at 60,000 lb/sq. in. has been developed.

The device consists of a pressure-sealed cylinder filled with oil and containing a piston carrying valve mechanism. Secured to the piston-head is a rod which emerges through a high-pressure gland. A grease-filled recess in the gland retaining nut lubricates the piston-rod.

When the rod is forced into the cylinder the oil is compressed and simultaneously transferred from one side of the piston to the other. The valve in the piston-head opens fully during compression, but on recoil it closes so that movement is damped and excellent shock-absorbing qualities obtained.

The liquid spring has been made possible by the development of the high-efficiency gland, which permits smooth action of the piston-rod.

D. L. S.

632. D.D.T. Possibilities for Oil Industry explained by Chemist: Distributors told of Limitations. H. Ridder. *Nat. Petrol. News*, 13.2.46, 38 (7), 22.—Kerosine, alcohols, ketones, and chlorinated hydrocarbons are among the most suitable solvents for D.D.T., and although kerosine is the most common and efficient it has its disadvantages, the most serious to housewives being its odour. Kerosine deodorized by the conventional methods has been found suitable. For household use solution of D.D.T. in deodorized kerosine is limited to 2%, although normal kerosine will take a 5% blend suitable for farm use and other places where odour is no objection.

D.D.T., properly applied, is effective against body lice, bedbugs, flies, mosquitoes, clothes moths, carpet beetles, and silver fish, but its effectiveness on ants, cockroaches, spiders, ticks, screw worm, heel fly, chigger, and poultry mite has not been fully determined.

Its use in oil paints so far is limited; in an oil-base solution it should not be used on animals since it is highly toxic. Powder forms are available. D.D.T. itself is not particularly harmful to human beings, but once mixed with oil it becomes very toxic and if taken internally may prove fatal.

As a spray on crops, it has certain advantages, but also presents many problems. Care must be taken so that in spraying to rid an area of a pest, the D.D.T. will not cause the destruction of numerous beneficial insects, particularly the honey bee. D.D.T. falling on streams can also kill fish.

Finally, D.D.T. should not be used on grain, forage, or other crops that are to be used as animal feed because of the possible danger associated with residues, and care should also be taken to avoid residues on fruits and other plants or plant products to be used as human food.

T. M. B. M.

633. Domestic Fly Sprays. 2. Insecticides. C. L. Gilbert. *Petroleum*, Apr. 1946, 9 (4), 79.—Synthetic insecticides, methods of test and theoretical aspects of their mode of action are discussed.

Thiocyanates and related products are the most important synthetic substitutes for

pyrethrum in fly-sprays, although the knockdown rate is not as rapid as with pyrethrum. D.D.T. (*paradichlordiphenyl trichlorethane*) has a very slow knockdown action, but the flies seldom recover, so that combinations with pyrethrum will probably be used. Activators and synergists are added to insecticides to enhance their effect, and perfumes are incorporated to mask the odour of kerosine. The Peet-Grady method of grading insecticides is now widely adopted, and consists of counting the number of flies knocked down after spraying under standardized conditions, which latter includes strain and age of flies, and their food.

Other methods of test have been devised, including the chamber method suggested by Kearns and Marsh, which uses less insects than that of the Peet-Grady.

The characteristics of the particles of spray at impact depend on the nature of the spray and type of gun used. Domestic-type sprayers yield a wasteful large particle spray, whilst very small particles of 20 μ down to 1 μ are formed by more specialized sprayers, such as the Phantomyst.

The toxic action will be due to penetration of the cuticle by the kerosine solution when first applied, but after a short time the remaining smaller-sized particles, mainly non-volatile, may cause poisoning by absorption into the breathing system. One effect of addition of sesame oil is to increase the size of residues after evaporation of kerosine and improve penetration by diluting the semi-solid pyrethrum residuo.

To be effective the toxic agent must be capable of penetrating into the living cell, and then react with some constituent of it, and thus disorganize the enzyme system. Laüger suggested that the toxic agent contains groupings conferring high lipid solubility and toxicity, such as the unsaturated lactone grouping in pyrethrum. Martin considers that the toxicity of D.D.T. is due to the CHCl_2 group, from which HCl can be split off by reaction in the insect cell. The Laüger theory does not explain differences in the activities of the *lævo* and *dextro* forms of nicotine, for example. It is thought that the active agent masquerades as a molecule essential for the life of the cell, hence certain insecticides are only effective against certain insects. Similar theories have been put forward to explain the action of drugs, bactericides, etc.

G. A. C.

Derived Chemical Products.

634. Carbon-Black Industry Strains to Meet Requirements for Rubber. F. R. Staley. *Oil Gas J.*, 9.3.46, 44 (44), 86.—90% of the U.S. production of carbon black is used in reinforcements of synthetic rubber. An average annual consumption for all purposes is estimated at 1140 million lb.

Increase in use of natural rubber would require greater quantities of channel process black, while a decrease in synthetic rubber consumption would reduce demand for semi-reinforcing furnace-type black and increase that of higher reinforcing type. Natural, stripped, and refinery gases are used in the plants which since 1916 are centred in the Texas Panhandle. Research has led to new processes and products, channel black plants have been modified to meet the great demand for this type of black, and new furnace-processes blacks developed for synthetic rubber.

Three processes are used for manufacturing carbon black: the channel, the continuous furnace, and the cycle furnace process. In the channel process natural gas is burnt in a limited supply of air through small lava tips, the fan-shaped smoky flames infringe upon moving iron channels on which the carbon black is deposited. The product is automatically scraped off and transported by a screw-conveyor to the storage tank.

The continuous furnace process permits partial combustion of the gas in specially designed furnaces; the carbon-black formed is cooled with water sprays and separated from the gaseous stream by very high voltage precipitators, aided by a battery of cyclone collectors.

In the cycle-furnace process natural gas is thermally decomposed in special furnaces packed with firebricks or refractory-walled flues. The bricks or flues are heated with a mixture of gas and air, followed by gas alone. The natural gas is decomposed into carbon black and hydrogen, cooled with water sprays, and the carbon black separated from the gaseous stream by a bag filter system. The hydrogen produced may be utilized in the synthesis of ammonia, or as fuel.

