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OILFIELD EXPLORATION AND EXPLOITATION.

Geology.

1.* Marine Micro-organisms which Oxidize Petroleum Hydrocarbons. C. E. Zobell, C. W. Grant, and H. F. Haas. *Bull. Amer. Ass. Petrol. Geol.*, September 1943, **27** (9), 1175–1193. Bibliography of 83 items.—Sea-water from the euphotic zone contains 10–1000 hydrocarbon-oxidizing bacteria per litre, and 100–100,000 such bacteria have been found per gram of recent marine sediments. All samples of sediments, regardless of distance from land, water depth, or core depth, have shown their presence. Most of the organisms in marine enrichment cultures have proved to be species of *Proactinomyces, Actinomyces, Pseudomonas, Micromonospora,* or *Mycobacterium. Proactinomyces* is a filamentous, mould-like bacterium, which is differentiated from *Actinomyces* by inability to form spores in the aerial mycelium. Five to 10% of the micro-organisms from marine bottom sediments are *Proactinomyces.* W. W. Umbreit (*J. Bact.*, 1939, **38**, 73–89) reports that many soil *Proactinomyces* oxidize hydrocarbons. Very few *Actinomyces* have been found in the sea at stations remote from terrigenous contamination. Terrestrial *A. elastica, A. fascus, A. oligocarbophilus, A. chromogenes albus, A. bovis, A. eppinger,* and *A. trautwein* oxidize hydrocarbons. Two new species of *Pseudomonas* from the sea also do this. Of several species of marine *Mycobacterium,* at least two can utilize hydrocarbons as their sole source of carbon and energy. F. E. Haag (*Centralbl. f. Bakt.*, 1927, Abt. II, **71**, 1–45) found that the ability of certain saprophytic *Mycobacteria* in this direction could be used to differentiate them from other bacteria. Species belonging to *Bacillus, Bacterium, Corynebacterium, Micrococcus, Sarcina, Serratia,* and *Spirillum* have also been credited with this function, as have certain moulds of the genera *Aspergillus* and *Penicillium,* and several yeasts or yeast-like organisms.

The great majority of the results of the microbial oxidation of petroleum hydrocarbons have been obtained with the plants growing in the presence of free oxygen. W. O. Tausson (*Planta*, 1928, **5**, 85–93) reports that *Bacterium benzoli* used up about 8 gms. of benzene in 42 days in the presence of nitrates. This is mainly of theoretical interest, since normally nitrates disappear from a sediment before it is exhausted of its oxygen. The occurrence of sulphate-reducing bacteria in crude oil and oil-well brines has frequently been reported, and Dr. Haas can now demonstrate the anaerobic utilization of paraffin, kerosene, decane, tetradecane, and cetane by bacteria growing in sulphate media. Ferrous iron was employed in the experiments to combine with the hydrogen sulphide as fast as it was formed in the reduction, since in concentrations exceeding 0·0001 mol. per litre, H_2S inhibits bacterial oxidation of petroleum hydrocarbons. In some cases in nature the sulphate may be reduced to free sulphur. The toxic effect is due to the sulphide ion and not to changes in the hydrogen-ion concentration. Hydrogen sulphide is not compatible with oxygen in an alkaline medium, but controls show that a pH as low as 6·0 does not prevent bacterial attack on hydrocarbons. Free oxygen promotes the bacterial activity, but the oxygen tension seems to be relatively unimportant, provided some free oxygen is present.

Most of the experiments have been conducted at 22° C., but some of the hydrocarbon-oxidizing bacteria are active at as low as 0° C., and others at as high as 53° C. Most of the marine forms will multiply at 0–4° C., but very few at over 30° C. Bacteria which tolerate high temperatures are especially active at these. A given culture at

55° oxidized seven times as much paraffin wax as at 22°. Highest temperature for growing bacteria is put at 85° C.

Marine bacteria are used to an average salinity of 3·4%, but some continue to grow if such a solution is diluted as much as 1 : 10 with distilled water. They also remain active on addition of 12–15% of sodium chloride. Toleration of other chlorides is being investigated. Limits of pH for the hydrocarbon-oxidizing species are from 6·0 to 10. Lowered pH may be due to carbonic acid. H. F. Johnson *et al.* (*J. Cell. and Comp. Physiol.*, 1942, **19**, 163–172) say that the ratio of carbon dioxide produced to oxygen consumed ranges from 0·47 to 0·63, according to the hydrocarbon acted upon. R. W. Stone *et al.* (*J. Bact.*, 1942, **44**, 169–177) give a mean value of 0·65 for the bacterial dissimilation of light oils, and also suggest that organic acids may result from the fermentation of hydrocarbons. S. J. Hopkins and A. C. Chibnall (1932) report that the intermediate products of metabolism of *Aspergillus versicolor* when it attacks higher paraffins are probably ketones and polyketones, and that further oxidation results in the production of shorter fatty acids.

Within certain limits long-chain hydrocarbons are oxidized more readily than those of smaller molecular weight, and aliphatic compounds are more susceptible than cyclic or aromatic compounds. End-products of bacterial action are carbon dioxide, methane, organic acids, and bacterial protoplasm. Although the reactions will take place fully in an aqueous system, the presence of sand, silt, diatomaceous earth, and other inert adsorbents accelerates the oxidation, since the bacteria have a better chance of attacking oil adsorbed on the surfaces of grains than of dealing with oil globules in water.

Samples of crude oil added to marine sediments are rapidly destroyed under aerobic conditions. The work of hydrocarbon-oxidizing bacteria, which appear to be of widespread occurrence, may account for the failure of certain scientists to find petroleum hydrocarbons in sediment samples. Likewise such bacteria might prevent the accumulation of detectable quantities of hydrocarbons in experiments with mixed cultures designed to demonstrate the transformation of organic matter into hydrocarbons. Probably it is only under conditions inimical to those bacteria that oil can accumulate in sediments. A. L.

2.* Regional Metamorphism of Coal in South-eastern West Virginia. E. T. Heck. *Bull. Amer. Ass. Petrol. Geol.*, September 1943, **27** (9), 1194–1227.—Variation in rank (fixed-carbon content) of coal has been accounted for in diverse ways. The area discussed falls within the Appalachian foreland, where the composite for all seams as accepted by Nolting and Headlee (1939) shows a steady increase eastward, from 55% to 90%, into the region of over-thrusting where some lower rank instances have hitherto been ascribed to anomalous local relief of pressure. In Greenbrier, Fayetteville, Raleigh, Wyoming, and Dowell Counties, West Virginia, the rank of the Sewell coal may increase westwards from 70 to about 85 in a distance of 25 miles. This is evidently not due to anomalous tension under an overthrust, but may be best ascribed to lateral thickening of the former load of sediments. This agrees with H. D. Rogers' early observation that the fixed-carbon content in a given vertical section is higher in the more deeply buried coals—a law which was more precisely stated by Carl Hilt (*Zeit. Ver. Deutscher Ingen*, 1873, **17** (4), 194–202). In 1879, in Pennsylvania, J. P. Lesley actually pointed out that the coal-bearing strata thickened towards the anthracite region, and suggested that the Permian had been thicker over the anthracite basin than in the western part of the State. Lesley also explained that differences in original overburden would account for " disturbed " Belgian coals not being anthracites, while Arkansas anthracites are not " disturbed."

David White and Reinhardt Thiessen (*U.S. Bur. Mines, Bull.*, 1913, **38**, 127) recognized in the Appalachian coal-field a loss of volatiles as high as 0·6% for each 100 ft. of depth. Other studies in various fields seem to show that the fixed-carbon content increases in bituminous coals at a rate of 0·5–0·8 per 100 ft. of *stratigraphic* depth. F. Reeves (*Bull. Amer. Ass. Petrol. Geol.*, 1928, **12**, 795–823) puts the average rate in the Appalachian area at 6·9. Reeves emphasized that much of the increase in rank on the well-known isocarb maps is due to the fact that successively older coal-seams outcrop as the mountains are approached, but also stated that the coals increased in fixed carbon with increasing present cover. If analyses of weathered coal are disregarded, it appears that variation in present depth of cover has little effect on the rank of Appalachian coals.

White's original theory that thrust pressure was transmitted through the coal measures with diminishing force entirely across the great Appalachian field, a distance of 150 ml., has already been challenged by P. H. Price (*J. Geol.*, 1931, **39**, 24–44), who declares that a mass of heterogeneous sediments will not transmit a tangential stress for any considerable distance. Transmission of stresses was through the Cambro-Ordovician limestones and the pre-Cambrian basement, and could not be evenly transmitted to the overlying very thick sediments (Sherrill, *J. Geol.*, 1934, **42**, 225–274). S. L. Galpin also comments that when deeply buried rocks fail by folding of the Appalachian type there is evidence that they behave like plastic material. If this be true, it follows that tangential thrust can never develop a stress that is materially higher than the vertical stress. The superincumbent rock column would determine the maximum amount of pressure in every case.

Possible change of rank because of climatic conditions influencing types of plant growth and the character of bacterial decomposition is discounted in the Appalachian field since variation is from east to west, not from north to south. In any case, when coals of several types reach the rank of semi-bituminous (fixed carbon 70–75%) their chemical analyses converge, and above this rank—apart from a continuing, but diminishing, difference between fusain and vitrain—analyses of the banded constituents of a single bed also become more nearly alike.

Effects of saline waters on bacteria which may carbonize organic matter to coal seem to be unimportant so far as Kanawha, Boone, Roane, etc., Counties are concerned, since there such waters are produced from rocks associated with coals of different ranks, which are quite similar to other coals in the area. Concerning the leakage of volatile material through certain types of roof, or adsorption and decomposition of hydrocarbons in certain shale layers, there is no evidence.

Igneous or hydrothermal effects are not much in evidence in the Appalachian area. A few small dykes do occur, but not in south-eastern West Virginia.

The fact that the percentage of dry wells increases as the 65 isocarb line is approached may be explained by the unfavourable structural conditions—intensity of folding and likelihood of oil formed prior to the cessation of deposition migrating away from the centre of the synclinal basin. It by no means follows, however, that *all* oil and gas have so migrated from regions having coals with high fixed-carbon contents.

A table for the Sewell and No. 3 Pocahontas coals indicates that the amount of fines produced in mining a coal tends to increase as the rank rises.

W. T. Thom, Jr., adds a commentary on the importance of pressures of a very few atmospheres at normal temperatures (50–70° F.) in converting the gelatinous colloids of peat into the "hard-rubber" groundmass of lignite. Subsequently pressure induces fracturing, and Thom attributes further degrees of coal metamorphism to temperature effects, since a rise to 212° F. breaks down many colloidal constituents and eliminates methane. In the Crested Butte and Anthracite Range regions, Colorado, heating is by volatile exudations from solidifying igneous rock-bodies. A. L.

3.* Problem of the Pre-Trinity [= Neocomian and Earlier] Deposits in South Texas. F. M. Getzendaner. *Bull. Amer. Ass. Petrol. Geol.*, September 1943, **27** (9), 1228–1244.—The Upper Jurassic–Lower Cretaceous succession in East Texas, Louisiana, and Arkansas has been revised by Shreveport Geological Society and R. W. Imlay, who has provided much comparative information from the west side of the Upper Jurassic "Mediterranean" in north-western Mexico. The new information may be summarized thus :

			Feet.
Lower Cretaceous	Trinity Division	Paluxy formation	270–1600
		Mooringsport formation	75– 750
		Ferry Lake anhydrite	to 500
		Rodessa formation	to 500
		Pine Island formation	280– 500
		Sligo (= Travis Peak) formation . .	160– 300
	Neocomian	Hosston formation	1600–2300
Upper Jurassic		Cotton Valley formation	2275–3175
		Buckner formation	275– 495
		Smackover formation	900–1200
		Eagle Mills formation	450–1200
		Morehouse formation	to 1200

Morehouse to Cotton Valley probably covers Oxfordian to Tithonian. Whatever the case may be higher up, Smackover limestone and Eagle Mills redbeds, anhydrite and salt are referred to the Jurassic.

Throughout all the time represented, there has been progressive tilting of the entire Coastal Plain area towards the Gulf of Mexico basin. The hinge-line of much of this tilting has been a great subsidence fault between the stable Ouachita-phase metamorphics on the north, and Permian, Jurassic, and older Neocomian deposits on the south. Rapid increase of the rate of dip is found on the Basin Margin flexure, and it is postulated that the rate of dip is a function of the sedimentary load.

In the western part of Limestone County, Texas, Gilliam No. 1 well found metamorphic basement at about 4867 ft. Trinity and pre-Trinity sediments amounted to 2471 ft. The Norris well, farther south in the same county, penetrated 6000 ft. of sediments and evaporites after topping the Trinity. Between the two wells can be drawn a segment of the Jurassic coast, and the indications are that in South Texas we have still greater thicknesses of pre-Trinity rocks.

Five of the formations—Cotton Valley, Hosston, Rodessa, Pine Island, and Sligo—produce oil at places in East Texas, Louisiana, and Arkansas. Salt domes seem to be located in the deeper parts of the basin. Three South Texan salt domes are already known—Piedras Pintas and Palangana in Duval County, and Gyp Hill, 35 ml. south of these in Brooks County. Numerous gravity minima in the south coastal area of Texas, and as far inland as Pescadito in Webb County, probably occur over salt domes.

Jurassic to Lower Glen Rose (= early Trinity, *viz.* Sligo, Pine Island, and Rodessa) seas contained many islands and peninsulas now buried. The near-shore permeable clastics from these require to be located and tested. Wells drilled on older hypotheses sought the crests of such structures rather than the richly productive flanks.

A. L.

4.* Classification of Faults. Stuart K. Clark. *Bull. Amer. Ass. Petrol. Geol.*, September 1943, 27 (9), 1245–1265.—The definition that " a normal fault hades to the downthrow, whereas a reverse fault hades to the upthrow " leaves us in the dark as to the forces or stresses which have resulted in the type of failure of the crust referred to. Actually a fault-plane approaching the vertical may wobble a few degrees to either side, as in the cases described by T. Clements in the Tejon Quadrangle, California (*Bull. Amer. Ass. Petrol. Geol.*, 1937, **21**, 212–232), without being tensional (= " normal ") or compressional (= " reverse ").

The following classification is proposed :—

1. *Normal diagonal shears* represent diagonal shearing failure due to relative local uplift (or subsidence). This is the commonest type, and it predominates in the oilfields of the Mid-Continent and Gulf Coast. The fault-plane may become more steeply inclined at depth, showing an increasing component of vertical shear—*e.g.*, Fitts Oilfield, Pototoc County, Oklahoma. Landslips may be classed under this heading.

2. *Reverse diagonal shears* (*thrust faults*) indicate diagonal shearing failure due to approximately horizontal compressive stresses, or in stratified rocks, stresses transmitted along the bedding planes. This is the same as normal diagonal shear except for the direction of the applied stress—*e.g.*, Turner Valley field, Alberta. Fault-planes and joints parallel to them tend to become less steeply inclined and to die out at depth—*e.g.*, Malvern Hills, England.

3. *Horizontal faults* (*bedding-plane shears*) include cases where masses of strata have been displaced along shearing-planes approaching the horizontal. Small displacements along bedding planes are probably common, but are naturally hard to recognize, unless there are slickensides. Their origin is the down-warping of a narrow syncline or a wide geosynclinal deep full of sediments, which sets up greater compressive stresses in the upper beds than in the lower ones—*e.g.*, repetition of the Wapanucka limestone by sliding on the Caney shale (Mississippian), Oklahoma, and Heart Mountain " overthrust," near Cody, Wyoming, where the nappe travelled on a land surface and in places quartzite cobbles acted as " rollers." Reverse diagonal shearing often occurs within, or underneath the moving mass—*e.g.*, *schuppen*-structure, North-west Highlands of Scotland.

4. *Tension faults* represent direct-tension fractures approximately at right angles to the bedding and to the directions of applied stress, and consequent gravity slumping of the segments involved. Tensile stresses are not prevalent over widespread areas,

since the weakness of rocks in tension precludes transmission over long distances. They are often found on anticlinal folds—*e.g.*, Kettleman Hills, North Dome, California. The collapsed crest, fault-planes at high angles of 70–80° inclined persistently towards the axis, and disappearance of faulting at depth are all characteristic.

5. *Lateral shears* due to shearing failure along nearly vertical planes, where vertical displacement is secondary in importance compared with lateral movement—*e.g.*, San Andreas fault, traceable for 500 ml. from the Mexican border to Punta Arenas in northern California, where it disappears beneath the Pacific.

6. *Vertical shears* are theoretically a result of differential uplift under sufficient thickness of overlying rock. Mathematical analysis indicates that burial to a depth of approximately 40,000 ft. is necessary for this type of failure to be initiated in solid homogeneous limestone, less competent beds developing such failures at lesser depths. They presumably occur at great depth as the initial fracture resulting from differential uplift, above the zone of flow or molecular readjustment, and propagate normal diagonal shears as the surface is approached. Regions of very deep erosion might be recognized from their occurrence at the surface.