The yields by the three processes are respectively 1.0-2.1 lb/1000 cu. ft. of natural gas in the channel process, 3-16 lb in the continuous furnace, and 16 lb/1000 cu. ft. in the cyclic process, depending on quality of gas furnace design, grade of black, and other factors.
G. A. C.

635. Synthetic Organic Chemicals. Anon. *Nat. Petrol. News (Tech. Sect.)*, 5.12.45, 37 (49), R. 997.—A recent report of the U.S. Tariff Commission states that some 1,564,914,665 lb of "chemical raw materials" (exclusive of toluene) were derived from petroleum in 1943, while in 1944 the figure amounted to 3,000,000,000 lb on a comparable basis.

The total included, in 1000 lb, naphthenic acid 28,462, xylenes 354,639, ethylene 272,188, propane and propylene 214,555, butadiene 488,945, 1 butene and 2 butene mixture 202,380, all other C₄ hydrocarbons 569,087, and all other chemical raw materials excluding toluene 841,240.

Toluene (chemical grades) from petroleum totalled 62,570,000 gal during 1944.

Many figures are given for other chemicals derived in large part from petroleum raw materials, and some interesting statistics are included on plastics and synthetic elastomers. Thus acyclic resins in which many "petroleum resins" fall amounted to 380,032,000 lb, while nearly 40,000,000 lb Buna N type and 315,000 lb Butyl production are listed.
D. L. S.

ENGINES AND AUTOMOTIVE EQUIPMENT.

636. Design and Performance of General Electric's Type 1-10 Jet-Propulsion Gas Turbine. D. D. Steid. *Refiner*, Feb. 1946, 25 (2), 94-96.—Dimensional and operational characteristics of this gas turbine are presented in several graphs. The following table gives a summary of the performance at 11,500 r.p.m. with standard inlet conditions of 14.7 lb/sq in, 59° F.

Thrust	4000 lb.
Fuel Flow	4740 lb/hr.
Specific fuel consumption	1.185 lb/hr/lb thrust.
Exhaust temperature	1170° F.
Compression ratio	4.126.
Compressor discharge temperature	413° F.
Combustion pressure drop	3.18 lb/sq. in.
Turbine inlet temperature	1492° F.
Air flow	79 lb/second.

A. H. N.

637. British Aircraft Gas Turbine Progress. H. R. Cox. *Aircraft Engng*, January 1946.—This is a general review, and, with the aid of excellent photographs and diagrams, documents, in chronological order, the design features and performance data of British gas turbine and jet propulsion engines.

(1) *Axial compressors*—typical performance data are:—

Date.	Type.	No Stages..	Optimum Pressure Ratio.	Max. Effic. %.
1939	Anne (RAE)	8	1.6	81
1930	Alice (Parsons)	8	1.3	85
1940	Ruth (RAE) (GEC)	6	2.4	83
1940	B10	9	1.4	87
1941	E5	8	1.4	85.5
1942	F2	9	3.0	88
1943	A.S.X.	14	3.7	87

(2) *The Gas Turbine Engines.*

Type.	R.P.M.	Thrust.	Jot Temp. ° C.	Fuel Consumption lb/lb Thrust/hr.
W1	17,750	855	—	—
W2B	16,750	1,755	606	1.13
W2/700	16,750	2,485	647	1.05
F2	7,700	3,500	630	1.1
Goblin II	17,300	3,000	660	1.3
Derwent V	14,500	3,500	660	1.1
Nene	12,600	5,000	665	1.04
ASX	8,000	2,500	600	1.0

(3) *Thrust Boosting Experiments.* With ammonia injection (Power Jets).

Engine.	Wt. of NH ₃ Wt. of air × 100.	Relative Humidity of Ambient Air.	Temp. Dop of Jet.	Thrust Increase.
W1 Mk. III	6.15%	85%	115° C.	28%
W2B	4.4%	81%	72° C.	22.4%

Thrust augmentation was extremely sensitive to humidity.

Experiments with methyl chloride injection were not encouraging.

With water injection on a W2/700 engine, a thrust increase of 18% was obtained with a rate of injection of 102 lb/min.

Reheating of W2B/23 engine:—

Measured Increase in Fuel Consump.	Measured Increase in Static Thrust at Sea Level.	Estimated Thrust Increase at 500 m.p.h. at Sea Level.
30%	5%	9%
70%	10.8%	17%
100%	16%	27.5%

The article is to be concluded.

I. G. B.

638. *Combustion in the Gas Turbine.* D. G. Shepherd. *Engineer*, 22.3.46, 181 (4706), 268; 29.3.46, 181 (4707), 300.—The paper seeks to outline the special problems of gas turbine combustion, and to generalize some of the experience gained in recent years. The author deals with the subject under the following general headings: Design of Combustion Chamber, Combustion Requirements, Efficiency of Combustion, Pressure Loss, Reliability, Carbon Deposit, Stability, Ignition, Temperature Distribution, Fuels and Fuel Injection, Testing and Development of Combustion Chambers.

In his concluding remarks under the heading "Future Requirements" the author states that the combustion chamber can be expected to show improvement with respect to reliability, pressure loss, and decrease in size and weight, and engines may have higher compression ratios and turbine temperatures. Much more knowledge is required on combustion chambers before the design can be predicted from known operating conditions, but advances will be more rapid than in the case of reciprocating engines, owing to the greater possibilities of bench testing.

C. D. B.

MISCELLANEOUS.

639. *Secrets of German Fuel Technology Unearthed.*—More C.I.O.S and B.I.O.S. Reports Reviewed. Anon. *Petrol. Times*, 2.3.46, 50 (1268), 230.—This is a brief review of C.I.O.S and B.I.O.S. reports now available:—

C.I.O.S.XXVII—55. A report on two short visits to the Linde Co.'s plant near

Munchen dealing particularly with discussions on the commercial manufacture of O₂ and N₂ and on the low-temperature separation of hydrocarbon gases (19 pages).

C.I.O.S.XXX—102. Report on activities of Scholven hydrogenation plant for production of aviation fuel (29 pages).

C.I.O.S.XXX—105. General report on operations of Gelsenberg hydrogenation plant (39 pages).

C.I.O.S.XXX—104. General report on activities of Botrop-Welheim hydrogenation plant originally built for extracting coal with a solvent (29 pages).

C.I.O.S. XXV—6. Detailed report on Fischer-Tropsch activities at the Moers-Meerbeck plant. First air attack on July 19/20, 1944, practically ended the production of synthetic fuels (150 pages).

B.I.O.S.—134. An account of the manufacture at I.G. works at Huls near Marl of synthetic rubber (Buna) from acetylene produced by the electric arc-cracking of hydrocarbon-rich gases (13 pages).

B.I.O.S.—118. Reports on the research and development work on fuels and lubricants carried out at the Munich Technical High School (71 pages).

B.I.O.S.—121. An account of the detailed examination of one of the chain of WIFO stations (Heiligenstadt installation) mainly engaged in blending and packaging petrol and lubricating oil for the German Army (9 pages).

B.I.O.S.—120. Report of an inspection of a WIFO installation (Hitzacker depot) handling Luftwaffe fuels and lubricants. An item of interest was a special portable unit for TEL blending (28 pages).

B.I.O.S.—119. Detailed report of the activities of the Deutsche Versuchsanstalt für Luftwaffe Institut für Betriebsstoff Forschung in regard to fuel and lubricant utilization and performance. This report contains the following sections:—Aviation, diesel, jet propulsion fuels; fuel for flying bombs; combustion research; aero lubricating oils; greases; anti-corrosion oils. (39 pages.)

D. L. S.

639. **Secrets of German Fuel Technology Unearthed.** Anon. *Petrol. Times*, 16.3.46, 50 (1269), 290.—The following C.I.O.S. and B.I.O.S. Reports are reviewed briefly:—

C.I.O.S.XXII—9. I.G. Farbenindustrie A.G. Leuna.

C.I.O.S.XXX—88-91. Lurgi Gesellschaft für Warmetechnik (Frankfurt-am-Main).

C.I.O.S.XXXI—23. Metallgesellschaft-Lurgi Frankfurt-am-Main.

C.I.O.S.XXX—103. I.G. Farbenindustrie A.G. Works, Ludwigshafen and Oppan.

C.I.O.S.XXXV—28. Diesel Engine Research and Development in Germany.

C.I.O.S.XXX—1-85. Edeleanu G.m.b.H., Altenburg.

A. H. N.

640. **Secrets of German Fuel Technology Unearthed.** Anon. *Petrol. Times*, 30.3.46, 50 (1270), 346-349.—The following C.I.O.S. and B.I.O.S. Reports are reviewed briefly:—

C.I.O.S.XXVII—68. Fischer-Tropsch Unit, Leipzig Gas Works.

C.I.O.S.XXVII—70. Gutehoffnungshut to A.G. Sterkrade.

C.I.O.S.XXIX—40. Lubricants Manufactured and Used by Zeiss in Jena.

C.I.O.S.XXVIII—62. Glossary of some German Names for Chemical Products.

C.I.O.S.XXXI—27. Coal extraction plant of Ruhrol G.m.b.H.

C.I.O.S.XXV—4. Wirtschaftliche Forschungen G.m.b.H. Aussenstelle München I (WIFO I) Stockdorf, nr. Munich.

C.I.O.S.XXVII—14. I.G. Farbenindustrie, Hoechst/Main.

C.I.O.S.XXIV—9. Synthetic Lubricating Oil Plant, Rhein-preussen, Homberg.

C.I.O.S.XXVIII—38. H. Koppers G.m.b.H., Essen.

C.I.O.S.XXVI—2. Synthetic Emulsifying agents, wetting agents, detergents and soap substitutes, I.G. Farbenindustrie A.G., Höchst/Main.

C.I.O.S.XXVII—85. Miscellaneous Chemicals, I.G. Farbenindustrie A.G. Ludwigshafen and Oppan.

C.I.O.S.XXV—26. I.G. Farbenindustrie, Mainkur-Hoechst.

C.I.O.S.XXIX—54. Ignition by Means of an Injection of "Ignition Oil."

C.I.O.S. XXVI—73. Insecticides, insect repellents, rodenticides and fungicides, I.G. Farbenindustrie A.G. Elberfeld and Leverkusen.

C.I.O.S. XXV—24. Die Staatliche Materialprüfungsanstalt an der Technische Hochschule.

C.I.O.S. XXXI—29. Fuel research activities at the A.G. der Kohlenwertstoff-Verbande, Bochum.

C.I.O.S. XXV—27. War-time research on synthetic fuels. Kaiser Wilhelm Institut für Kohlenforschung.

C.I.O.S. XXX—70. The preparation of tetrahydrofuran polymer as a synthetic lubricant for metals.

C.I.O.S. XXVII—18. The Oxo Plant, Ruhrchemie, Oberhausen-Holden.

C.I.O.S. XXII—21. Synthetic rubber plant Chemische Werke-Huls.

C.I.O.S. XXII—7. I.G. Farbenindustrie synthetic rubber plant, Ludwigshafen.

B.I.O.S. No. 122. Wirtschaftliche Forschungsgesellschaft m.b.H.

B.I.O.S. No. 137. Cyclopolylefines: Paper by Dr. J. W. Reppe, I.G. Farben. Research Chemist.

A. H. N.

BOOKS RECEIVED.

C.R.C. Handbook, 1946. New York: Coordinating Research Council Inc., 1946. Pp. 558.

Published primarily for technologists engaged in fuel, lubricant, and engine research development, the subject matter falls into two classes, (a) current test procedures for fuels developed by the Coordinating Fuel Research Committee, and for lubricants developed by the Coordinating Lubricants Research Committee, and (b) information bearing on the formulation, use, and subject matter of these procedures.