Unfortunately most faults are badly exposed, and often correspond with lines of erosion, but slickensiding may tell the direction of latest movement. A. L.

5.* **Note on the Present Knowledge of the Tertiary Sequence in Papua and the Mandated Territory of New Guinea.** Irene Crespin. **Summary Review** by B. W. Collins. *Bull. Amer. Ass. Petrol. Geol.*, September 1943, 27 (9), 1266–1268. Bibliography of 45 items includes Solomon Islands.—The native tribes are apt to be unfriendly towards oil prospectors and the terrain is difficult: high mountain ranges with outcrops only in deep river valleys. The Tertiary foraminiferal, coral, and molluscan assemblages are similar to those in the Netherlands East Indies. The same stratigraphical classification seems to apply.

Eocene rocks *in situ* have been sparingly observed along the Sepik divide towards the border of Dutch New Guinea and on the Wahgi plateau. They also occur in south-eastern Papua, especially near Port Moresby. Foraminifera include *Camerina*, *Assilina*, *Discocyclina*, *Biplanispira*, *Pellatispira*, and *Borelis*. There are a few Oligocene localities with "*Lepidocyclina*" and reticulate late *Camerina*.

Lower Miocene (Aquitanian, stage "e" of East Indian Tertiary) is moderately well developed in both territories—*e.g.*, at Bootless Inlet, near Port Moresby, where large eulepidines are abundant in limestone. On Tumleo Island, north-east New Guinea, a limestone is almost entirely composed of tests of *Spiroclypeus*. At another locality *Miogypsinoides* is characteristic. Middle and lower Upper Miocene (Burdigalian, stage "f") are also well represented, and contain "*Lepidocyclina*," *Trybliolepidina*, *Miogypsina*, *Katacycloclypeus*, *Alveolina bontangensis*, but no *Eulepidina* or *Spiroclypeus*.

Mio-Pliocene (top of Upper Miocene to Lower Pliocene, roughly stage "g" of East Indies) is widespread in both New Guinea and Papua. Large Foraminifera are absent, but small types are abundant in mudstones, which in places reach a considerable thickness. Mollusca are well represented.

Upper Pliocene sediments of New Guinea cannot be correlated accurately with East Indian deposits, but beds with above a certain percentage of modern forms are put in the Pleistocene (?). Upper Pliocene mudstones, recognized in Papua on this negative basis, contain small Foraminifera including rotalines; and at Cape Possession there is a rich molluscan fauna of similar age. In New Guinea, beds equivalent to the Upper Wanimo series are Upper Pliocene.

The Pleistocene is chiefly of chalky coral limestones with Foraminifera of typical present-day coastal types mixed with the usual pelagic species. The finest development seems to be in the east of New Guinea and in adjacent islands as far as New Britain. A. L.

6.* **Big Snowy Group: Lithology and Correlation in the Northern Great Plains.** E. S. Perry and L. L. Sloss. *Bull. Amer. Ass. Petrol. Geol.*, October 1943, 27 (10), 1287–1304).—The Big Snowy group (Middle and Upper Mississippian) comprises shales, sandstones, limestones, and evaporites. It has yielded some oil, and compares in age and deposition with highly productive beds in the Illinois basin. The Big Snowy is not so widely distributed as the Madison limestone which was deposited in a sea stretching across Montana and the western half of North Dakota, that reached its greatest areal development at the end of Osage (Mission Canyon) time.

The lowest division of the Big Snowy is the Charles, deposited during a shrinkage of the Montana–Dakota sea which was cut off from the Cordilleran geosyncline in Meramec time. The Charles, as contrasted with the Madison, is a pale earthy limestone, with frequent dolomites, and in places oolitic and commonly anhydritic. Minor amounts of red shale have been noted. Near the top, sandy zones are present. It is up to 950 ft. in known thickness.

The succeeding division, the Kibbey, is of dull, brick-red, dolomitic, shaly sandstone, containing local beds of gypsum, and devoid of fossils. The material is poorly sorted, ranging from silt-grade to sand grains of moderately high roundness, mostly frosted and pitted. Some of the quartz grains have black, needle-like inclusions. Grains of chert account for 10% of the total, and probably come from weathered Madison, but the quartz grains are from still earlier rocks. In Kibbey time, marine waters from the Cordilleran trough re-entered the Montana–Saskatchewan–Dakota basin. Towards the south, the Kibbey becomes dolomitic with finer sand-grains.

The Otter division at outcrop is typified by verdant green shales, intercalated with grey shales and fossiliferous (warm-sea) oolitic limestones. When traced east of the Big Snowy Mountains, the green shales are replaced by variegated and red shales, resulting from more complete oxidation of iron compounds. In the east pale, oolitic, highly ostracodal limestones come in abundantly, accompanied by anhydrite. Greatest thickness of the Otter is in the Little Belt Mountains, where it is 500 ft.

The Heath has abundance of black, fissile, conodont-bearing shales, intercalated in grey shales, massive brown sandstones containing plant fragments, and minor grey limestones. No petroleum is extracted from the black shales with carbon tetrachloride, but some layers yield up to 15 gal./ton on destructive distillation. Some of the shales can be lighted with a match. Quartz grains in the sands which range up to 20 ft. thick are clear and of low sphericity. They often show secondary enlargement. The thickness of the Heath along the east–west axis of the basin reaches over 600 ft. It wedges out southward, where it has been removed by pre-Amsden (high Mississippian) erosion, and is missing in wells at the south end of the Baker–Glendive anticline.

After the deposition of the Heath, during the latter part of Chester time, erosion prevailed on the south-east side of the Williston basin. As a result, south of the north end of the Baker–Glendive anticline, successively older units of the Big Snowy group underlie with slight unconformity the base of the Amsden (topmost Mississippian). The Amsden is thicker in Montana than in Wyoming, but it ultimately blanketed almost the whole of the latter state as well as the western third of South Dakota. The sandy nature of the blanket reflects the influence of the Cambridge arch on the south-east.

Erosion on the ancestral Sweetgrass arch and Sioux uplift is suggested by the large size of sand grains in the Kibbey. Much later widespread early Mesozoic erosion, prior to deposition of the Jurassic Ellis formation, caused removal of Big Snowy and later Palæozoic sediments in this positive area.

In the Devil's Basin anticline, oolitic limestone near the top of the Otter yielded about 20,000 brl. black low-gravity oil between 1919 and 1937. On the Baker–Glendive anticline up to 150 brl./day have been obtained from a position near the base of the Charles or at the top of the Madison.

Coarse Heath sandstones close to the Sweetgrass arch have not been tested, though overlain by impermeable Ellis so as to give a stratigraphical trap. In central Montana, shallow wells in the Kibbey yield much water, indicating good porosity. It is very possible that where unconformable on the Madison some of these sands may act as oil reservoirs. A. L.

7.* Stratigraphy and Palæontology of Santa Maria District, California. W. P. Woodring, M. N. Bramlette, and K. E. Lohman. *Bull. Amer. Ass. Petrol. Geol.*, October 1943, 27 (10), 1355–1360.—The present demand for heavy oil has directed special attention to the Santa Maria district, where oil was first produced in 1903 and in which there are now nine producing or potentially productive oil-fields. In this coastal basin, formations range from the Franciscan (Jurassic ?) gabbro and serpentine of Point Sal, to Recent containing ancient hardpan (Louderback's pseudostrata) which may be mistaken for bedrock. The maximum outcrop thickness in the Santa Maria basin is 13,000 ft.

The Knoxville (late Jurassic–Portlandian) is of dark shale, but includes thin-bedded sandstone with much mica and black chert conglomerate. At Point Sal a small slender *Aucella* cf. *piochii* is found, of a type associated with late Jurassic ammonites elsewhere in the Coast Ranges.

The Lospe reddish sands and green gypsiferous silts, with some lenses of white volcanic tuff containing glassy shards, are assigned to lower Miocene, but may include Oligocene, or even Eocene. The non-marine Lospe is overlain by the muds and silts of the Point Sal formation, in the upper part of which oil-sands have been penetrated at the Santa Maria Valley and Orcutt fields. The large foraminiferal fauna includes: *Baggina californica*, *Bolivina* aff. *cuneiformis*, *B. floridana*, *B. imbricata*, *B. marginata*, *B. salinasensis*, *B.* aff. *tumida*, *Buliminella subfusiformis*, *Nodogenerina advena*, *Nonion costiferum*, *Planulina* cf. *depressa*, *Plectofrondicularia* cf. *cookei*, *Pulvinulinella subperuviana*, *Robulus hughesi*, *R. reedi*, *Siphogenerina hughesi* var., *Uvigerinella obesa*, *Valvulineria depressa*, *V. ornata*, and *Virgulina californiensis*. *Globigerina bulloides* is abundant, and suggests that this fauna represents more open pelagic conditions than those at higher horizons.

The Monterey shale, conformable on the Point Sal in the Casmalia Hills, but overlapping northwards on to the basement, includes the principal oil-zones. The lower member has phosphatic, porcelanous, and silty shales; the middle member is cherty and porcelanous; the upper member has porcelanous shale and soft diatomaceous strata. The lower member is Middle Miocene (upper part of Relizian and entire Luisian stage of Kleinpell). *Siphogenerina* is conspicuous, with *S. branneri* succeeded by *S. collomi*. The middle member, somewhat barren of Foraminifera, seems to be early Upper Miocene. The upper member, with still undescribed species of large *Ellipsoglandulina*, *Hopkinsina*, and *Pulvinulinella*, also contains limestone concretions yielding a diatom flora of about 200 species characterized by *Coscinodiscus gigas*, *C. gigas* var. *diorama*, *C. oculus-iridis* var. *borealis*, *Auliscus mirabilis*, *Asterolampra marylandica*, *Lithodesmium californicum*, *Gonothecium rogersii*, and *Campylodiscus montereyanus*. These indicate late Miocene; and the foraminiferal fauna points to a horizon intermediate between those of *Bolivina hiughesi* and *B. obliqua*.

The succeeding muds of the Sisquoc and the Foxen, which lead us on to the early Upper Miocene, also have their diatoms of the genus *Coscinodiscus*, but nothing so large as *C. gigas* and *C. oculus-iridis* var. *borealis*. The Tinaquaic sandstone of Sisquoc age has typical shallow-water Foraminifera like *Elphidiella hannai* and *Nonion belridgensis*. The basin or shaly facies is neritic with *Bolivina obliqua*, *Buliminella curta*, *B. elegantissima*, *Eponides* sp., *N. belridgensis*, *N.* aff. *scapha*, *Nonionella miocenica*, and *Virgulina californiensis*, as the common forms. Foraminifera in the Foxen are often "provincial" forms not known elsewhere, and, as C. R. Canfield (*Bull. Amer. Ass. Petrol. Geol.*, 1939, **23**, 58) first remarked, suggest progressively shallower depths at higher horizons.

The succeeding Careaga sandstone coarsens upwards to conglomerate and has Upper Pliocene echinoids and molluscs, such as *Dendraster ashleyi*, *Patinopecten healeyi*, and *Lyropecten cerrosensis*. Early beds have a few *Elphidiella hannai*.

The Paso Robles formation (Upper Pliocene to Lower Pleistocene (?)) consists of freshwater sand, gravel, and limestone. It and the Orcutt sand (Upper Pleistocene) have ostracods not yet used for correlation. Terrace deposits of marine beaches up to 6 ft. thick and screes and alluvia up to 100 ft. are younger than Orcutt, but still Upper Pleistocene.

Recent deposits are of well-sorted dune-sand. A. L.

8. Cal-Tex Is Rigging Up for Egyptian Wildcat. Anon. *Oil Wkly*, 18.9.44, **115** (3), 68.—South Mediterranean Oil-fields is to drill a test well a few miles west of Cairo. The coastal area east and west of the Nile delta has a great thickness of Mesozoic and Carboniferous beds, and there are pronounced structures.

Near the centre of the Jebel El Tih area, between Suez and the Palestine border, the Standard Oil Company of Egypt plans to drill another test. It has drilled five dry holes west of the Gulf of Suez in efforts to extend the Ras Ghareb field.

G. D. H.

9. Richmond to Drill Wildcat on Colombia Holdings. Anon. *Oil Wkly*, 18.9.44, **115** (3), 68.—Richmond Petroleum Company is to drill a wildcat on a prominent anticline on the Caraballo tract. This concession lies 60 km. south-east of Baranquila.

Richmond has abandoned its second well on the El Retiro tract, far sbort of the Oligocene pay objective. G. D. H.

10. Russians Find New Eield on Shore of Caspian Sea. Anon. *Oil Wkly*, 25.9.44, **115** (4), 68.—The discovery of an oil-field is reported at Kashkara, a few miles west of Astrakhan, in the Volga delta region. Oil has been obtained from five wells about 750 ft. deep. G. D. H.

11. Wildcat Completions and Discoveries. Anon. *Oil Gas J.*, 30.9.44, **43** (21), 129.—65 wildcats were completed in U.S.A. during the week ended 23rd September, 1944. 6 found oil and 4 found distillate.

The wildcat completions are summarized by States and districts for the above week. G. D. H.

12. Texas Venezuela Wildcat Drilling at 6595 feet. Anon. *Oil Wkly*, 2.10.44, **115** (5), 68.—Texas 2, Delta Amacuro wildcat, was below 6595 ft. on 26th September, 1944. It is 40 km. from the nearest production in extreme Eastern Venezuela.

Sociedad Anonima Petrolera Las Mercedes was reported coring shale at 4025 ft. in Mercedes 8. G. D. H.

13.* Wildcat Completions and Discoveries. Anon. *Oil Gas J.*, 7.10.44, **43** (22), 129.—During the week ended 30th September, 1944, 81 wildcats were completed in U.S.A. 11 found oil, 3 distillate, and 2 gas. The completion results are tabulated by States and districts. G. D. H.

14. Eight Southern Chile Wildcats Are Failures. Anon. *Oil Wkly*, 9.10.44, **115** (6), 70.—Eight dry holes have been drilled within a radius of 25 ml. on a seismograph structure in Punta Arenas, southern Chile. G. D. H.

Geophysics and Geochemical Prospecting.

15. Geochemistry as Aid to Successful Exploration. J. W. Merritt. *Oil Wkly*, 9.10.44, **115** (6), 35.—In the early days prospecting drilling was near seeps, but with the development of the anticlinal theory a more prosperous era opened. First surface mapping was used, then, as shallow prospects were exhausted, subsurface methods. Next geophysics was introduced. However, the discovery rate is declining in U.S.A., and the costs of discovery are rising in spite of the use of combinations of surface and subsurface geology and geophysics.

A few years ago the soil air in shallow holes was examined, and the hydrocarbon values determined. The greatest concentration was found as a marginal band round the edge of the productive area.

The method of sampling has changed from soil air to direct analysis of the soil itself. Solid, liquid, and gaseous hydrocarbons have been examined.

In some cases a density pattern which increases to the centre of the pool has been observed, and isochemical contours can be drawn.

Cuttings from wells in the producing area, at the edges of production, just outside the producing area and in non-productive areas, have been analysed. These analyses show three-dimensional geochemical patterns, and the relationship between surface and sub-surface concentrations and production is revealed. Surface " background " irregularities disappear with deeper sampling.

Grid-spacing of the sampling points is preferable to profiles. Some of the spacing was at $\frac{1}{4}$–1 ml. intervals, but this is risky. 660-ft. spacing is much more satisfactory, and for some purposes even closer spacing may be used.

Soil variability, weather and barometric changes, and losses on storage combine to make reproducibility difficult in some cases.

It is not possible to determine depths from geochemical data, and when there are multiple sands the surface patterns may be very complicated and difficult to interpret.

A fault cutting a producing horizon is usually marked by high values vertically above the line of intersection of the fault-plane with the pay horizon.

A pattern standing out well above the background values must be sought, and the interpretation must take into account all available geological and geophysical information.

Associated with the hydrocarbon movements in soils are changes in soil bacteria population, in the composition of ground-waters, and in seismic velocities. Geochemical methods can locate oil-traps not associated with structure. They are an aid in discovery, and do not warrant the discarding of geological and geophysical methods.
G. D. H.

Drilling.

16. Blowouts—Their Causes and Prevention. Part 2. M. T. Works. *Oil Wkly*, 17.7.44, **114** (7), 35. *Paper Presented before American Petroleum Institute.*—The author stresses the importance of properly educating the men to know the hazards of drilling and methods of prevention. Posters are suggested as a highly effective medium for presenting an educational programme to workmen, which should return exceptional dividends in preventing blow-out causes under the control of subordinate personnel. Posters could be designed to direct attention to the various hazards and to explain why certain things are bad practice.