The fuel projects are further classified under Motor, Aviation, and Automotive Diesel Fuels and the lubricants projects under Engine Oils and General Lubricants (Gear Oils, Greases, and Hydraulic Fluids).

The Exploration for Oil in Great Britain and Its Economic Consequences. G. M. Lees. Nottingham: University College, 1946. Pp. 10. 1s.

The 1946 Abbott Memorial Lecture of University College, Nottingham, delivered by Dr. G. M. Lees, surveys the results of the geological work carried out during the past fifteen years by the Anglo-Iranian Oil Co. in the United Kingdom in the search for oilfields.

Proceedings of the Institution of Mechanical Engineers. Vol. 152, 1945. London: The Institution of Mechanical Engineers, 1946. Pp. 468 + xi.

This volume contains in its pages the 1944 Presidential Address by Dr. Harry R. Ricardo on "Applied Research." There is also some contributed discussion on the paper by N. Tetlow on "A Survey of Modern Centrifugal Pump Practice for Oilfield and Oil Refinery Services" which appeared in Vol. 150 of the Proceedings of the Institution.



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T. A. BOYD.	T. G. DETWILER.
E. W. DEAN.	F. D. TUEMLER.

The following report to Standardization Committee :—

- Sub-Committee No. 1.—Measurement and Sampling.
 No. 2.—Crude Oil.
 No. 3.—Liquefied Petroleum Gases, Gasoline, Kerosine, and Light Distillates.
 No. 4.—Gas, Diesel, and Fuel Oil.
 No. 5.—Engine Tests.
 No. 6.—Lubricants.
 No. 7.—Asphaltic Bitumen.
 No. 8.—Petroleum Wax.
 No. 9.—Derived Chemicals.
 No. 10.—Apparatus.
 No. 11.—Nomenclature.
 No. 12.—Greases.

Editorial Sub-Committee.

NORTHERN BRANCH.

Officers and Committee of the Northern Branch of the Institute for the 1946–47 Session are :

G. H. THORNLEY, *Chairman.*
 E. J. DUNSTAN, *Vice-Chairman.*
 V. M. FARRANT, *Hon. Secretary.*
 E. R. WILSON, *Hon. Treasurer.*

Committee :

H. H. BALLARD.	J. E. HASLAM.
C. E. BURNETT.	ALICK OGDEN
A. J. FEATHERSTONE.	T. W. RANSON
B. A. C. GRAY.	A. W. WOOLRIDGE.

SCOTTISH BRANCH.

The Scottish Branch of the Institute of Petroleum was re-inaugurated at a meeting in Glasgow on April 5, 1946, when Mr. Robert Crichton, Chairman of the Branch, presided. He recalled that the

Branch was first formed in 1938 and functioned with considerable success until the outbreak of the war. With so many members on war work or in the Forces and the difficulties of travel and black-out it had not been possible to hold meetings during the war. However, the committee had been kept in being and contact maintained with other learned societies. The Branch has now been re-inaugurated, he said, and a programme for the session commencing in October is in preparation.

Officers of the Branch for the 1946-47 Session are :

ROBERT CRICHTON, *Chairman.*
 J. T. GUTHRIE, *Vice-Chairman.*
 G. H. SMITH, *Hon. Treasurer.*
 A. FLEMING, *Hon. Recorder.*
 W. ROBERT GUY, *Hon. Secretary.*

Committee :

J. M. CALDWELL	}	<i>Corporate members.</i>
Prof. W. M. CUMMING		
H. MACARTHUR		
W. REID	}	<i>Non-corporate members.</i>
H. B. NISBET		
H. PEDEN.		

At the conclusion of the business meeting, Prof. F. H. Garner delivered his address on "Petroleum in War Time."

APPLICATIONS FOR MEMBERSHIP OR TRANSFER.

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

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

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

Applications for Membership.

BADDILEY, John Raymond, Petroleum Engineer, Agwi Petroleum Corpn. Ltd. (*H. D. Demoulins ; G. Noble.*)

BIDDLEPH, Charles William John, Commercial Manager, Pressure Lubricants Ltd. (*R. B. Hobson ; Harold Moore.*)

BROOKS, Roy, Chemist, Agwi Petroleum Corpn. Ltd. (*H. D. Demoulins ; G. Noble.*)

- BUTLER, Arthur Henry Stanley, Process Supervisor, Agwi Petroleum Corpn. Ltd. (*H. D. Demoulins ; G. Noble.*)
- DAY, Sidney, Refinery Cost Accountant, Agwi Petroleum Corpn. Ltd. (*H. D. Demoulins ; G. Noble.*)
- GOLLIN, Geoffrey Joseph, Chief Engineer, Fuel Oil Technical Dept., Shell Petroleum Co. Ltd. (*J. A. Oriel ; R. I. Lewis.*)
- HALL, Peter Charles, Assistant Chemist, Ministry of Supply. (*H. A. Ruffell ; A. C. Pepper.*)
- HOLMES, George William Dan, Works Chemist, Berry Wiggins & Co. Ltd. (*A. Evans ; D. Eve.*)
- JAGGER, Henry, Technical Assistant, Agwi Petroleum Corpn. Ltd. (*H. D. Demoulins ; G. Noble.*)
- LITHERLAND, Frederick Warren, Technical Representative, Silvertown Lubricants Ltd. (*L. O. Maskell ; J. A. Bennett.*)
- MAXWELL, George Barton, Lieut.-Col., R.A.S.C., Petroleum Co-Ord. Authority, Germany. (*G. H. Coxon ; A. E. Dunstan.*)
- MILLER, Wilfred George, Acting Assistant Chief Chemist, Agwi Petroleum Corpn. Ltd. (*H. D. Demoulins ; G. Noble.*)
- REES, Leslie Michael John, Works Chemist, Agwi Petroleum Corpn. Ltd. (*H. D. Demoulins ; G. Noble.*)
- SALOMON, Tobie G., Professor, School of Petroleum, Strasbourg University. (*A. E. Dunstan ; E. A. Evans.*)
- STROUD, Herbert James, Designer Draughtsman, "Shell" Refining & Marketing Co. Ltd. (*E. LeQ. Herbert ; J. W. Vincent.*)
- WALKER, Arthur, Technical Assistant, Agwi Petroleum Corpn. Ltd. (*H. D. Demoulins ; G. Noble.*)
- WILLIAMS, Harold Derek, Examiner, Petroleum Section, A.I.D. Test House. (*J. Mason ; Harold Moore.*)

Applications for Transfer.

- BALFOUR, Nicholas Robert, Sales Engineer, Oil Well Supply Co. (*C. T. Longcroft ; Ashley Carter.*) (*Student to Member.*)
- JAVES, Archie Ronald, Chemist, Anglo-Iranian Oil Co. Ltd. (*A. E. Dunstan ; D. A. Howes.*) (*Associate Member to Fellow.*)

NEW MEMBERS.

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

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

As Fellows.

- | | |
|-------------------|-----------------------|
| BELCHETZ, Leonard | HAYGARTH, Cecil H. S. |
| BROWN, Ewart G. | MARTIN, C. W. G. |
| HANSON, Thomas K. | THOMPSON, O. F. |

Transfers to Fellow.

- | | |
|-------------------|-------------------|
| DEWDNEY, D. A. C. | NISSAN, Alfred H. |
|-------------------|-------------------|

As Members.

ANDREW, W.
 AULT, W. S.
 BAGG, Douglas G.
 BEVAN, Leslie.
 BLACK, R. J.
 BOTTOM, J.
 CAMERON, Ian
 COURTNEY, J.
 DAINTITH, Harold
 DALLOW, F.
 DUCKWORTH, D. M.
 ELLIS, E. G.
 FARAG, Wahib
 FLEMING, H. W.
 GOLDIE, A.
 HALEY, A. H.
 JAPES, D. H.

JONES, N. E.
 KING-FARLOW, D.
 LE CLAIR, C. C. S.
 LEE, G. H.
 MCGECHAN, A. C.
 MURRAY, M. A. K.
 OGILVIE, R.
 REGAN, J. W.
 SLINGER, F. C. P.
 SPENS, P. A.
 SUGAR, H.
 SULIMIRSKI, S.
 WARDILL, T. E. M.
 WATERS, J. F.
 WILLIAMS, K. A.
 VERSFELD, Ivan H.

Transfers to Member.

BLACK, J. L.
 BOWEN, C. O.
 DOWN, A. L.
 EVERIST, G. E.
 FREWING, J. J.
 MCEWEN, G. C.

MARTIN, R. I.
 POMEROY, Ralph G.
 ROWNTREE, W. B.
 ROY, Clarke
 SEFTON, R.

As Associate Members.

ABLEWHITE, L.
 BEDFORD, D. E.
 BURGESS, Henry M.
 COSKER, William L.
 COSTELLOE, H. C.
 COWDEN, Leslie H.
 DONALDSON, J.
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 PAGE, George F.
 RAINE, G. T.
 RIDGEN, D. T.
 SNOWDEN, Alfred G.
 STREET, W. R.
 STROUD, A. L.
 SWANN, Raymond V.
 TOOMER, D. A.
 TREMAINE, J. F.
 WARDEN, T. W. M.
 WILDE, M. F.

Transfers to Associate Member.

CAHILL, P.
 DE BRUIJN, J. A.
 HICKS, A. E.
 McGRATH, L.

SASSON, A.
 WOOD, G. F.
 WRAY, A. T.

As Students.

BOTTOMLEY, G. Y.
 CHURCHFIELD, S. E.
 FALLAH, Abbas
 FALLAH, Mohsen
 FRASER, J. A.
 FRITH, J. F. S.
 HALL, P. G.
 HOLDING, A. E.
 HYNE, B. G.
 IRVINE, D.
 KNIGHT, R. H.
 RAFIEE, Ali-Asghar
 RHODES, F. H. T.

ROSE, E. C.
 RYALLS, R.
 SEFEHRI, Esfandiar
 SKELLAND, A. H. P.
 SOLHKHAH, Edward
 STREET, B. F.
 SPENCE, H. G.
 SZWAJECER, M.
 THISTLETON, P.
 TOGNI, P.
 WETHERELL, K.
 WILKIE, S. K.
 WRIGHT, E. P.

PERSONAL NOTES.

HAROLD G. B. PERRY, who before the war was with the Standard Vacuum Oil Co. Ltd. in Shanghai and was a political prisoner during the war, writes us from 94, Canton Road, Shanghai.

THOMAS H. G. BRAYFIELD, who was released from the Stanley Internment Camp in September last, left Hongkong in March on vacation during which he hoped "to take in the Rainbow trout fishing on the lakes in the vicinity of Kamloops, British Columbia." He expects to be in England in August or September.

ARTHUR G. V. BERRY, superintendent of the Research and Development Department of Trinidad Leaseholds Ltd., expects to leave Trinidad late in June on vacation and to arrive in England early in July.

BRIAN ORCHARD LISLE, who served with the American Forces during the war and lately with the Oil Section of the Economics Division of the U.S. Office of Military Government of Germany, has now returned to New York.

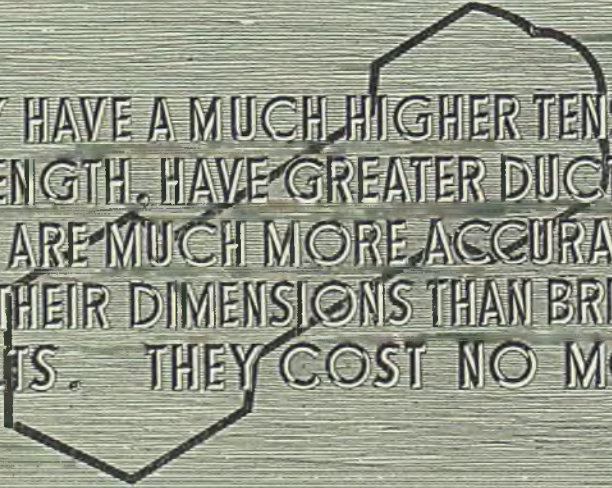
JOURNALS FOR LIBERATED EUROPE.