This part of the paper deals particularly with causes under the control of subordinate personnel. These include drilling gas sands too fast, pulling drill-pipe off bottom too rapidly, balling up bit or drill collar, use of low-pressure fittings in high-pressure control manifolds, delay in making repairs to rig, lack of vigilance for unmistakable signs of gas, and other such lapses. A. H. N.

17. Horizontal Drilling is Tried in Partially Depleted Fields. W. A. Sawdon. *Petrol. Engr*, August 1944, **15** (12), 160.—A means of tapping less thoroughly drained areas lying between wells in partly, or almost completely, depleted fields has recently been developed, and the drilling procedure using equipment designed for the purpose has been tried out experimentally in two wells in the Midway-Sunset area of California. The method consists essentially of cutting a window, or otherwise providing an opening, through the liner at a predetermined depth in the producing zone of a well, and through this opening drilling a horizontal hole in a specified direction to a desired distance from the bore of the vertical well employed for the purpose. Using one well, three or four horizontal holes may be drilled, and these holes may be at different levels. The method of horizontal drilling was devised and the equipment designed by J. A. Zublin, of Universal Engineering Company, Ltd., Los Angeles. The outstanding features of the equipment are a turbo-bit and flexible drill-pipe. The bit is rotated by the drilling fluid, which is circulated by the mud-pumps, the mud being maintained at a suitable viscosity for operation of the bit. The drill-string is, of course, not rotated.

A sketch shows the working of the turbo drill on a curved joint of approximately 20-ft. radius of curvature—drilling horizontally through a window in the slotted liner after having completed one horizontal hole in an opposite direction at a lower level. The operation of the system is described. A. H. N.

18. Symptoms of Pipe Break-Offs On Mechanical Rotary Rigs. H. F. Simons. *Petrol. Engr*, August 1944, **15** (12), 170.—If a break-off is immediately recognized, the fishing job of the cleanly broken pipe may be only a routine matter of running an overshot once or twice. Should the break-off not be recognized, the top of the fish tends to bell out or to sliver and spiral, and it may take weeks to recover the fish.

A drill-pipe break-off and the washed-out condition that precedes it are much more difficult to recognize on a mechanical rig than on a steam-driven one. On the latter-type rig only ordinary caution and observation are required to catch a wash-out before a break develops, and usually the actual parting of the drill-pipe is known immediately. The symptoms of a pump-out and a break-off are the same on all type rigs, except that they are masked on a mechanical rig to the point where they are often missed. The easily recognized symptoms of a leak in the pipe due to cashing out on a steam rig are: (1) a loss in pump pressure, (2) an acceleration in the number of strokes/minute of the pump, and (3) a decrease in the rate of penetration due to part of the drilling fluid being short-circuited through the leak in the pipe and the consequent reduction in the fluid available to clean the bit. The break-off is identified by a sudden increase in the speed of the rotary table, a sharp drop in the pump pressure, an upward jump in the strokes/minute on the pump, and a decrease in the weight of the drill-string as shown by the weight indicator. In engine-driven rigs these symptoms are not very obvious or recognizable, due to the characteristics of the engine.

The only easily recognized symptom of a pipe break-off on the mechanical rig is a reduction in the weight of the drill-string as shown by the weight indicator. There may be no discernible increase in rotary table revolutions/minute, no reduction in pump pressure and no recognizable speeding up of the pump. Unfortunately, some weight indicators are not sensitive enough to small changes in weight to reflect the loss; in addition, the reading of some weight indicators is affected by exterior conditions. There have been cases where drillers have weighed the pipe several times in an effort to determine if it remained intact, and they still were not sure. Again, the engine tachometer and vacuum gauge, plus a rotary table tachometer, are the most practical indicators of the trouble. The reduction in load is generally sufficient to produce an appreciable increase, as shown by these gauges, in engine speed and manifold pressure. The changes would not be discernible to the eye and ear of the driller, however. Automatic recording of rig functions may reveal a break-off in many cases.
A. H. N.

19. Drilling Materials Under War Conditions. W. H. Morrison. *Petrol. Engr*, August 1944, **15** (12), 186. *Paper Presented before American Petroleum Institute.*—American drilling equipment problems due to war shortages are discussed. Considerations are given to (*a*) improved quality of materials, (*b*) greater quantity of repair parts for stocks, (*c*) improved service facilities (machine and repair shops, transportation, and dirt-moving equipment, etc.), (*d*) man-power shortage. A. H. N.

20. Oil-Base Drilling Fluids Often Boost Production. A. W. Alexander. *Oil Wkly*, 4.9.44, **115** (1), 36.—A study of the requirements of water-base and oil-base fluids is made. The dispersion and stabilization of the solid phase in oil-base made is next considered, the use of soaps having been found useful to stabilize such mixtures. The best practice is considered to form such soaps in the drilling fluid itself. For this purpose a suitable soap-producing material—for example, an oil of vegetable origin rich in highly unsaturated fatty acids—may be added to the drilling fluid, preceded or followed by the addition of a neutralizing or saponifying agent—that is, of a basic-reacting material capable of forming a soap by reaction with the fatty acids of the soap-producing material. One of the most satisfactory agents to give oil-base drilling fluids the desired plastering properties is blown or oxidized asphalt. The addition of a blown asphalt having a penetration of 10–20 at 77° F. and a melting point (by the Ring and Ball Method) of from 225 to 230° F. will as a general rule insure the formation of a thin and fluid-impervious sheath on the walls of the borehole, and reduce the fluid losses to the formation substantially to zero.

A detailed consideration of the application of oil-base fluids is given. It is satisfactory from a mechanical behaviour viewpoint, coring and cementing, and has many advantages over water-base fluids in its effects on productivity. Electrical coring requires electrodes which actually contact the walls.

The paper ends with references to other literature on the subject, and to a list of U.S. Patents on oil-base fluids. A. H. N.

Production.

21. Methods for Shooting Thin Multiple Sand-Zones. A. Gibbon. *Oil Wkly*, 17.7.44, **114** (7), 21.—Selective or multiple-zone shooting, to be successful, requires careful study, particularly in areas where the formation is varied as to degree of hardness, porosity, permeability, consolidation, density, and saturation. Problems arise and must be worked out where saturated zones of either uniform or varied type are separated by fault-zones or other non-saturated zones of varied thickness. Where multiple-zone shooting is planned involving rock characteristics of varied type, the desirable procedure is to determine the type of explosive best suited for each zone, and then to use in that zone the quantity of explosive which will give the widest economical fracturing range. The ideal condition would be to have a wide choice of explosives, but since, for the present under war-time conditions, the choice of explosives for oil-well shooting is limited, every preliminary step should be taken in the well survey to ensure the utmost efficiency and economy with existing limited material. Besides studying the characteristics of zones to be shot, the operator would benefit by learning something of the nature of available explosives and what to expect from their use. The paper deals with conditioning the hole, determining the necessary characteristics and quantities of explosive, and the shooting procedure. A. H. N.

22. Practical Completion of Secondary-Recovery Wells. Anon. *Oil Wkly*, 17.7.44, **114** (7), 30.—New wells should be cored, analysed, and treated as an individual unit. Air or gas-pressure wells should not be shot or acidized, while the advisability of thooting water input wells depends on the character of the sand. Selective shooting tends to equalize vertical sand characteristics for a sufficient distance from the input well to permit formation of a uniform " wall of water." The paper deals briefly with the operations necessary. A. H. N.

23. Repressuring Has its Possibilities in Oklahoma City. A. Gibbon. *Oil Wkly*, 31.7.44, **114** (9), 17.—Oklahoma City Wilcox pool is produced in a multiplicity of small-scale sections, due to the large number of ownerships involved. Production curves show a steep decline. The paper points out the advantages of a co-operative repressuring programme for this pool. A. H. N.

24. Flexibility of Underground Gas Storage Demonstrated. W. R. Kubista. *Oil Wkly*, 31.7.44, **114** (9), 22.—The use of an underground reservoir for gas is detailed and formulæ are shown for the calculations of the characteristics of one particular sand which was used as storage sand, and for prediction of future behaviour. Load curves and their use, including modified curves used with the particular system being studied, are discussed in some detail. The conclusion reached from studying this system is that its flexibility and usefulness exceeded expectation. A. H. N.

25. Design, Construction, and Operation of Salt-Water Disposal System. L. H. Dial. *Petrol. Engr*, August 1944, **15** (12), 51–56.—The paper deals with the work of the East Texas Salt Disposal Company who have recently placed in operation a disposal system known as the W. S. Morris System. It represents the latest in the design of open-type systems installed by the company to date. It serves 84 producing oil-wells, and acts as a relief to the Suman system, which serves 104 oil-wells. It is located in the W. B. Davis survey in Upshur County. The designed capacity of the plant, 10,000 brl./day, can be increased to 15,000 brl./day by the addition of a third filter unit. All illustrations and design data described in this article apply to the Morris system.

The objective in treating water for disposal is to produce a water that is free of oil, precipitates, and organic matter, and which is chemically stable, so that no plugging materials will develop after filtration to lower the intake capacity of the disposal well. The main steps in achieving these objectives are described under skimming, aerating, chemical treatment, coagulating, and settling, and the essentials of the processes are given. The clear water flows to the disposal well by gravity. The drilling and completion of the disposal well was more or less routine, the procedure having been as follows: (1) The surface hole was drilled to approximately 110 ft., at which depth 10¾-in. casing was set and cemented with 150 sacks of cement. (2) The cement was allowed to set a minimum of 24 hr., and a 9⅞-in. hole was drilled to the top of the Woodbine sand. At this point the diameter of the hole was reduced to 6¼ in. and the hole was drilled to the base of the sand. (3) The casing seat was selected after an electric log was run to determine the base of the first shale break below subsea depth of 3320 ft., the original oil–water interface. (4) Seven-inch casing was then run to the casing seat and cemented with 150 sacks. An official Railroad Commission test was then made after the cement had been allowed to set for a minimum of 48 hr. (5) After a satisfactory test, the plug was drilled and the 6¼-in. hole was under-reamed from the casing seat to the total depth of the well to 8 in. diameter. (6) The well was then flowed by gas-lift until it was thoroughly cleaned. (7) Cement lined tubing 5½ in. in diameter and equipped with a hookwall packer was run in the hole, and the packer was set as near the bottom of the 7-in. casing as was practical. The well was then ready to receive the water from the filters. A. H. N.

26. Deep Well Completion Involves Water Shutoff. C. C. Pryor. *Petrol. Engr*, August 1944, **15** (12), 57–58.—The completion operations where salt water is encountered in deep discovery wells present very complex problems. The paper describes the completion operations of Cottingham No. 1, McClarn County, Oklahoma, as an illustration of the difficulties encountered, studies made, and remedies adopted. A. H. N.

27. Corrosion in Gas and Condensate Wells in the Katy Field of Texas. F. W. Jessen. *Petrol. Engr*, August 1944, **15** (12), 59. *Paper Presented before National Association of Corrosion Engineers* (*U.S.A.*).—See Abstract No. 1117, (1944). A. H. N.

28. Method of Approach to Determine the Optimum Spacing of Wells. N. Van Wingen. *Petrol. Engr*, August 1944, **15** (12), 67.—The paper represents a summary of findings of a group of engineers and geologists in California who made extensive study of well-spacing problems. The results were presented at a symposium, led by Stanley Herold. The method devised is graphical and is tested.

For the purpose of developing the generalized form of the analysis, the following assumptions were made upon which the method is to be based: (1) The reservoir has been considered to be a homogeneous sand body in which no lenticularity exists. (2) A unit area equal to one square mile has been taken in which the reservoir involved represents mid-flankal conditions, that is, a normal oil zone with a normal saturation of gas. (3) It has been taken that no faulting exists within the unit area of one square mile. (4) Fields with extensive gas caps or those subject to active water drives will require special treatment. By such treatment gas-cap and edge well areas would be developed to some other optimum spacing and should involve the drilling of less wells/unit of area than would be required for the average mid-flankal well.

Any method of determining optimum well spacing involves prediction of the following factors: (1) Determination of the tank oil in place. This implied that initially a wide spacing development programme is to be adhered to in order to delineate accurately the productive limits of the reservoir and to establish the necessary basic characteristics of the producing horizon. (2) Cost of drilling in terms of dollars/foot, or dollars/well. (3) Initial and future production rates. (4) Operating costs, taxes, insurance, and overhead. (5) Future values of oil, gas, and gasoline. (6) Economic life of the well. (7) Determination of a present worth factor to be applied in discounting future earnings. The paper gives a method of plotting curves to determine the optimum spacing of wells. A. H. N.

29. Gun Perforating for Multi-Zone Control in California. T. H. Wallace. *Petrol. Engr*, August 1944, **15** (12), 138. *Paper Presented before Institute of Mining and Metallurgical Engineers.*—By combining gun perforation and a special perforation washing process, good results are obtained in several wells of over 7000 ft. depth with an effective saving of casing, at the same time maintaining the inside diameter of the well equal to or greater than what it would be if larger casing were used and a liner run. The original programme in these wells was to complete a well using 7-in. casing with a 4¾-in. slotted liner landed through the producing zone. As a test, in one well, the 7-in. casing was set through the producing section and gun perforated after making the required water shut-off test. The productive capacity of the well, as nearly as could be determined from sub-surface pressures and other data, was comparable to that of the wells completed in the normal manner. In the next well and subsequent wells, instead of using 7-in. casing, a full string of 5½-in. casing was run and cemented through the producing section and gun perforated. The tubing size was reduced from 2½ in. to 2 in. and the surface pipe reduced from 13⅜ in. to 10¾-in. The hole size was also reduced from 11 in. to 9⅝ in. The reduction in pipe sizes represented a saving of nearly 45 tons of steel/well. No appreciable difference could be noticed between the productive capacity of the wells completed with 5½ in. casing and those completed with 7-in. casing. A. H. N.

30. Importance of Internal Corrosion of Tubing. T. W. Johnson. *Petrol. Engr*, August 1944, **15** (12), 220. *Paper Presented before National Association of Corrosion Engineers.*—A very short paper deals with the main item of the problem. It appears that the rate of internal corrosion might be correlated with the increase in temperature and pressure of the gas, and if this is the case, then with deeper drilling, which would result in wells with high temperatures and pressures, it is reasonable to expect that in the future, operating difficulties and expenses will increase unless some satisfactory solution to the problem of internal corrosion is developed. The problem of internal corrosion of gas condensate wells is certainly a part of the broad field of corrosion of pipe lines, since the tubing and well-head fittings are the first link in the transportation system. A. H. N.

31.* Construction of Log-Log Charts. E. N. Kemler. *Refiner*, August 1944, **23** (8), 296–299.—The use of log-log charts to represent the general equation :

$$\log y = a \log x \pm \log z.$$

is discussed and illustrated. A. H. N.

32.* Application of Unit Operations to Fractionation and Other Vaporization Processes. Part 7. The Utility of Phase Diagrams. R. L. Huntington. *Refiner*, August 1944, **23** (8), 301–304.—Solid diagrams for the P-V-T relationships for water are discussed and their application is illustrated by worked-out examples, one of which is on the amount of gas required to lift water by gas-lift process. A. H. N.

33. Pumping of Wells Dually-Completed. E. Davis and W. C. Sojourner. *Oil Wkly*, 18.8.44, **114** (11), 30.—A new pump designed for dually-completed wells has been working for several months without trouble, pumping now at the rate of 30 barrels from each horizon. This new type pump is operated in the same manner as a conventional working barrel pump, except small bore tubing is used instead of sucker rods. The bottom or lower horizon is produced through this small bore tubing, in this instance $\frac{3}{4}$ in. The other horizon is produced through the annular space between the $\frac{3}{4}$-in. tubing and the 2-in. tubing. The lower working barrel is $1\frac{1}{2}$-in., with blind cages on the cup-type travelling valve. The upper barrel is $1\frac{25}{32}$-in. with a metal-to-metal travelling valve. The standing valve in the lower barrel is within the barrel, and the standing valve, of the right type, in the upper barrel is attached to the tubing. The fluid enters from the tubing through a hollow plunger around a hollow pull rod, and is delivered through the ring-type travelling valve. The packer in the tubing separating the two pays is mounted within a short $1\frac{25}{32}$-in. working barrel with an automatic lock that is tripped when the rods are pulled. The inside packing is a repack with a tension spring, and the pull-rod is of chrome steel which travels through this packing. The outside is packed off by two sets of cups arranged to take care of the pressure, either up or down.

Surface connections require only a small additional amount of equipment, there being but one pumping unit and a single prime mover. Instead of a polish rod, a polish rod-liner is used with a regular liner stuffing-box around the $\frac{3}{4}$-in. tubing. The upper pay is produced in the conventional manner through the 2-in. tubing, and is flowed through the pumping tee into the flow-lines. The lower pay, producing through the $\frac{3}{4}$-in. tubing, necessitates attachment of a hose connection to the upper outlet of the $\frac{3}{4}$-in. tubing, whereby the flow is directed into the other flow-line. The hose is attached to the $\frac{3}{4}$-in. tubing and brought back over the horsehead with sufficient slack to allow bending and connects to the flow-line above the ground near the pitman. This requires a minimum of flexing of the hose. An illustration shows the installation.
A. H. N.