The Institute is receiving requests from universities and scientific and technical bodies in the liberated countries of Europe for copies of back numbers of the *Journal* of the Institute. In some cases the contents of libraries were confiscated by the Germans or destroyed.

Unfortunately the Institute is not able to meet these requests as, due to paper restrictions and increased demands, many back numbers are now out of print. It is hoped, therefore, that members who have no further use for their *Journals*, particularly of those issued during the war, will give consideration to the suggestion that they might be prepared to make them available for presentation to libraries in liberated countries.

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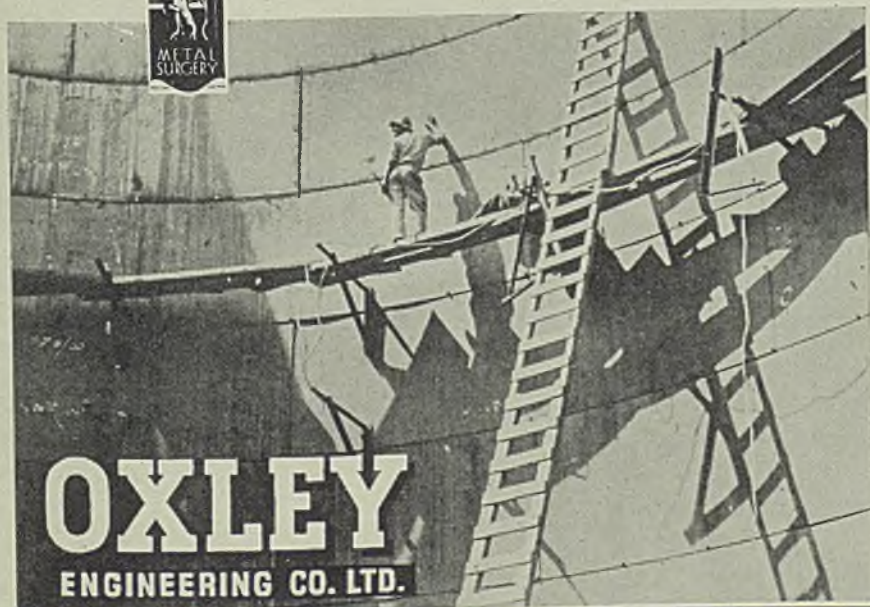
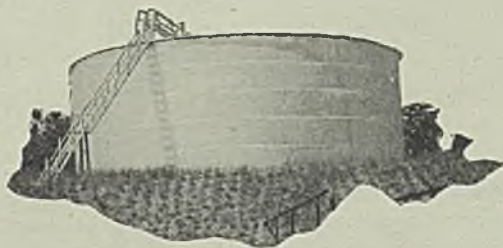
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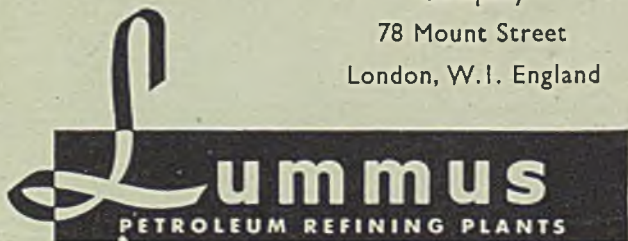
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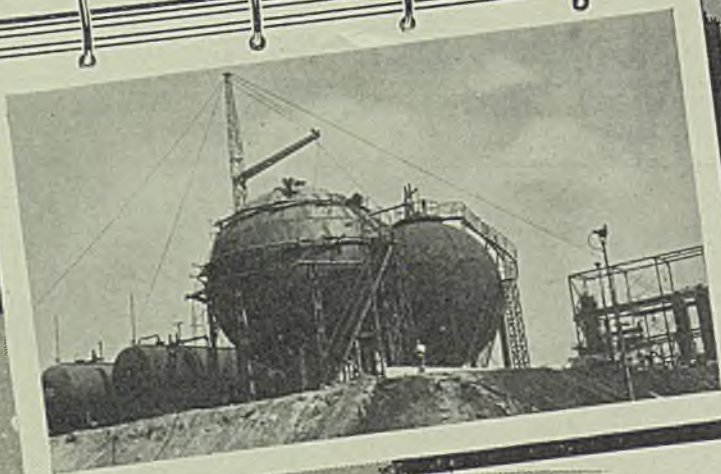
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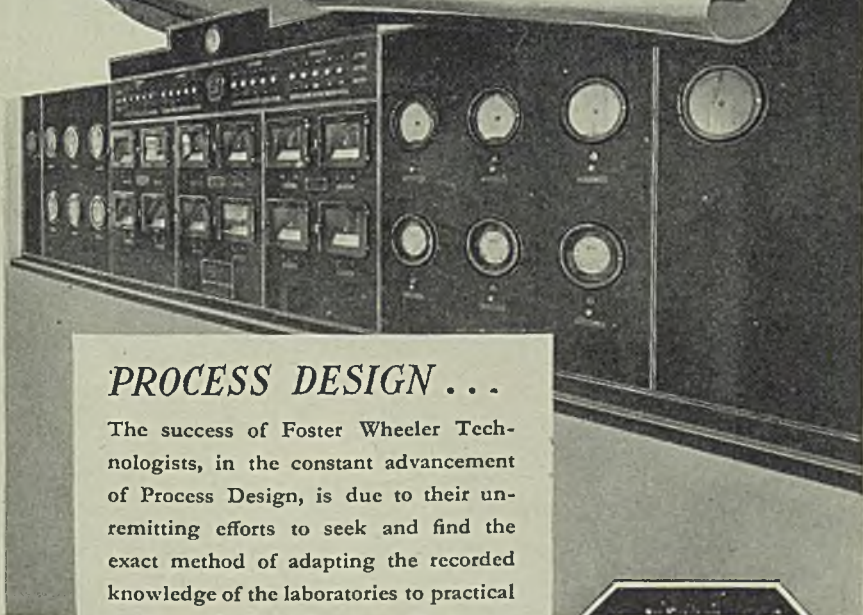
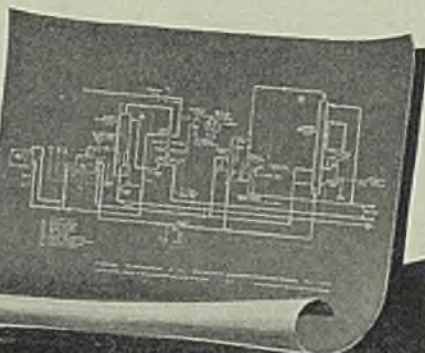
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	PAGE
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BAIRD & TATLOCK (LONDON) LTD. ...	xxiii
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LEGRAND SUTCLIFF AND GELL, LTD. ...	—
LUMMUS Co. ...	x
NATIONAL SUPPLY CORPORATION ...	—
A. P. NEWALL AND Co., LTD. ...	viii
NEWMAN, HENDER & Co., LTD. ...	xix
OIL WELL SUPPLY Co. ...	Back cover
OXLEY ENGINEERING Co., LTD. ...	ix
PHILLIPS PETROLEUM Co. ...	—
PULSOMETER ENGINEERING Co., LTD. ...	xiv
SENIOR ECONOMISERS, LTD. ...	—
JOHN G. STEIN & Co., LTD. ...	xx
STEWARTS AND LLOYDS, LTD. ...	—
SUNVIC CONTROLS, LTD. ...	xi
TUCK & Co., LTD. ...	xxi
TYLORS, LTD. ...	xiii
G. & J. WEIR, LTD. ...	xi