34. Wells Successfully Reconditioned With Explosive-Propelled Marbles. J. G. Burch. *Oil Wkly*, 14.8.44, **114** (11), 31–33.—A new tool, the Burch agate torpedo, is described. It consists of a central container for explosive lined by an annulus full of glass marbles. When the explosive detonates, the marbles blast the surface of the well, disintegrating and cleaning it. An average 350% increase in production is claimed from the use of this tool in cleaning wells. The fundamental principle which governs operation of this device is that it harnesses the explosive used so as to drive solids against the wall of the well as projectiles. The effectiveness of a small column of explosive used to drive projectiles is incomparably greater than that of a larger column of explosive which is unharnessed. The efficiency is not increased, however, by using a larger column of explosive to drive the projectiles, because the latter attain a velocity approximately equal to the speed of detonation of the explosive used, and this is a constant, no matter how large the column. The marbles reach the wall of the well with such high velocity that they penetrate the formation, the distance depending on the nature of the formation and on the size of the marbles. The average depth of penetration of the $\frac{5}{8}$-in. marbles used is 1 in. in hard lime, which is greater than the zone of congested porosity in any well unless porosity has been congested to a greater depth by the misuse of artificial pressuring. Therefore one shot with this torpedo should be sufficient. Penetration of the marbles is equal to that of metallic pellets of equal size. The marbles have a definite superiority, however, over metallic pellets because they disintegrate after penetrating formation, whereas metallic pellets do not. When resistance of the formation checks the speed of the marbles, they dissipate their energy by exploding violently. disintegrating with blasting effect towards the centre of the well-bore with a force greater than that of an equal amount of unharnessed explosive. Because of this characteristic, glass spheres have been found by experimentation and elimination to be the most effective type of projectile. The presence of oil or water does not affect the operation materially.

A. H. N.

35. How to Improve Sucker-Rod Life. E. N. Kemler. *Oil Wkly*, 14.8.44, **114** (11), 42.—The identification of the causes of failure is discussed, with emphasis laid on fatigue failures. These are illustrated photographically, and samples discussed individually. Increasing sucker-rod life by eliminating as many causes of fatigue as possible, by reducing pump size, using different materials or changing speed and stroke of pumping is studied and illustrated by typical examples. A. H. N.

36. Area Map Shading Designed to Show Encroachment of Salt Water. H. A. Hess. *Oil Wkly*, 21.8.44, **114** (12), 36–37.—A method is proposed for showing the extent of water encroachment either by natural or artificial water-drives. By using different colours for different periods, it is possible to show the state of the water encroachment throughout the life of the field. Construction of the initial shading areas can, in most cases, be attained by marking off perpendicular bisectors between adjacent wells and calculating the area to be shaded—or, if a planimeter be available, running over the area with such instrument—so as to give proportional areas for shaded and clear sections of each producing or well unit. When such a map is applied to a field under proration, such as the East Texas field, the percentage of brine shown by the shading is proportioned to the relation between brine and total fluid allowed under regulations, and is not to be construed as indicating that the well of approaching depletion, or has reached the same depletion percentage as is shown for salt water.

A. H. N.

37. How to Figure Pump Size. E. N. Kemler. *Oil Wkly*, 28.8.44, **114** (13), 22.—The selection of pump size which will deliver the necessary rate of fluid with optimum values of stresses on the equipment is discussed, and formulæ and graphs given to illustrate the various conclusions reached. If a pump which is too large is installed, it will get the production, but the use of too large a pump means higher loads in the sucker rods and higher torques in the pumping equipment. If the well is not operated at the proper cycle with the large pump, fluid pounding will develop, which in turn results in severe loading on sucker rods and tubing. The effect of fluid pound is very serious as far as sucker-rod and tubing failures are concerned, and while it is difficult to evaluate how much effect it will have on sucker-rod life, its elimination will in many cases give much longer rod life.

When too small a pump is installed, the available production will not be obtained, or in case of a prorated well, longer pumping hours must be used. When production cannot be obtained with normal pumping hours it may be possible to increase the pumping cycle or stroke. Since tests are generally made to check on the capacity of wells produced, difficulties which result from too small a pump are usually soon corrected in the field. Difficulties from over-pumping, however, are not generally given proper consideration. Two formulæ are discussed for the determination of plunger diameter :

$$(1) \qquad d = \left(\frac{KQ}{126}\right)^{1/4}$$

$$(2) \qquad d = \left(\frac{KQN}{2750eS}\right)^{1/4} = \left(\frac{KQN}{1600}\right)^{1/4}$$

where d = plunger diameter in inches ; K = average weight/ft. of sucker rod string ; Q = production in brl./day ; N = number of strokes/minute ; e = the volumetric efficiency usually taken 70% ; and S = specific gravity of fluid. A. H. N.

38. Determination of Sulphides in Petroleum Waste Waters. R. Pomeroy. *Petrol. Engr*, September 1944, **15** (13), 156/164.—Corrosion of iron, damage to concrete sewers, and tarnishing of brass and paints may occur with waters containing respectively 0·5, 0·2, and 0·1 part per million of sulphides. Control of sulphide content is thus often essential, and proper application depends on application of suitable analytical methods. Results of a study, sponsored by Santa Fe Springs Waste Water Disposal Co., of such methods are given. The test methods recommended are : (1) for total sulphide content (*a*) maximum accuracy is given by the precipitation-titration method, except where concentration is below 1·0 p.p.m. when modification of (*b*) is more accurate ; (*b*) moderate accuracy is given by methylene-blue method, preceded if necessary by precipitation with zinc acetate and sodium carbonate solution to concentrate small quantities or eliminate soluble interfering substances such as iodides ; (2) for dissolved sulphide content, (*c*) for maximum accuracy, remove suspended matter by coagulation with aluminium sulphate and soda solutions, and apply 1 (*a*) or 1 (*b*) ; (*d*) for approximate results, direct application of the antimony colorimetric method, with prior removal of suspended matter if necessary. This is the most generally useful test for petroleum waste waters. (3) for H_2S content, (*e*) for maximum accuracy determine H_2S concentration in an inert gas brought to equilibrium with the sample, (*f*) for approximate results determine dissolved sulphide and pH value and calculate H_2S concentration with the aid of tables provided.

Current methods of determining total sulphide are not adequate where sulphites are also present, and method (*a*) was developed. It involves precipitation of sulphides by addition of zinc acetate and sodium carbonate solutions and determining the total and non-sulphide iodine requirements of measured portions. Method (*b*) depends on the reaction between *p*-aminodimethylaniline, chloride ion, and sulphide in acid solution to produce methylene blue, the concentration of which is determined colorimetrically. Application of the test is limited to concentrations of 20 p.p.m. of sulphides and is affected by presence of considerable copper sulphide, iodide, sulphites, and thiosulphates. Method (*d*) is based on colorimetric determination of antimony sulphide against standard solutions of potassium chloroplatinate, and a correlation chart is presented. To the sample, after removal of suspended matter if necessary, ammonium potassium tartrate solution is added and sufficient diluted acetic acid added to bring final pH value to 8·0 or lower. In this way, only dissolved sulphides are evaluated. The test is not recommended for total sulphides after acidification of the solution.

Precautions to be observed in sampling and testing are described with emphasis on the need to avoid oxidation. R. A. E.

39. Communal Gauge Saves Money and Manpower. R. L. Fowler. *Oil Wkly*, 4.9.44, **115** (1), 33.—One California operator has developed a method that not only gives accurate gauges, but also saves considerable man-power by having the gauge for an entire lease at one central point. Instead of having individual gauge-tanks for each well, which would involve considerable expense, and would necessitate the pumper taking many gauges at several points, this operator uses a simple system comprising two troughs, one weigh-meter, and only one tank. All the lead lines from various wells are brought to one location at the base of a 250-barrel collecting tank. The operation of the gauging system is as follows. All wells except the one being gauged are diverted into the trough leading directly into the collecting tank. All that is necessary to do this is to swing the return bends over the desired trough. The well being gauged is diverted into the trough leading to the weigh meter. The lead lines are placed in order starting from one end of the spacer board to correspond with the well numbers. Therefore it is almost impossible to make a mistake such as is possible in " valving ". A pumper can see at a glance just which well is being gauged. The setup is for fourteen wells. A. H. N.

Development.

40. Efficient Development of Elk Hills Now Under Way. W. A. Sawdon. *Petrol. Engr*, September 1944, **15** (13), 146.—Naval Petroleum Reserve No. 1 at Elk Hills, California, is now being developed. Sufficient wells will be drilled to increase production from 15,000 to 65,000 brl./day. New wells are expected to average 200 brl./day. About a third of the production will come from Standard Oil Company holdings, two-thirds from Navy acreage.

Secondary recovery is contemplated at a later date. Repressuring will be used, with possible water-flooding in some areas.

The well depths average 3000 ft. The two producing zones have high permeability and porosity. Half the wells will be completed in one zone, half in the other, each with a sand spacing of 20 acres.

A gas zone at 1500–2000 ft. is being cased off. The Stevens zone at 5000–9000 ft. underlies the producing zones being developed. Four exploratory wells drilled to this zone are shut in. G. D. H.

41. Mene Grande Operating 12 Rigs in Venezuela Fields. Anon. *Oil Wkly*, 18.9.44, **115** (3), 68.—In the East and West Guara fields completion depths range 6500–7500 ft. in a multiple pay-zone. Initially the wells average about 400 brl./day. 12 rigs are operating in the proved and semi-proved areas of these fields which lie between the Oficina field proper and the Leona field.

A wildcat in the Pando area midway between the Oficina and Areo areas is nearing its completion depth.

Areo, Merey, Yopales, and Socororo are non-shipping fields in the Greater Oficina area. G. D. H.

42. Mercedes Field Has Five Producers but No Outlet. Anon. *Oil Wkly*, 18.9.44, **115** (3), 68.—The Mercedes field in Guarico has five producing wells among seven completions. Production is at 4300–4800 ft. in a thick Oligocene sand. The field is shut in pending greater development and decisions regarding building a pipe-line. G. D. H.

43. Wells Completed in the United States in Week Ended September 16th, 1944. Anon. *Oil Wkly*, 18.9.44, **115** (3), 69.—446 field wells (284 oil-producers and 51 gas-producers) and 91 wildcats (11 oil-producers and two gas-producers) were completed in U.S.A. in the week ended 16th September, 1944.

The results of the completions are summarized by States and districts. G. D. H.

44. Only Two Areas Now Producing in Colombia. Anon. *Oil Wkly*, 25.9.44, **115** (4), 68.—Currently Colombia's production is 54,000 brl./day, from the De Mares and Barco concessions. 40,000 brl./day comes from the De Mares concession (Infantas and La Cira). Petrolia, Tibu and Rio de Oro are the producing fields on the Barco concession. The Casabe field has 20 producing wells which are shut in. Dificil has only 1 producing well. G. D. H.

45. Wells Completed in the United States in Week Ended September 23. Anon. *Oil Wkly*, 25.9.44, **115** (4), 69.—436 field wells (279 producing oil and 68 producing gas) and 60 wildcats (6 producing oil) were completed in U.S.A. in the week ended 23rd September, 1944. The results of completions are summarized by States and districts. G. D. H.

46. Navy's Elk Hills Reserve Tapped to Meet Critical Oil Shortage. E. S. Bunch. *Oil Wkly*, 2.10.44, **115** (5), 36.—By the end of August 14 wells had been completed at Elk Hills, giving over 3000 brl./day. It is aimed to make available 30,000,000 brl. within eighteen months.

The Naval Reserve covers more than 41,000 acres, over nine-tenths of the entire Elk Hills field, from which 167,532,062 brl. had been produced to the beginning of 1944. The recoverable oil remaining in the Reserve is estimated at 500,000,000 brl.

Oil was first discovered at Elk Hills in 1919 at a depth of 253 ft. In 1912, 38,069 acres was established as Naval Petroleum Reserve No. 1.

At the surface are Quaternary sands, gravels, and silts. These rest on the Tulare, which is mainly non-marine shales. The Etchegoin–Jacalitos junction is more than 8000 ft. deep. Generally the Maricopa underlies the Etchegoin unconformably. The structure is an anticline. A closed dome occurs in the eastern area, and four north-east-trending faults with displacements of 50–200 ft. Wells drilled in the fault-zone have generally obtained little or no oil. In the eastern area there is 35–40 ft. of solid sand in the 100–200 ft. of productive zone. The main production is 2750–3500 ft. deep. The oil is of asphalt base. Progressive water encroachment occurs.

In the western area the oil is of higher A.P.I. gravity. Large gas and condensate wells have been completed at depths of 1800–3500 ft. in a shale-sand oil-zone.

The history of the field and Reserve is given, and production data, a stratum contour map, and a cross-section are included. G. D. H.

47. Survey Says Ample Oil Reserves for Centuries. Anon. *Oil Wkly*, 2.10.44, **115** (5), 57.—Present reserves are estimated at 20,000 million brl. in U.S.A., but the known oil in the ground is nearer 100,000 million brl., much of it being capable of production by some new method if higher prices obtained.

The world's undiscovered reserves are probably equal to, and possibly several times as great as, to-day's known reserves. When prices warrant the trouble, these reserves will be discovered. No country has had all its possibilities explored, not even U.S.A. There are promising areas in an arc from Trinidad to Argentina, in Western Canada, Alaska, the Middle East, Russia, and the East Indies. G. D. H.

48. China Reserves Estimated at 1,843,000,000 Barrels. Anon. *Oil Wkly*, 2.10.44, **115** (5), 68.—The Lanchow field of Kansu province, China, has proven reserves of 1,843,000,000 brl. The current production is about 3000 brl./day, but the potential is much higher. Lack of equipment and transport facilities has all but stopped development. G. D. H.

49. Wells Completed in United States in Week Ended September 30, 1944. Anon. *Oil Wkly*, 2.10.44, **115** (5), 71.—383 field wells and 86 wildcats were completed in U.S.A. in the week ended 30th September, 1944. 261 of the former and 12 of the latter found oil or distillate, and 44 of the former and three of the latter found gas.

The completion results are summarized by States and districts for the above week. G. D. H.

50.* Norman Wells Now Second Largest Field in Canada. Anon. *Oil Gas J.*, 7.10.44, **43** (22), 51.—Norman Wells is now producing 2200–3700 brl. of oil/day. Turner Valley's production is 23,000 brl./day and the rest of Alberta gives 1400 brl./day.

Crude oil deliveries to the Whitehorse refinery began in May and are 3500–4000 brl./day. Norman Wells has more than 50 producing wells, and its potential production is believed to be twice the current pipe-line runs.

During the first seven months of 1944 Norman Wells produced 638,168 brl. of oil, compared with 106,003 brl. in the same period of 1943. In June 1944 the production was 111,124 brl., and in July 68,384 brl. G. D. H.

51.* Secret British Field Yielding 1800 brl. Daily. Anon. *Oil Gas J.*, 7.10.44, **43** (22), 51.—Great Britain is producing 700,000 brl. a year. There are 238 wells in the oil field. A total of 2,100,000 brl. has been produced.

In 1938 Britain imported 113,600,000 brl. of oil. G. D. H.

52.* Venezuelan Oil Output Rises to All-Time Record. Anon. *Oil Gas J.*, 7.10.44, **43** (22), 51.—The Venezuelan oil production is nearing 900,000 brl./day, compared with 600,000–650,000 brl./day earlier this year.

38 exploration parties are operating in Colombia, including the Oriente region.

Exploration is being considered by Shell in the Madre de Dios region, Peru, east of the Andes. A wildcat location has been tentatively chosen near the Orellava river, 50 ml. from Contamana.

In the first quarter of 1944 Ecuador produced 638,916 brl. of oil, a little more than in the same period of 1943. G. D. H.

53. Colombian Oil Production Shows Gain During July. Anon. *Oil Wkly*, 9.10.44, **115** (6), 70.—During July the Colombian production was as follows: Infantas, 292,226 brl.; La Cira, 1,324,711 brl.; Petrolea, 350,522 brl.; Tibu, 86,675 brl. The total was 130,896 brl. more than in June. G. D. H.

54. 27 of 51 Wells Planned in Mulata Field Completed. Anon. *Oil Wkly*, 9.10.44, **115** (6), 70.—At the beginning of September, Mulata had 63 flowing wells, 3 gas wells, 4 dry holes, and 2 abandoned wells. The daily average production in August was 22,500 brl. 27 of the 51 wells planned for 1944 have been completed. G. D. H.

55. Wells Completed in the United States in Week Ended 7th October. Anon. *Oil Wkly*, 9.10.44, **115** (6), 73.—311 oil-wells and 28 gas-wells were among the 429 field completions in U.S.A. in the week ended 7th October, 1944. The 88 wildcat completions included 15 oil-wells and 4 gas-wells. A table summarizes the completions in the above week by States and districts. G. D. H.

Transport and Storage.

56.* The Refiner's Notebook—No. 10: Strapping of Tanks. W. L. Nelson. *Oil Gas J.*, 23.9.44, **43** (20), 293.—The capacity of refinery movement tanks can be strapped and/or computed with sufficient accuracy by the method given, but marketing tanks, spheres, and tanks with floating roofs or tanks of freak design should be calibrated by a professional firm. The A.P.I. Code 25 and the Instruction for Measuring, Sampling, and the Testing of Petroleum Shipments of the Standard Inspection Laboratory of the Standard Development Co. give details of the procedure.

Horizontal cylindrical tanks of the form bumped heads, dished or basket heads, and dome ends are described, and the measurements to be taken in the various cases and the method of calculation are given. Equations are given for calculating the volume (1) of the cylindrical portion; (2) the two regular heads; (3) the two hemisphere heads; in gallons and barrels per inch.

Two tabulations are given: (1) for gauging cylindrical tanks—horizontal cylindrical portions only; (2) for gauging the bumped ends of horizontal cylindrical tanks (radius of heads equal to diameter of cylindrical portion).

These are based on the percentages of diameter and percentages of full capacity. Up to half of the diameter the tables are used as per cent. full, and past half-full are used as per cent. empty. The procedure for compiling the capacity tables from the data obtained is explained.

Strappings of regular vertical tanks are taken at each ring of the plates and corrections must be made for all rivets, coils, supports, base plates, etc., in their vertical positions. Volumes are computed by the equations given. W. H. C.

57.* Capacity Charts for Horizontal Cylindrical Tanks. L. T. Monson. *Oil Gas J.*, 7.10.44, **43** (22), 82.—A reproduction is given of charts for determining the capacity of horizontal cylindrical tanks, whose lengths are 60 ft. or less, and whose diameters are between 3 ft. and 20 ft. They are not suitable for tanks having dished, conical, or other shaped ends. The total capacity of any contained volume, in gallons or barrels, may be easily ascertained by the procedure described. The charts can be used to calibrate gauging scales for the tanks described by reversing the procedure. Large-scale charts may be obtained, free of cost, on application to the author at the address given. W. H. C.

58.* The Refiner's Notebook. No. 12. Heating Coils for Tanks. W. L. Nelson. *Oil Gas J.*, 7.10.44, **43** (22), 103.—The mechanism of heating and heat losses in an uninsulated tank are discussed, and the factors to be considered in computing the amount of heating surface required are described.

Three charts are given from which data on heating tanks can be obtained. They are based on standard tank capacities and differences of oil and air temperatures (0–150° F.) and relate steam (exhaust) heating surface required in square feet to hours required to heat tank containing : (1) high pour-test distillate, gas oil, light crude, or light lubricating oil ; (2) high pour-test oils or viscous lubricating oils ; (3) semi-solids—heavy fuel oil, residuums, and very heavy asphaltic crude oils, but not asphalts or waxes.

Factors for use when steam, other than exhaust steam, is used are : for 31 p.s.i., at 260° F. × 0·67 ; for 63 p.s.i. at 310° F. × 0·5 ; for 138 p.s.i. at 360° F. × 0·33.

Three examples explain the procedure for using the charts. W. H. C.

REFINERY OPERATIONS.

Refineries and Auxiliary Refinery Plant.

59.* Alkylation-Unit Pumping. I. Taylor. *Refiner*, August 1944, **23** (8), 283–289.—The elements of the alkylation processes are briefly described in so far as they tend to explain the functions and limitations they impose on the pumps. The chief point discussed is the packing problem. Single mechanical seals are recommended as the best solution to the packing-box problem for the majority of the pumps in the fractionation section of alkylation units. For the two or three pumps in this section which have the higher temperatures, single seals could also be used instead of packing if desired. To do this, a small side stream should be taken from the pump discharge, piped through a small cooler and filter, and connected into the packing-box, whence it will flow back into the pump past the throat bushing, thus keeping the seal cool. The reasons for choosing a single mechanical seal are detailed.

For the centrifugal pumps which are to handle either concentrated acids or hydrocarbons which contain a trace of acid, it is advisable, and frequently essential, that some flushing oil be injected into the pump through the throat bushing to keep the acid from entering the packing box. A small amount of contamination takes place, of course, but this is seldom of any concern in the reactor section of an alkylation unit. Having prevented corrosion, either packing or double seals can be used in these pumps.

For propeller-type pump packing boxes, a flushing oil is again the first requirement, to keep the acid out of the box. *iso*Butane is usually chosen to flush the throat bushing, since it is available under sufficient pressure and is not a contaminator, it being one of the hydrocarbons charged into the reactor. Double mechanical seals are recommended for the packing boxes, because with all their “ trimmings and trappings ” they are a lesser evil than packing for these pumps. Packing has been, and still is, being tried in some of these large cold-acid pumps with only partial success. It is necessary to adjust the pressures of the flushing oil and the seal oil used for lubrication (in lantern rings) very carefully to obtain satisfactory packing life. Also it is advisable that the pump be built with a special device to permit occasional re-packing without emptying the pump of the acid mixture. To do this some means must be provided of closing off tightly a clearance between the shaft and the casing, the joint being located in the vicinity of the throat bushing. A. H. N.

60.* Maintenance of Electric Equipment Begins with Design. R. M. Hamilton. *Refiner*, August 1944, **23** (8), 292–295.—Experience in designing electrical installations in the Gulf Coast is the background for this article. While the climatic conditions of this area are not typical of all refining centres there are some with heat and humidity conditions so nearly identical that recommendations here presented will apply uniformly. Where weather conditions are more favourable, the engineer can make required allowances. The author holds to the conviction that the most advantageous time for providing for maintenance of electrical equipment is when a plant is being designed. His recommendations and observations are offered as a guide under conditions with which he is most familiar.

Process hazards are determined by the extent of refining operations. Among the injurious elements and conditions commonly found are: (1) Excessive heat from process operations. (2) Abrasive dusts. (3) Conductive dusts and fumes. (4) Corrosive gases and fumes. (5) Mechanical injuries. (6) Stray oil. Other hazards resulting from design, growth, operation or a combination of these are: (1) Improper voltage. (2) Faulty lubrication. (3) Poor plant lay-out. (4) Inadequate fault protection. Each hazard is discussed. A. H. N.

61.* Processing of West Texas Sour Crudes at Shell's Wood River Refinery. L. R. Gray. *Oil Gas J.*, 7.10.44, **43** (22), 73.—A description is given of the 35 000-brl./day topping unit for processing West Texas sour crudes, the products obtained, and the anti-corrosive measures adopted. The steam-refined light gasoline and naphthas are scrubbed with NaOH at the unit, and NH_3 is admitted into the vapour lines, so that the accumulator water is maintained at pH 8·4. The consumption of chemicals is 0·2 lb./brl. NaOH and 0·04 lb./brl. NH_3.

Data are given and discussed in respect of operating temperature, sizes and dimensions, composition of constructional materials, corrosion allowance, corrosion rate per year, under the following sections: Columns, Heater tubes, Heat exchange equipment, Process piping, Heavy oil furnaces and lines, Light oil furnaces and lines, Coking furnaces, and lines, Vessels, Process lines, Pumps and Storage tanks.

The paper also briefly describes the 18,000-brl./day once-through cracking and continuous coking unit. In this unit 0·4–0·5 lb./brl. of lime is injected into the unit to reduce corrosion. The procedure of forming the lime-reduced crude slurry, and its measurement, are described. It is noted that lime has little effect where it does not actually contact the metal.

Four tables show the corrosion rates, in 1/64th inches/year, for the different sections and materials covered, and the relative corrosion rates and relative costs of alloys are discussed. The ratios, corrosion without lime : corrosion with lime for heavy oil furnaces and lines are also shown. W. H. C.

62.* Practical Refinery Engineering. No. 15. Fouling Resistances. P. Buthod and B. W. Whiteley. *Oil Gas J.*, 7.10.44, **43** (22), 84.—Fouling of heat-exchanger surfaces and the resulting loss in heat transfer is discussed. Deposition from the liquids travelling through the system will result in a layer of substances which may act as a heat-insulating material, and also affect the velocity distribution near the film boundary, thus increasing the thickness of the fluid film at the heat-exchanging surfaces. In calculating the heat-transfer rate, fouling resistances for both sides of the exchanger surfaces should be added to the fluid film and metal wall resistances. The fouling resistances for different types of operation and typical fluids, handled in a refinery, as adopted by the Heat Exchange Institute, are given in a table. An example and its solution is shown. A plot, per cent. heat transferred in terms of clean coefficient/clean coefficient, for varying degrees of fouling, shows the importance of fouling conditions. W. H. C.

63.* Practical Refinery Engineering. No. 16. Economic Approach Temperature. P. Buthod and B. W. Whiteley. *Oil Gas J.*, 14.10.44, **43** (23), 110.—In heat exchange between hot and cold streams as the two streams approach the same temperature level the required amount of heat-exchange surface rapidly approaches infinity. In heat-exchange notation the least temperature difference between the two streams is called the approach temperature.

In evaluating the economic approach temperature the factors to be considered are: (1) the saving resulting from the utilization of waste heat; (2) the investment costs in the heat exchange system expressed in terms of depreciation rate and interest on investment, and (3) operating costs incurred by the heat exchange system.

The economic approach temperature can be determined by calculating the heat transfer rate at a series of approach temperatures and computing the net profit from the heat exchange for each of these conditions.

A graphical plot for the purpose is described and illustrated by an example and its solution. From such a plot the economic approach temperature and the number of exchangers required for this approach can be easily read. W. H. C.

Distillation.

64. Fractional Distillation. J. W. J. Fay. *Progress of Chemistry Annual Report for 1943*, p. 216.—An extensive and critical review of the literature is given which covers the apparatus required and application to problems of atmospheric pressure, normal distillation, azeotropic distillation, vacuum and molecular distillation. An extensive bibliography of 78 references is given of the original papers on which the article is based. The methods of determining the number of theoretical plates are described, and the factors governing the selection of a particular type of fractionating column for a specific purpose are discussed. Comparative data on the efficiency of 19 different types of packing are given, which includes values for the H.E.T.P., static, and dynamic hold-ups and hold-up factors. In the section on azeotropic distillation numerous references are given to the application of this process to the separation of hydrocarbons. J. W. H.

65.* Molecular Distillation. T. R. Olive. *Chem. Metall. Engng*, August 1944, **51** (8), 100–104.—The necessity for molecular distillation of high-boiling material and the principles governing such distillation are given. After reviewing early laboratory stills and indicating their limitations, a centrifugal disc still which is capable of technical scale manufacture and use is described. The basic idea is that a very thin film is produced by dropping the charge from a pipe on to the centre of a conical disc revolving at high speed. The charge is rapidly spread out in a thin, uniform film which is heated under high vacuum by contact with the disc. The distillate is condensed on a condenser bank of tubes not far from the disc, whilst the residue is scooped by a pipe from the rim of the revolving disc. The first unit built to employ the centrifugal principle had a 7-in.-diameter rotor, while later models were built with 32-in. and 14-in.-diameter rotors, designed to operate at speeds up to 5000 r.p.m. In the later types the smaller machines are mounted vertically, and the larger horizontally, or substantially so, with just enough departure from rectilinear mounting to secure good condenser drainage. In each type the still consists of a dome enclosing the rotor, condenser, feed, and discharge connections. An air-cooled glass bell serves for the smaller type, and a metal dome with sight-glasses and welded-on water cooling pipes for the larger. The glass condenser of the smaller is generally supplemented by a water-cooled pipe-coil of beehive shape placed opposite the rotor face and within the glass bell. In both types the residue discharged from the rotor is collected in a gutter spun on the edge of the disc, from which it discharges through a velocity-head pick-up tube. Both types employ an over-sized diffusion pump of the multistage condensation type, directly connected to the still backing plate behind the rotor. The possibility of fractionation is discussed. A. H. N.

Solvent Extraction.

66. Patent on Solvent Extraction. H. J. Hibshman (Standard Oil Development Co., Delaware). U.S.P. 2,344,406, 14.3.44. Appl. 16.7.42.—In a process for refining a petroleum lubricating-oil fraction, the oil is extracted with a mixture consisting of 70–74% by volume of phenol and 26–30% by volume of water, at a temperature between 300° and 450° F. and at a pressure sufficient to maintain the contacting materials in liquid phase. The extract thus formed is washed with sufficient water, containing only small amounts of phenol, to produce, after separation of the oil from it, a mixture of phenol and water containing 40–60% by volume of water. It is then cooled to ordinary temperatures to cause separation of the phases, and the predominantly phenolic phase is returned to the original extraction zone. H. B. M.

Cracking.

67. Patents on Cracking. O. L. Roberts (Atlantic Refining Co.). U.S.P. 2,343,927, 14.3.44. Appl. 11.3.40.—Hydrocarbons of high boiling point are converted into those of lower boiling point by heating them to a temperature between 850° and 1000° F. in the presence of an incombustible, solid adsorbent catalyst and from 0·3% to 1·5% by weight of sulphur dioxide. A fraction boiling within the gasoline range is separated from the resulting conversion products.

E. D. Reeves and P. H. Holt (Standard Oil Development Co., Delaware). U.S.P. 2,344,900, 21.3.44. Appl. 2.4.42. In a process for converting hydrocarbons, heated vapours are mixed with finely divided catalyst particles which have from 0·5% to 1% of carbonaceous deposit on them from a previous regeneration. The suspension is passed through a conversion zone, and during this process the catalyst particles have deposited on them between 0·1% and 2% of carbonaceous material. Afterwards the catalyst is separated from products of conversion.

K. J. Korpi (The Texas Co.). U.S.P. 2,345,128, 28.3.44. Appl. 7.8.42. In a process for the production of gasoline, a feed-oil of higher boiling point is passed to a catalytic reaction zone and subjected to the action of a catalyst in solid granular form at a high temperature. In this way a substantial amount of the oil is converted into gasoline hydrocarbons. A cracked hydrocarbon mixture containing gasoline hydrocarbons and hydrocarbons boiling higher than gasoline is obtained from the reaction, also partly spent catalyst which has been in contact with the feed-oil for not more than 5 minutes between reactivations. Gasoline hydrocarbons are separated from the reaction mixture, and are separately subjected to the action of the partly spent catalyst, without intervening reactivation and without substantial cooling of the catalyst. Conditions are less drastic than in the original cracking zone, and substantial reforming of gasoline hydrocarbons is achieved.

L. de Florez and J. W. Gray (Gasoline Products Co.). U.S.P. 2,345,558, 4.4.44. Appl. 8.4.41. In a process for cracking hydrocarbon oils a condensate stock is passed through a heating coil in a heating zone. Fuel is burned to generate heat in this zone and to subject the oil stream to a high cracking temperature. The heated oil is discharged from the zone and passed through a confined passage-way in a cooling zone to effect reduction in temperature. A black oil stock is introduced into the cooled stream, and the mixture is passed in a confined passage-way with successive changes in the direction of flow to produce a homogeneous material. This is passed through a subsequent heating coil and generated heat is applied to effect further cracking.

G. B. Zimmerman (Universal Oil Products Co.). U.S.P. 2,345,785, 4.4.44. Appl. 13.12.39. Hydrocarbons are subjected to endothermic catalytic conversion in a first reaction zone, and at the same time, in another reaction zone, catalyst is subjected to exothermic regeneration to remove carbonaceous matter. Vaporous products from the first zone are fractionated to condense and separate heavier fractions. The resulting reflux condensate is heated to cracking temperature and passed in indirect heat exchange with the hydrocarbons in the first reaction zone to supply heat for the endothermic conversion therein. Afterwards the reflux condensate is cracked and vaporous products are fractionated to condense the heavier fractions. The resultant thermal reflux condensate is passed in indirect heat exchange with the catalyst undergoing regeneration in the other reaction zone to absorb heat of the burning operation.

W. Kroenig (Standard Catalytic Co.). U.S.P. 2,345,877, 4.4.44, Appl. 14.2.40. A process is described for converting a hydrocarbon oil containing asphalt into pitch and a normally liquid hydrocarbon product. The initial material is heated to a temperature between 400° and 470° C. under a pressure between 2 and 50 atmospheres, at such a rate that the time of heating from about 350° C. to the desired maximum is ½ to 3 min. The pressure is released, and the heated material is passed into a vessel where a hot scavenging gas maintains the temperature of the material, which can then be separated into pitch and vaporous products. Total heating time is so controlled as to cause cracking of a substantial part of the constituents boiling above 325° C. *in vacuo* to products boiling between 325° C. under atmospheric pressure and 325° C. *in vacuo* without substantial increase in constituents boiling below 325° C. under atmospheric pressure. Pitch and vaporous products are withdrawn separately after the reaction.