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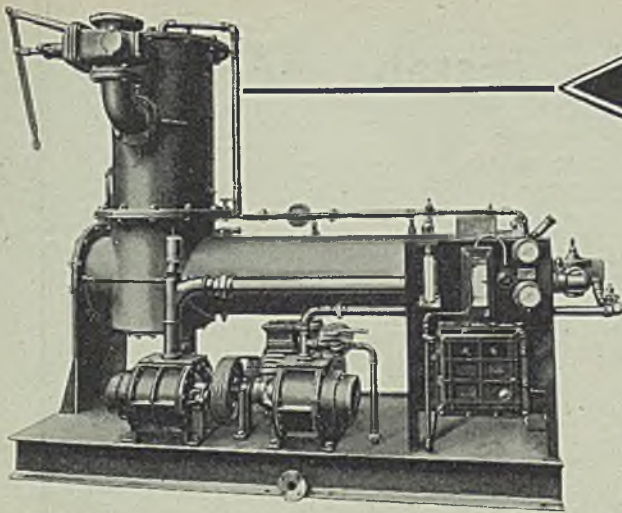
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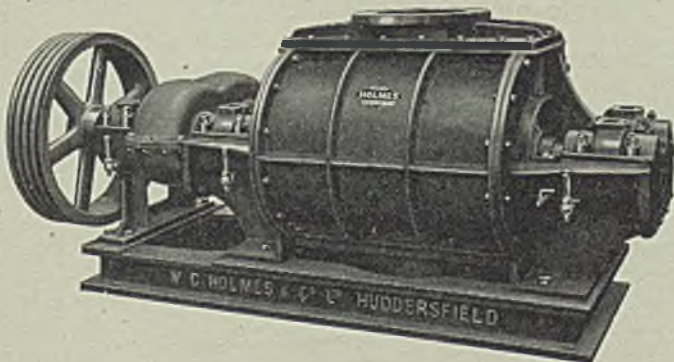
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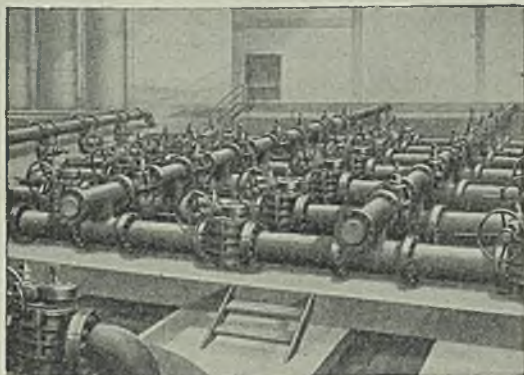
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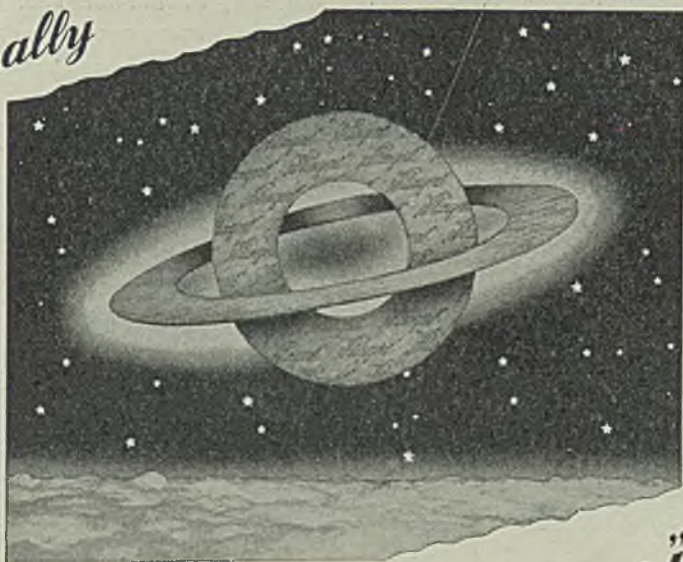
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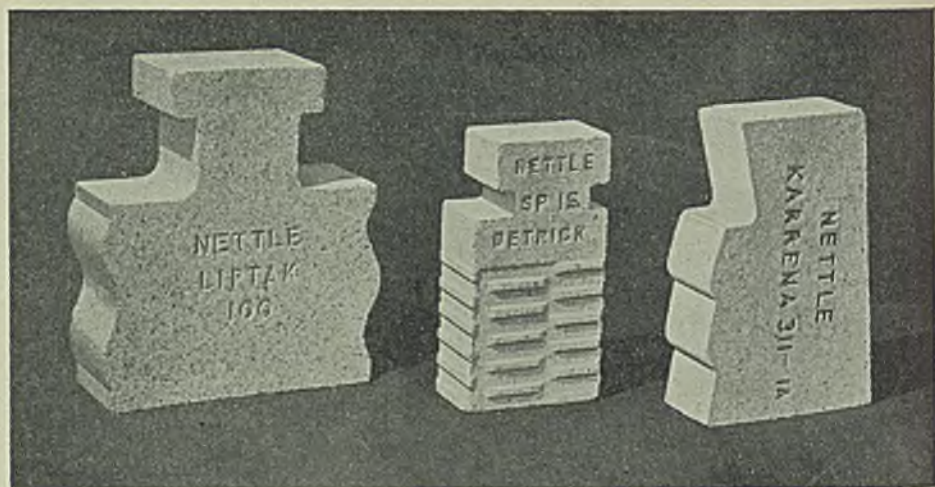
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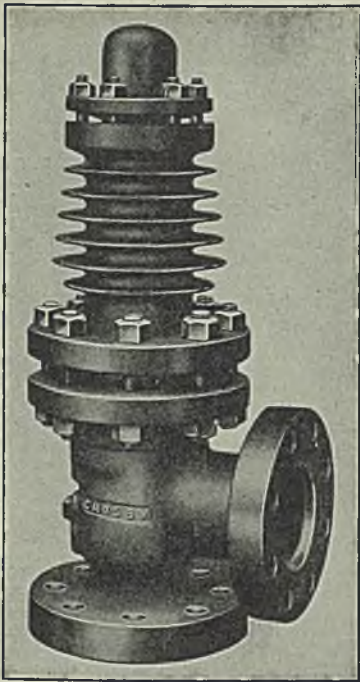
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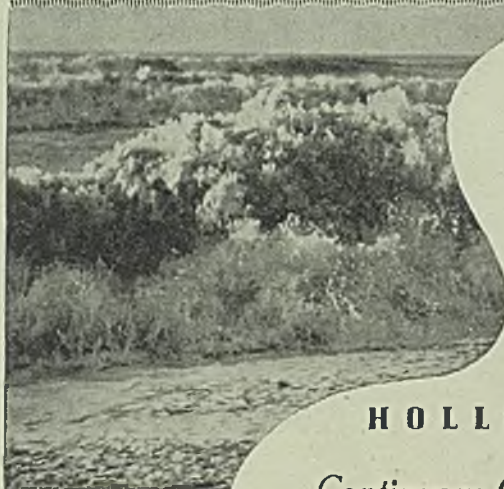
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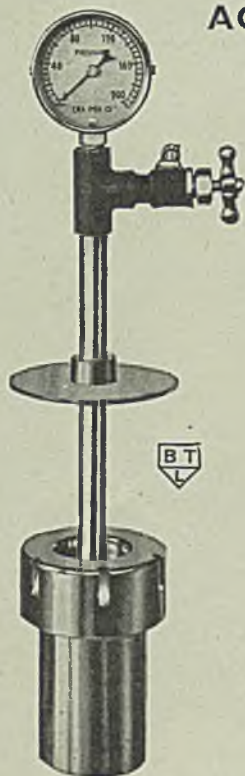
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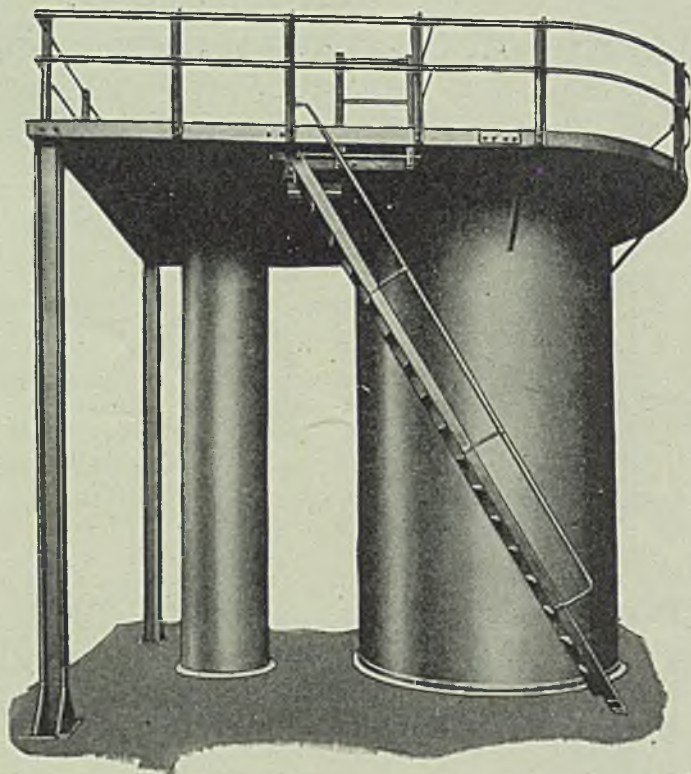
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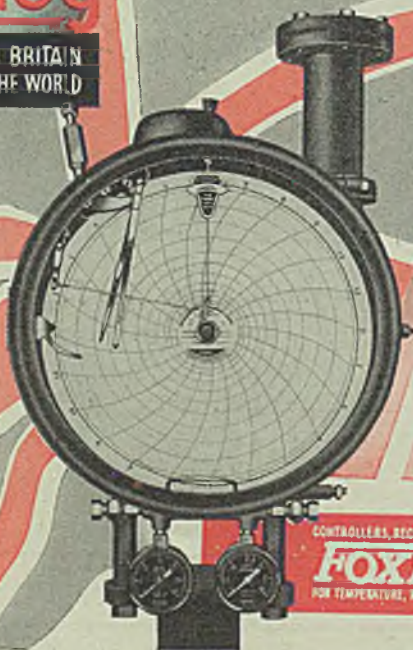
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