H. R. Warrick (The Texas Co.). U.S.P. 2,345,995, 4.4.44. Appl. 22.11.41. In a hydrocarbon conversion process, the oils are catalytically cracked in the presence of a catalyst to effect conversion into lower-boiling hydrocarbons. Higher-boiling constituents are separated from the cracking products and subjected to thermal cracking. Resultant products of thermal cracking are fractionated to separate a lighter fraction, which is afterwards isomerized in the presence of partly spent catalytic material previously used in catalytic cracking.

D. F. Babcock, A. W. Larchar (E. I. du Pont de Nemours and Co.). U.S.P. 2,346,642, 18.4.44. Appl. 30.12.37. To produce ethylene and aromatic hydrocarbons, higher-boiling tarry materials are first removed from a normally liquid hydrocarbon fraction, which is then cracked at temperatures between 650° and 750° C. Heavy oils and tarry constituents are removed from the cracked products, and afterwards unconverted raw material and materials in approximately the same boiling range are separated, also a light aromatic distillate fraction, and finally cracked gaseous products. The cracked gaseous products are separated into the following fractions: a fraction containing hydrogen and methane, a second containing ethylene, a third containing the aromatic hydrocarbons, a fourth containing predominantly ethane and C_3 and C_4 hydrocarbons, a fifth consisting of a mixture of C_4, C_5, C_6 and C_7 aliphatic hydrocarbons. The fourth fraction is cracked at a higher temperature, and additional ethylene and aromatic hydrocarbons are recovered. The fifth fraction is returned to the first cracking zone, together with the unconverted raw material and constituents boiling in approximately the same range.

J. G. Alther (Universal Oil Products). U.S.P. 2,346,652, 18.4.44. Appl. 16.8.41. In the catalytic conversion of hydrocarbons a refractory liquid is passed through the catalyst bed. The liquid comprises a halogenated polynuclear compound.

J. E. Guyer (Phillips Petroleum Co.). U.S.P. 2,346,750, 18.4.44. Appl. 14.4.41. To reactivate solid catalysts employed in the conversion of hydrocarbons, a portion of a gas is passed into contact with them to remove hydrocarbon vapours. Another portion of the gas is mixed with oxygen-containing combustion products to produce a mixture of suitable reduced oxygen content. The mixture is then passed into contact with the catalyst to remove carbonaceous material by combustion and gasification. The gas used is generated by burning fuel gas in an atmosphere of combustion products having not more than 10% of oxygen. The proportions of fuel and combustion products are so adjusted as to produce a gas containing carbon dioxide but being substantially free of oxygen and carbon monoxide. H. B. M.

Alkylation.

68. Reactions Catalyzed by Hydrogen Fluoride. F. S. Spring. *Progress of Chemistry Annual Report for 1943*, p. 105.—In the organic chemistry section, a sub-section is devoted to reactions catalyzed by hydrogen fluoride the majority of these reactions being the alkylation of hydrocarbons. The reaction of benzene with propylene, *iso*butene, *cyclo*hexene, and *cyclo*propane is shown to result in the formation of *iso*propylbenzene, di*iso*propylbenzene, tetra*iso*propylbenzene, *tert.*-butylbenzene, di-*tert.*-butylbenzene, *cyclo*hexylbenzene, and *n*-propylbenzene. The alkylation of naphthalene with propylene yields tetra*iso*propylnaphthalene, and *m*-xylene with *tert.*-butyl alcohol forms *tert.*-butyl-*m*-xylene; in a similar manner naphthalene and phenanthrene form a *tert.*-butyl compound. J. W. H.

69. H. F. Alkylation Unit Placed on Stream in Record Time. J. H. Kunkel. *Petrol. Engr*, September 1944, **15** (13), 80/94.—A description is given of the new Socony-Vacuum H.F. alkylation unit at Paulsboro, New Jersey, and also of the break-in run preparations that made possible the record on stream time of 7 hrs. The operation and construction of evacuation system, feed salt driers and dehydrators, and the dehydrator regeneration system, acid contractor and its refrigeration system, acid settler, acid regenerator, acid stripper, and the hydrocarbon distillation section are described and illustrated. The acid area has its own closed water system, to avoid risk of contaminating the main refinery cooling water supply. Driocel is used in the feed dehydrators, and bauxite treaters are used to remove organic fluorides from the de-*iso*butaniser bottoms in the distillation section. Typical analyses are provided of charge stock, *iso*butane recycle, contactor charge, hydrofluoric acid, light and heavy alkylate, with details of acid circulation and hydrocarbon ratios in the contactor.

Four men with previous gas-plant experience were selected and given theoretical and practical training in the operation of alkylation units before proceeding to Paulsboro to prepare the plant for placing on stream. The break-in run was achieved with the use of *iso*butane only, instead of the mixed feed, and occupied 6 days. The plant was first evacuated, and the order in which sections were brought into operation, together with precise details of each step of the operation, are given. The break-in run enabled production of alkylate to be achieved 9 hrs. after introduction of acid into the system, and 7 hrs. after commencement of charging B-B fractions to the unit.

R. A. E.

70. Patents on Alkylation. F. H. Bruner, L. A. Clarke, and R. L. Sawyer (The Texas Co.). U.S.P. 2,345,095, 28.3.44. Appl. 4.5.39. In the alkylation of hydrocarbons, an *iso*paraffin is reacted with an olefin in the presence of a liquid catalyst composed of water saturated with boron trifluoride.

P. Lobdell and G. L. Mateer (Standard Oil Development Co., Ohio). U.S.P. 2,346,770, 18.4.44. Appl. 27.2.39. In the production of normally liquid, saturated branched-chain hydrocarbons in the gasoline range by reacting a paraffin mixture containing *iso*paraffin and normal paraffins with a mono-olefin, the following improvement is incorporated. From the reacted mixture a fraction is separated which comprises essentially unreacted *iso*paraffin and any lighter hydrocarbons formed. Afterwards there is separated from the resulting residual reacted mixture a fraction consisting essentially of normal paraffin. At least part of the *iso*paraffin from the first separated fraction is passed to the alkylation zone.

H. B. M.

Chemical and Physical Refining.

71.* Clays in the Petroleum Industry. Anon. *Petroleum,* September 1944, 7 (9), 164/165.—The composition and the factors which control the properties of the various types of clay are illustrated and discussed. The principal types which are of interest in petroleum refining are fuller's earth and bentonite. The methods adopted in the preparation of the unactivated fuller's earth and of the activated earths of both types are briefly described. To determine the efficiency of an earth it is generally considered necessary to make a practical trial with the actual oil requiring treatment, since the order of efficiency of earths often vary with different products. Normally, contact treatment is employed for decolorizing gasoline and kerosine, but heavier fractions, such as lubricating oils, may be treated by contact or percolation methods. Activated earths are suitable only for contact treatment. Some operational hints are provided.

Reference is also made to other uses of bentonite clays in the petroleum industry—*e.g.*, preparation of drilling muds, emulsions of the asphalt type. Brief reference is given to applications of bauxite.

R. A. E.

72.* Iron Oxide *Versus* Liquid Treating for Purifying Natural Gas. C. F. Turner. *Oil Gas J.*, 23.9.44, **43** (20), 191.—Two processes are used by the East Ohio Gas Co. for the removal of H_2S from the natural gases produced from different strata beds. The production gases from the Newburgh sand contain 10 grains of H_2S per 100 cu. ft., and are purified by passing through iron oxide. The gases from the Oriskany sand contains 220 grains of H_2S per 100 cu. ft., and are treated by the Girbotol process. The Oxide method employs Fe_2O_3 or $Fe_2(OH)_3$ supported on soft-wood shavings, hard-wood chips, pumice stone, or slag, to provide an easier flow of the gases through the mixture than if the oxide alone were used. Soft pine-shavings are preferred, as they curl well and when moist the oxide adheres well.

The contacting mixture is prepared by taking 25 lb. of the oxide to a bushel of shavings; these are dry mixed, using tinned scoops, and then sprinkled with water until thoroughly wetted, but with no excess of water. The purification train, connections, and by-passes are described and illustrated. Each of the two rows of four tanks (15 × 4 ft.) is filled with about 90 bushels of the mixture, this occupying about 10 ft. of the tank. The gas is passed through the series in parallel at 325 p.s.i. until the gas from the second tank stains a lead acetate paper; the first box is then cut out for regenerating the oxide. When this is refilled, it is connected in the series as the last in the line, in this way the position of each tank is rotated and the fresh charge is always the last in the series. The procedure of cleaning the spent tank is described.

The spent material is regenerated by exposure to air, keeping it moist, to avoid combustion, and turning it over once a day. Usually 3 days are sufficient for its regeneration. The life period of the mixture is about 10–12 regenerations, and a slightly alkaline condition (pH 10·5–11) and a temperature of 50° F. are best maintained for purifying.

When purifying 15,000,000 cu. ft. (at N.T.P.) a day, the velocity of the gas through the mixture is 8 linear ft. per sec. The spent material for regeneration is about 125 bushels per day.

Purification of gases in the Girbotol plant is briefly described and the advantages of both methods are given and discussed. The oxide method is less flexible and unsuitable for high H_2S concentrations, but requires less facilities and control, while the by-product spent oxide presents difficulties in disposal in inhabited areas.

W. H. C.

72*a*. Patents on Chemical and Physical Refining. J. R. Schonberg (Standard Oil Development Co., Delaware). U.S.P. 2,344,418, 14.3.44. Appl. 5.10.44. Undesirable sulphur compounds are removed from petroleum oils boiling in the motor-fuel range by treating the oil at a temperature above 65° F. with a mixture of sulphuric acid and a liquefied saturated normally gaseous hydrocarbon. The treatment is carried out under conditions designed to vaporize the liquefied hydrocarbon throughout the mass and to remove the heat of reaction as it is formed. In this way excessive polymerization and side reactions are prevented.

E. R. Birkhimer (The Atlantic Refining Company). U.S.P. 2,345,449, 28.3.44. Appl. 29.3.41. Hydrocarbon oils are desulphurized by contacting them with an aqueous solution containing 35–50% of an alkali-metal hydroxide and 2–10% of a water-soluble organic solvent. After contact the solution is separated from the oil.

B. Morris. U.S.P. 2,346,042, 4.4.44. Appl. 7.7.41. A lubricating-oil reclaimer consists of an inner and an outer casing. The two casings are spaced to provide an encircling drip-chamber. An oil inlet communicates with the inner chamber at the base, and there is filtering material in this chamber. One or more discharge points are incorporated at the top of the inner chamber, and a heating element at least partly encircles this chamber. Filtered oil passes out at the discharge point and drips on to the heating element and on to an oil-return fitted to the outer casing.

W. B. Shanley (Universal Oil Products). U.S.P. 2,346,401, 11.4.44. Appl. 30.6.41. Gasoline-containing vapours are refined by continuously passing a stream of them through a bed of adsorbent refining agent. As the activity of the agent decreases, the temperature is increased by adding to the vapour stream a hydrocarbon oil heavier than gasoline, and heated to a higher temperature than the initial vapours.

H. B. M.

Special Processes.

73.* The Obtaining of Aldehydes by the Oxidation of By-Products of the Synthetic Rubber Industry. I. Cold-Flame Oxidation of "S.K." Motor Fuel. E. A. Andreev, V. I. Avramenko, M. N. Mikhailova, and F. Men'shikov. *J. Appl. Chem.* (*U.S.S.R.*), 1943, **16** (9–10), 356–364.—Cold-flame oxidation is oxidation at low temperatures and accompanied by the emission of light. The feed was "S.K." motor fuel, a by-product of the synthetic rubber industry having sp. gr. 0·754, an oxygen content of 6·9% and approximately 30% of dienes (C_6H_{10}). The optimum conditions for oxidation are a reaction chamber temperature of 400–420° C. and an air-flow of about 12% of that required for complete combustion. By means of condensers and scrubbers, a 96% recovery of the aldehydes formed may be obtained; the overall yield of aldehydes on the feed is 6·1–9·6%. The larger portion of the aldehyde mixture is a suitable agricultural disinfectant, the production of which was the primary purpose of the investigation. Flow-sheet and operating conditions of the pilot plant used are given.

V. B.

74.* Synthetic Toluol From Petroleum by Hydro-forming Process. H. G. M. Fischer and A. B. Welty, Jr. *Chem. Metall. Engng*, August 1944, **51** (8), 92–95.—Brief statistical data for the production of toluol in the U.S. are given, followed by a short discussion of the development and principle of the hydro-forming process. The dehydrogenation of naphthenes to give aromatics in the presence of recirculated hydrogen, over a catalyst constitutes, in principle, the process. Methyl*cyclo*hexane gives high yields of toluol, and its content in the charge-stocks can be used approximately to calculate the capacity of the charge to produce toluol. The development of the research to increase the production of toluol is described, together with typical data discussed in some detail. A. H. N.

75.* Recent Advances in Manufacture of Synthetic Lubricants from Kogasin. F. Fischer, H. Koch, and K. Wiedeking. Translated by E. J. Barth. *Refiner*, August 1944, **23** (8), 312–316.—It is shown that the temperature susceptibility of viscosity of the lubricants made with xylol and chlorinated kogasin can be greatly improved by increasing the contents of paraffinic raw material used in the condensation. Lubricating oils were prepared by treating a mono- or dichloro-kogasin with activated aluminium metal without the use of aromatic hydrocarbons. These oils show a high viscosity index, and are therefore classified, and belong to the typical paraffin-base lubricants. Lubricants were also prepared by straight polymerization using aluminium chloride, and one synthetic benzene containing appreciable quantities of olefinic material. The viscosity index of these oils depends considerably on the boiling point of the original fraction used in the polymerization, and when a kogasin fraction boiling point 200–250° C. is used, the resultant oil will show a viscosity index typical of paraffinic-base lubricating oils. The remaining properties of lubricants prepared by various procedures from kogasin are also shown. Judging the synthetic oils according to their stability against oxidation, carbon-residue, and pour-point, it is seen that all these synthetic oils compare favourably with products manufactured from crude petroleum. A. H. N.

76.* Plan to Build Synthetic Oil Plant at Hugoton. Anon. *Nat. Petrol. News*, 20.9.44, **36** (38), 56.—Winckler-Koch Engineering Co. intend to build a Fischer–Tropsch plant to synthesize gasoline from natural gas in the Hugoton field, Oklahoma–Kansas. Leases have been acquired on 150,000 acres of proven and semi-proven land in the field, and drilling to supply the plant is to start in the near future. Previously gasoline could not be produced by the process economically; but research had shown marked improvements possible in the process, and after the war German improvements may be available. The likelihood of production of chemical by-products should not be ignored. Germany had used the Fischer–Tropsch catalytic process for supplying gasoline and lubricating oils, obtaining the necessary carbon monoxide and hydrogen by reacting coke with superheated steam. Methane is also a suitable starting material. Variations in plant conditions could result in production of alcohols, ethers, and aldehydes. G. A. C.

77. Chloral and D.D.T. Manufacture. Anon. *Chem. Tr. J.*, 8.12.44, **115**, 597.—A description is given of the Brothman Continuous process for the manufacture of Chloral and D.D.T. based on a commercial unit designed to produce 200,000 lb. D.D.T. per month. The plant is estimated to cost $211,000, of which $27,000 represents the equipment for the Chloral Unit and $28,000 for the D.D.T. Unit. The process consists of: (1) production of chloral by catalytic chlorination of alcohol, to chloral alcoholate, from which alcohol is liberated by addition of water, and finally by 96% H_2SO_4, followed by fractionation in two stages to remove by-products–organic chlorides, trichloracetal and resinous matter; (2) production of D.D.T. from chloral, oleum, and excess of chlorbenzole, the resulting emulsion being passed through four towers, where acid is removed, the product water-washed, neutralized, and again water-washed. Chlorbenzol solvent is finally removed in two distillation stages, the molten D.D.T. being run to a flaker and then to a pulverizer. The yield of chloral from alcohol is about 60% and that of D.D.T. from chloral about 95%, the final product having a minimum setting point of 88° C. C. L. G.

78. Patents on Special Processes. H. S. Bloch and R. E. Schaad (Universal Oil Products Co.). U.S.P. 2,346,657, 18.4.44. Appl. 16.2.39. *iso*Butene and normal butenes are produced by subjecting normal butane at a temperature between 900° and 1100° F. to the simultaneous action of a dehydrogenating catalyst consisting of aluminium and chromium oxides and an isomerizing catalyst consisting of a calcined mixture of hydrogels of silica and zirconia.

H. J. Dempsey (Standard Oil Development Co., Delaware). U.S.P. 2,346,734, 18.4.44. Appl. 22.3.41. Naphthenic-acid constituents are removed and recovered from mineral oils by contacting the initial material at a temperature between 100° and 200° F. with a catalyst having chromic oxide as its essential active ingredient. After contact the catalyst is segregated and treated with a primary solvent to remove oily constituents and colour bodies. It is then contacted with a secondary oxygenated solvent to remove naphthenic acid constituents, which can afterwards be recovered. The secondary solvent is selected from the class consisting of ketones and alcohols.

H. B. M.

Safety Precautions.

79. Safe Practices in Loading Gasoline Tank Cars. P. Attaway. *Petrol. Engr*, September 1944, **15** (13), 188/200.—The object of the article is to set forth certain safe practices, based on actual experience, to assist loaders in avoiding situations and mistakes that might cause fire or accident.

They are confined to loading rack operations at natural gasoline plants handling unleaded motor fuel or casinghead gasoline. These safe practices are not to be confused with Federal or State regulations or insurance or national codes.

Sections deal with inflammability and toxicity of gasoline vapours, selection and training of personnel, location, equipment, and supervision of loading racks, bonding lines, precautions in handling locomotives and trains, catchbasins and drains, walkways and platforms, inspection of and precautions to be observed when opening manhole covers of various types, internal inspection and entering of tank cars, loading open dome cars, loading cars under pressure, sampling, measuring and sealing of cars, general precautions for safety of personnel, disposal of waste materials, smoking, and fire protection.

R. A. E.

PRODUCTS.

Chemistry and Physics.

80. Density and Transition Points of the *n*-Paraffin Hydrocarbons. W. F. Seyer, R. F. Patterson, and J. L. Keays. *J. Amer. chem. Soc.*, 1944, **66**, 179–182.—The preparation and purification of the even numbered *n*-paraffin hydrocarbons from C_{10} to C_{34}, also C_{29} of the odd series are described. The melting points, setting points, transition points, and densities of these hydrocarbons are reported, together with the melting points of all the other *n*-paraffin hydrocarbons from C_6 to C_{70}. It was concluded from the density results that the structure of the *n*-paraffin hydrocarbons is the same in the liquid and solid states.

The transition points of hydrocarbons C_{18}, C_{20}, and C_{22} could only be observed on cooling, while in the series of C_{24} to C_{34} the transition point was observed during heating and cooling. The density in the solid phase of the C_{29} hydrocarbon was much less than the adjacent even-numbered members of the series.

E. H. W.

81. 1 : 2 : 3 : 4-Dibenzphenanthrene and its Derivatives. II. Some New Synthetic Attempts. F. Bergmann and H. E. Eschinazi. *J. Amer. chem. Soc.*, 1944, **66**, 183–184.—In an attempted synthesis of 1 : 2 : 3 : 4-dibenzphenanthrene by cyclization of 1-(α-naphthyl) 2-*cyclo*hexenyl-*cyclo*hexanol-1, a 9 : 9-spirane derivative of 3 : 4-benzfluorene was produced instead of the expected dibenzphenanthrene (see next abstract).

The corresponding reaction between *cyclo*hexenyl *cyclo*hexanone and 9-phenanthrylmagnesium bromide gave a small amount of tetrabenznaphthalene and a product to which the spirane structure was assigned, by analogy with the above results.

E. H. W.

82. Spectrographic Characterization of a Hydrocarbon Synthesized by Bergmann and Eschinazi. R. N. Jones. *J. Amer. chem. Soc.*, 1944, **68**, 185–186.—The ultra-violet absorption spectra of the hydrocarbon synthesized by Bergmann and Eschinazi was compared with the spectra of chrysene, 3 : 4-benzphenanthrene, and 3 : 4-benzfluorene. The results suggested that the new hydrocarbon was 9 : 9-spiro*cyclo*-hexanyl-3 : 4-benzfluorene. E. H. W.

83. The Ternary System : Dioxane–Benzene–Water. R. J. Berndt and C. C. Lynch. *J. Amer. chem. Soc.*, 1944, **66**, 282–284.—Data for the binodal curve for the 25° C. isotherm for the dioxane–benzene–water system are presented.

Refractive indices and densities at 25° C. of the binary system dioxane–benzene and the ternary system dioxane–benzene–water are reported, together with an analysis diagram for the miscible region of the latter system.

In the ternary system the dineric distribution is shown to satisfy the relation employed by Bancroft and Hubbard for several ternary liquid systems.

E. H. W.

84. Dehydrochlorination of 3-Chloro-2 propen-1-ol : Preparation of Propargyl Alcohol. L. F. Hatch and A. C. Moore. *J. Amer. chem. Soc.*, 1944, **66**, 285–287.—The isomers of 3-chloro-2-propen-1-ol have been prepared by hydrolysis of the corresponding 1 : 3-dichloropropenes. Physical constants and yields are tabulated, but it was not possible to assign configurations to the stereoisomers from the data available. The dehydrochlorination of the two isomers was studied, and the lower-boiling isomer (α) was found to be more reactive. Under the conditions necessary for the removal of hydrogen chloride from the β-isomer, no propargyl was given, but good yields were obtained from the α-isomer and from a mixture of the two isomers. E. H. W.

85. 3 : 6-Epoxy*cyclo*hexene from Furan and Ethylene. Note by W. Nudenberg and L. W. Butz. *J. Amer. chem. Soc.*, 1944, **66**, 307–308.—The preparation of 3 : 5-epoxy*cyclo*hexene from furan and a few crystals of hydroquinone ethylene is reported.

E. H. W.

86. 1-*n*-Alkyl-*cyclo*pentanols and their Derivatives. C. R. McLellan and W. R. Edwards, Jr. *J. Amer. chem. Soc.*, 1944, **66**, 409–412.—The preparation and properties of ten 1-*n*-alkyl-*cyclo*pentanols are described, including four compounds not previously reported. Various properties of these compounds are compared graphically with related series of compounds.

Ten 3 : 5-dinitrobenzoates and five *p*-nitrobenzoates were prepared and their melting points recorded.

Seven *p*-(1-*n*-alkyl-*cyclo*pentyl)-phenols were prepared and constants are tabulated. Their bacteriostatic strengths are also recorded. E. H. W.

87. Influence of *n*-Alkyl Groups on the Rate of a Cyclization Reaction. E. Berliner. *J. Amer. chem. Soc.*, 1944, **66**, 533–535.—Measurements have been made of the rate of cyclization of a series of ketones forming 9 : 10-disubstituted anthracenes. The rate decreased with increasing length of the alkyl groups.

An explanation in terms of the inductive effect of the alkyl groups is given, but the author emphasizes that equally probable explanations might be obtained from stereochemical considerations.

A number of 9-alkyl-10-methylanthracenes were prepared, and their constants are listed. E. H. W.

88. Hydrogenation of Anthracene by Tetralin. M. Orchin. *J. Amer. chem. Soc.*, 1944, **66**, 535–538.—When heated at one atmosphere pressure and in the presence of a palladium catalyst, anthracene and tetralin gave a 30 per cent. yield of 1 : 2 : 3 : 4-tetrahydroanthracene. When heated in a sealed tube, 61 per cent. 1 : 2 : 3 : 4-tetrahydroanthracene, together with small amounts of 9 : 10-dihydroanthracene and 1 : 2 : 3 : 4 : 5 : 6 : 7 : 8-octahydroanthracene, were obtained. This latter reaction, resembling a catalytic hydrogenation, could also be achieved with 2-*cyclo*hexanone. In attempts made to follow the course of the reactions reported, it was found that either anthracene or 9 : 10-dihydroanthracene, when refluxed with Raney nickel, gave good yields of 1 : 2 : 3 : 4-tetrahydroanthracene. E. H. W.

89. Nitrogen Compounds in Petroleum Distillates. XXV. Isolation and Identification of 3-, and 4-*cyclo*Pentylpyridines from California Petroleum. H. C. Lochte, E. D. Thomas, and P. Truitt. *J. Amer. chem. Soc.*, 1944, **66**, 550–552.—Following previous work (*J. Amer. chem. Soc.*, 1942, **66**, 2753) on bases boiling between 210° and 213° C., two isomeric *cyclo*pentylpyridines have been isolated and identified as 3- and 4-*cyclo*-pentylpyridine. The syntheses of 2-, 3-, and 4-*cyclo*pentylpyridine are given.
E. H. W.

90. Condensation of *cyclo*Hexene Oxide, 1 : 2-Dichloro*cyclo*hexane and 3 : 4-Dichlorohexane with Anisole. C. C. Price and G. P. Mueller. *J. Amer. chem. Soc.*, 1944, **66**, 628–631.—In the presence of aluminium chloride or boron fluoride, 1 : 2-dichloro*cyclo*hexane or *cyclo*hexene oxide react with anisole giving two stereoisomeric 1 : 3-dianisyl*cyclo*hexanes, *p*-*cyclo*hexylanisole and 4 : 4″-dimethoxyterphenol. Poor yields of these compounds were isolated.

3 : 4-Dichlorohexane condenses with anisole to give a small amount of oily products from which a 1% yield of hexestrol dimethyl ether was isolated. E. H. W.

91. Structures of Methylene*cyclo*butane and of 1-Methyl*cyclo*butene. W. Shand, Jr., V. Schomaker, and J. R. Fischer. *J. Amer. chem. Soc.*, 1944, **66**, 636–640.—The preparation and physical constants of methylene *cyclo*butane and 1-methyl*cyclo*-butane are described. The expected cyclic structures for these two compounds were verified by an electron diffraction investigation, but the two compounds could not be distinguished from each other by this method. E. H. W.

92. Studies on Diene-addition Reactions. II. The Reaction of 6 : 6-Pentamethylene-fulvene and Maleic Anhydride. R. R. Woodward and H. Baer. *J. Amer. chem. Soc.*, 1944, **66**, 645–649.—A dissociable endo-product and a stable exo-isomer are shown to result from the addition of maleic anhydride and 6 : 6-pentamethylenefulvene. Proof of the configuration of these isomers is given, and the relation of their properties and conditions of formation to the mechanism of diene-addition reactions is discussed.
E. H. W.

93. Dielectric Constants and Dipole Moments of Acetylenic Ethers. Note by T. L. Jacobs, J. D. Roberts, and W. G. MacMillan. *J. Amer. chem. Soc.*, 1944, **66**, 656–657.—The dielectric constants and dipole moments of ethoxy-, butoxy-, and phenoxy-acetylene are reported. The dipole moments were calculated using the Onsager equation. Dipole moments of diethyl ether, di-*n*-propyl ether, anisole, phenetole, and diphenyl ether were also calculated in this way, and the results obtained compared with values from measurements in solution or in the vapour. E. H. W.

94. An Azeotrope in the System *n*-Butane-Methyl Bromide. Communication from J. D. Heldman, *J. Amer. chem. Soc.*, 1944, **66**, 661.—An azeotrope in the system *n*-butane-methyl bromide has been characterized, with a boiling point of −4·4° C. and composition of 58·1 ± 0·5 mole % *n*-butane. E. H. W.

95. Acetylenic Ethers. IV. Hydration. T. L. Jacobs and S. Searles, Jr. *J. Amer. chem. Soc.*, 1944, **66**, 686–689.—The acid catalysed hydrations of ethoxy-, butoxy-, and phenoxy-acetylene have been studied at 25° C. in dilute alcoholic solutions by a dilatometric method. The rate of reaction was of first order with respect to ether and hydronium-ion concentration. The reaction consists of addition of water to the triple bond yielding an ester. A mechanism consistent with the kinetics is proposed. The hydration is very similar to that of vinyl ethers, but proceeds more rapidly.
E. H. W.

96. The Reaction of Dibromides of Mono-substituted Ethylenes with Potassium Iodide. D. Pressman and W. G. Young, *J. Amer. chem. Soc.*, 1944, **66**, 705–709.—The reaction rate constants and the heats and entropies of activation were determined for the reaction in 99% methanol of potassium iodide with mono-substituted ethylene dibromides, $RCH\ BrCH_2Br$, where R was C_3H_7, C_6H_5, $C_6H_5CH_2$, CH_2OH, COOH, and Br. The results are discussed, and it is shown that no theoretical significance can be given to the effect of the various substituents, R, on the values of the heats and entropies of activation. E. H. W.

97. Thermal Decomposition of Substituted *cyclo*Hexenes. F. O. Rice and M. T. Murphy. *J. Amer. chem. Soc.*, 1944, **66**, 765–767.—In a recent discussion (*J. Chem. Phys.*, 1938, **6**, 489) the thermal decomposition of *cyclo*hexene forming butadiene and ethylene has been shown to follow the principle of least motion. It is now reported that similar reactions take place with 1-methyl-, 3-vinyl-, and 1-phenyl*cyclo*hexene, where ethylene and the corresponding substituted butadienes are formed. With ethyl*cyclo*hexene, no ethylbutadiene could be detected. Dipentene gave a good yield of isoprene, but 3-*p*-methene gave only propylene, no *iso*propylbutadiene could be detected. E. H. W.

98. Configuration of the 2 : 3-Butylene Glycols. S. A. Morell and A. E. Auernheimer. *J. Amer. chem. Soc.*, 1944, **66**, 792–793.—In studying the conversion of optically active 2 : 3-butylene glycols to butadiene, by pyrolysis of their diacetates, optically active derivatives of known configuration were isolated. By this means, it has been established that the configuration of these glycols is L — (+) — and D — (−) — for the dextro- and lævorotatory forms respectively. E. H. W.

99. Debromination of Pentaerythrityl Bromide by Zinc. Isolation of Spiropentane. M. J. Murray and E. H. Stevenson. *J. Amer. chem. Soc.*, 1944, **66**, 812–816.—A Raman spectroscopic investigation of the products obtained from reduction of pentaerythrityl bromide by zinc in aqueous methanol showed two Raman lines not assignable to either the main product, methylene*cyclo*butane, or to 2-methyl-1-butene. A mixture containing a larger proportion of this third compound was obtained by reduction of pentaerythrityl bromide with zinc in molten acetamide in the presence of sodium carbonate and sodium iodide. The new compound was isolated by removal of the olefins with aqueous solutions of silver salts and with bromine. The possible identity of the compound is discussed, and in this preliminary study the belief is expressed that the isolation of spiropentane has been effected. E. H. W.

100. Reaction of Benzene with Butadiene in the Presence of Sulphuric Acid and Hydrogen Fluoride Catalysts. V. N. Ipatieff, H. Pines, and R. E. Schaad. *J. Amer. chem. Soc.*, 1944, **66**, 816–817.—A study has been made of the reaction of butadiene and excess benzene with sulphuric acid or hydrogen fluoride as catalysts. In the presence of sulphuric acid, approximately 1·5 moles of benzene reacted with 1 mole of butadiene giving a 14% yield (based on benzene which reacted) of 1 : 2-diphenylbutane. With hydrogen fluoride, approximately 1·2 moles of benzene reacted with 1 mole of butadiene giving a 59% yield of 1 : 2-diphenylbutane. E. H. W.

101. Viscosity of the Methyl Ester of Dilinoleic Acid. D. W. Young and R. E. Biertuempfel. *J. Amer. chem. Soc.*, 1944, **66**, 843–844.—The kinematic viscosity of a pure sample of methyl dilinoleate over the range −40° C. to 100° C. is reported. The interest of these results is due to the rarity of the pure material, and the fact that the dimer has a viscosity index (Dean and Davis system) of 123·0. E. H. W.

102. *n*-Nonatriacontane. E. Stenhagen and B. Tagström. *J. Amer. chem. Soc.*, 1944, **66**, 845–846.—The preparation and isolation of *n*-nonatriacontane are reported. An X-ray study of the crystals of this new compound was made, and it was shown to exhibit dimorphism. E. H. W.

103. Zinc Alkyls from Secondary Alkyl Halides. H. Soroos and M. Morgana. *J. Amer. chem. Soc.*, 1944, **66**, 893–894.—Di*iso*propyl zinc and di-*s*-butyl zinc have been prepared with good yields, by adding a mixture of the secondary alkyl bromide and iodide slowly with stirring, under controlled temperature conditions, to an excess of zinc–copper couple. The reaction mixture is then distilled under as low a temperature and pressure as possible. E. H. W.

104. Dissociation of Hexaarylethanes. XVI. Alkyl and Halogen Derivatives. C. S. Marvel, H. W. Johnston, J. W. Meier, T. W. Mastin, J. Whitson, and C. M. Himel, *J. Amer. chem. Soc.*, 1944, **66**, 914–918.—The dissociations, measured by the magnetic susceptibility method, of twelve new substituted hexaarylethanes containing different alkyl groups and various halogen atoms, are reported, and the preparations of these compounds are described.

It was found, that of the hexaarylethanes prepared, those with mixed *m*- and *p*-substitution showed in general a higher degree of dissociation than many related hexa-*p*-alkylphenylethanes. The authors are unable to explain these unexpected results at present. Since further work on these problems must be postponed, the preparation and characteristics of a variety of intermediates for the preparation of related ethanes are recorded in this paper.

E. H. W.

105. Surfaces of Solids. X. Extension of the Attractive Energy of a Solid into an Adjacent Liquid or Film, the Decrease of Energy with Distance and the Thickness of Films. W. D. Harkins and G. Jura. *J. Amer. chem. Soc.*, 1944, **66**, 919–927.—A thermodynamical theory is developed and an experimental method is described whereby it is shown that the decrease of the energy of intermolecular attraction between a solid and an adjacent liquid or adsorbed film is essentially an exponential function of the distance from the surface of the solid. It is also shown that the film of water adsorbed on titanium oxide (as anatase) at 25° C. should attain a thickness of five molecular layers before saturation of the vapour is attained. This result was confirmed by measurement of the thickness of the film, which was shown to be somewhat greater than 15 Å. (five molecular layers). Similarly the thickness of the layer of nitrogen adsorbed at −195° C. was shown to be 36 Å, or ten molecular layers. On the same solid (titanium oxide) at 0° C., the film of *n*-butane was shown to be 64° Å, which corresponds to about 11 or 12 mols. Here the thickness of the first layer, where the molecules lie flat on the surface, is about 4 Å, in the sixth or seventh layer the degree of orientation should be small, while the surface of the film should show the same orientation as that in liquid butane at the same temperature.

These results are contrary to Langmuir's theory of the general occurrence of monomolecular adsorption at vapour pressures close to saturation. Further, the combined mono-layer plus capillary condensation theory is shown to be incorrect. The authors emphasize that these results do not show that monomolecular films are non-existent, or that capillary condensation does not occur in porous solids. Adsorbed films on plane surfaces are, however, shown to be generally thicker than those on porous surfaces. Also, from a study of the adsorption of *n*-butane on titanium oxide with a tighter packing than previously used, evidence was obtained which indicated that capillary condensation does not have any significant effect on the adsorption with this type of powder.

While the paper is based on the adsorption of a single solid, earlier work by the same authors shows that almost all the films adsorbed on the surfaces of non-porous solids are highly polymolecular at vapour pressures very slightly below saturation.

E. H. W.

106. A Study of Organic Parachors. VII. A Series of Saturated Hydrocarbons. O. H. Quayle, R. A. Day, and G. M. Brown. *J. Amer. chem. Soc.*, 1944, **66**, 938–941.—The densities, surface tensions, and parachors are reported for the normal paraffins from pentane to duodecane also 2-, 3-, 4-methyl heptane, 3-methyl pentane, and 3-ethyl hexane. In the normal hydrocarbons the parachor of the CH_2 group was 40·0, the atomic parachor of H was 15·5, and of C 9·0. There was no apparent change in the CH_2 increment as the chain increased in the series of normal hydrocarbons. From the compounds studied in this paper, and from previously published data, the effect of branching the chain in saturated hydrocarbons does not appear to be uniform.

E. H. W.

107. The Jacobsen Rearrangement. VIII. Cyclic Systems; Mechanism. R. T. Arnold and R. A. Barnes. *J. Amer. chem. Soc.*, 1944, **66**, 960–964. The Jacobsen rearrangement of cyclic hydrocarbons related to hydrindene and tetralin has been studied. The results obtained are given as structural formulæ. The action of aluminium chloride on 6 : 7-diethyltetralin, 5-ethyl-6-methylhydrindene, and *s.*-hydrindacene is described. 1 : 4-diethyl-naphthalene has been synthesized by a new method.

A proposed mechanism for the Jacobsen rearrangement is discussed. E. H. W.

108. Mechanism of Peroxide Initiated Styrene Polymerization. H. F. Pfann, D. J. Salley, and H. Mark, *J. Amer. chem. Soc.*, 1944, **66**, 983–985.—Halogen-containing polymers have been prepared from styrene and various amounts of *m*-bromobenzyl peroxide in the liquid phase at various temperatures. The bromine contents of the polymers were determined gravimetrically and also by using a radioactive bromine isotope.

The polymers contained on the average between one and three bromine atoms per chain, if the viscosity average chain length was compared with the analytical bromine content. E. H. W.

109. Rearrangement of Alkyl Halides. F. R. Mayo and A. A. Dolnick. *J. Amer. chem. Soc.*, 1944, **66**, 985–990.—The liquid phase rearrangement of normal and *iso*-propyl bromides to an equilibrium mixture, and the effect of various catalysts and inhibitors have been studied. From analogues between this reaction and the addition of hydrogen bromide to alkenes, reaction mechanisms have been suggested. Experiments were also made with *i*- and *t*-butyl chlorides and the two dibromoethanes.

Previous work on the subject is reviewed and correlated with the results now obtained. E. H. W.

110. Alkyl Sulphites—*cyclo*Hexyl Sulphite. L. P. Kyrides. *J. Amer. chem. Soc.*, 1944, **66**, 1006–1007.—The preparation of alkyl sulphites by the reaction of primary and secondary alcohols with thionyl chloride at low pressures is described.

*cyclo*Hexyl sulphite made by this method is a relatively stable product, and can be redistilled repeatedly without change in composition. E. H. W.

111.* α-Methylenic Reactivity in Olefinic Systems. Part I. The Prins Reaction with Propylene. J. W. Baker. *J. chem. Soc.*, 1944, 296–301.—Propylene reacts with *para*formaldehyde in the presence of a mixture of 100% acetic and sulphuric acids at 35° to give : (1) the diacetate of *n*-butane-1 : 3-diol (63·5%), (2) the cyclic formal (14%) of this diol, and (3) 4-acetoxytetrahydro-γ-pyran (22·5%). The rate of absorption of each of the reaction ingredients during the course of the reaction has been determined, and mechanisms for the formation of the products are suggested on the basis of these results. C. F. M.

112.* The Action of Aluminium Chloride on Some Phenyl Ethers. G. Baddeley. *J. chem. Soc.*, 1944, 330–332.—The alkylation of the phenol nucleus is shown to be exclusively in the *p*-position in the presence of aluminium chloride, whereas that of the phenol homologues is directed by the alkyl groups present in the nucleus. Ethylation occurs more readily than methylation, and the products of the former are very readily isomerized. C. F. M.

113.* The Metal-catalysed Reaction between Acetylene and Hydrogen. Part I. Nickel Catalysts. J. Sheridan. *J. chem. Soc.*, 1944, 373–380.—The rate of fall in total pressure in hydrogen–acetylene mixtures over nickel-pumice catalysts increases, under constant conditions, during the early stages of use of the catalysts. The yields of ethylene, ethane, and higher hydrocarbons, expressed in terms of the acetylene not recovered, are the same on fresh and old catalysts. The course of reaction in 1 : 1 and 2 : 1 hydrogen : acetylene mixtures on catalysts of constant activity is plotted. Ethylene is produced at about 5 times the rate of ethane formation until most of the acetylene is removed. The products other than C_2 hydrocarbons have an empirical gross composition of about C_4H_7, and are formed in yields of 55–60% of the acetylene not recovered at all stages of reaction, with both gas ratios. The initial reaction on catalysts of constant activity is of first order with respect to hydrogen and of approximately zero order with respect to acetylene. The hydrogenation to ethylene and the formation of reduced polymers of acetylene both have kinetics of approximately this type, but differing slightly such that an increase from 1 : 8 to 8 : 1 in initial hydrogen : acetylene ratio causes an increase from about 40% to 67% in the yield of

C_2 hydrocarbons, expressed in terms of the acetylene not recovered. Ethylene added to the system acts principally as an inert diluent, and is apparently less strongly adsorbed than acetylene on nickel. The same catalysts have negligible action on acetylene alone under conditions of rapid reaction in acetylene–hydrogen mixtures. The results are discussed with special reference to previous work on the chemisorption of ethylene and acetylene.

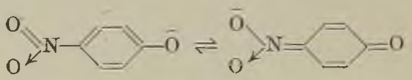
C. F. M.

114. Absorption Spectra. E. J. Bowen. *Progress of Chemistry Annual Report for 1943*, p. 12.—A brief non-mathematical description is given of the relation between the wave mechanical theory of electronic orbitals and molecular absorption spectra of organic substances. As an illustration the absorption spectrum of the hydrogen molecule is given in terms of the electronic orbital changes. In single-bonded organic compounds the orbitals are essentially σ_g in character, but when a double bond is introduced the extra pair of electrons occupy π_u orbitals in which the binding is less than in the σ_g orbitals, so that ethylene, for example, absorbs at longer wave-lengths than ethane. With conjugated double-bond systems there is an increase in the number of nodal planes across the axis of the molecule—*i.e.*, there is an increase in the anti-bonding electrons resulting in the appearance of more absorption bands, the absorption moving to longer wave-lengths. This principle is applied to the conjugated polyenes, and it is shown that for the longest wave-length of absorption the reciprocal of the frequency squared is almost a linear function of the number of double bonds.

Methods of calculating the longest wave-length of absorption are at present too approximate to be of direct use, though some success has been achieved in the case of the benzene molecule.

The replacement of carbon by nitrogen or oxygen does not greatly alter the energy values of the orbitals of the type mentioned, and there is therefore little change in the light absorption. The oxygen atom, however, has four electrons over and above those shared with the carbon in the C = O link. These are in 2*p* orbitals, and changes in these non-bonding electron orbitals are responsible for the weak ketonic absorption in the region of 3000 A.

Recent attempts to explain the colour of dyes are based on increased resonance between alternative electronic valency structures—*e.g.*, the ion of *p*-nitrophenol.



J. W. H.

115.* Correlating Vapour Pressure and Equilibrium Constant Data. D. F. Othmer. *Industr. Engng Chem.*, 1944, **36** (7), 669.—On plotting the vapour pressure of hexane against the vapour pressure of water at the same temperature, a straight-line relationship was obtained, and because of the ease of working with the tabular data for water, this substance has been selected as the reference vapour-pressure standard. It is shown that on plotting the equilibrium constants for hydrocarbons at constant pressure against the vapour pressure of water at the corresponding temperature on log paper a straight-line relationship is obtained. From a series of plots of this type for the equilibrium constants at different pressures, a nomogram has been constructed which permits the immediate evaluation of the equilibrium constant at any temperature and pressure over the range 0·5–25 atmos. and at temperatures of 50–400° F. for the C_1–C_8 paraffin hydrocarbons. A second nomogram is presented which permits the immediate evaluation of all the equilibrium constants for the components of a hydrocarbon mixture at any particular temperature and pressure, this form of presentation being very useful in plate to plate calculations. The precise method of constructing both these nomograms is described.

J. W. H.

116.* Phase Equilibria in the System Ethane–Ethylene–Acetylene. J. L. McCurdy and D. L. Katz. *Industr. Engng Chem.*, 1944, **36** (7), 674.—The phase equilibria in the above systems have been studied at 40° F. and 60° F. over the pressure range 50–900 p.s.i. The following data are presented: vapour pressures of the pure components, experimental equilibrium data for the binary and ternary systems, pressure–temperature–composition diagrams for the binary and ternary systems at 40° F. and

60° F. showing equilibria at constant pressure and the complete pressure-composition diagram at 40° F. in the form of a right-triangular prism plot. The constant-boiling mixtures of ethane–acetylene and ethylene–acetylene persist through the triangular three-component diagrams. At constant temperature and pressure these diagrams have two phase areas. Acetylene is the most volatile constituent in one area and the least volatile in the other area. J. W. H.

117.* Determining Fall or Rise Velocity of Spheres in Fluids. R. C. Binder. *Chem. Metall. Engng*, August 1944, **51** (8), 104–105.—A chart and a set of formulæ are presented for determining the velocity of spheres in fluids, based on the use of the Binder and Reynolds numbers. A. H. N.

118.* Viscosity of Normal Pentane. Anon. *Refiner*, August 1944, **23** (8), 306.—A table is given of the viscosity of *n*-pentane for temperatures ranging from 25° to 250° C. (inclusive), and pressures ranging from saturation pressures at 25° C. up to saturation pressure at 195° C., and for other pressures ranging from 100 lb./sq. in. up to 1000 lb./sq. in. The data are taken from the paper by Hubbard and Brown which appeared in *Industrial and Engineering Chemistry*, December 1943, **35**, No. 12. A. H. N.

119.* Chemistry in Petroleum. J. L. Franklin. *Refiner*, August 1944, **23** (8), 307–311.—The paper deals in a descriptive manner with the application of chemistry to engine design, petrol, and other products, special processes in refining and synthesis, and general use of petroleum in war. A. H. N.

120. Chemistry of Catalytic Hydropolymerization of Acetylene. L. I. Antsus and A. D. Petrov. Translated by J. G. Tolpin. *Refiner*, August 1944, **23** (8), 317–320.—Acetylene tetramers of branched-chain structure were obtained for the first time as products of partial hydrogenation of acetylene. Among the hydrotrimers of acetylene, the following olefins were found: 1-hexene, 2-hexene, 3-hexene, 3-methyl-1-pentene, 3-methyl-2-pentene, 2-methyl-1-pentene, 2-methyl-2-pentene, and 2 : 3-dimethyl-2-butene; of diolefins, the following were found: 1 : 5-hexadiene, 3-methyl-1, 4-pentadiene, and 2-methyl-2 : 4-pentadiene. The products of exhaustive hydrogenation of these polymers were found by Raman spectroscopy to contain normal hexane, 3-methylpentane, and 2-methylpentane, and by determination of the intensity of the absorption spectrum lines the proportions of these hydrocarbons in the various fractions were determined. Hydrotetramers of acetylene were found to contain 3-ethylhexenes, 2-methylheptenes, 3-methylheptenes, and 4-methylheptenes. The approximate content of *iso*-octanes was determined from the octane number of this fraction after its exhaustive hydrogenation. A general outline of hydropolymerization of acetylene over a mixed catalyst (nickel plus zinc chloride) is given, leading to formation of di-, tri-, and tetramers. A. H. N.

Analysis and Testing.

121. Method for Determining Individual Hydrocarbons in Mixtures of Hydrocarbons by Measurement of Freezing Points. A. J. Streiff and F. D. Rossini. Research Paper R.P. 1584, *Bur. Stand. J. Res.*, May 1944, **32** (5), 185–196.—The amount of a known hydrocarbon in an unknown mixture of hydrocarbons can be determined by measuring the depression of the freezing point caused by its addition to a given amount of the unknown mixture. 2–3 ml. of the unknown mixture to 40 ml. of the pure hydrocarbon are used, and the results are accurate to $\pm 1\%$ of the total sample. The freezing-point lowering is obtained from time–temperature freezing or melting curves with a platinum resistance thermometer. It is essential that each mixture of hydrocarbons examined be one that forms an ideal or sufficiently dilute solution with each of the hydrocarbons to be determined, or be fractionated to give solutions that will. Data are given for the determination of four C_8 aromatic hydrocarbons in an unknown mixture of aromatic hydrocarbons. The method is applicable to the determination of individual paraffin or *cyclo*paraffin hydrocarbons in mixtures of these hydrocarbons, and there appears no reason why it cannot be used for olefins. W. H. C.

122. Theoretical Analysis of Certain Time–Temperature Freezing and Melting Curves as Applied to Hydrocarbons. W. J. Taylor and F. D. Rossini. Research Paper R.P. 1585, *Bur. Stand. J. Res.*, May 1944, **32** (5), 197–213.—Describes a method which may be used analytically or graphically for extrapolating the equilibrium part of a time–temperature freezing or melting curve to give the freezing point of a given hydrocarbon substance. A method is also shown for deducing the freezing point for zero impurity which is applicable when the time–temperature data extend over a sufficiently large fraction of the material crystallized or melted. W. H. C.

123.* Practical Examination of Lubricating Greases. Part 5. Low-Temperature Performance. M. W. Webber. *Petroleum*, September 1944, **7** (9), 162–163.—There is no standard method for determination of the low-temperature properties of lubricating greases. There are, however, three types of method covered by M.A.P. D.T.D. specifications which are in general use in the industry, and these methods are described. The two which are based on determinations of resistance to torque are considered to give more reliable and useful information than does determination of penetration, which is the third method. There is still need for development of a pressure viscometer for low-temperature testing.

The Timken Wear and Lubricant-Testing machine is described, and has been found by the author to give satisfactory results when testing greases for load-carrying capacity, friction—and wear—reducing properties.

The copper strip test is the only one in regular use for determining any tendency of greases to cause corrosion. The typical requirement of British and American specifications of no corrosion after 24 hr. at room temperature is not considered sufficiently stringent. Increase in temperature or period of test and alternative metals and alloys are suggested to increase the stringency.

A number of tests for determination of water resistance of greases are described; that given in Appendix VI to M.A.P. specification DTD. 577 is considered to be valuable. The methods described can be adapted to measure resistance to other liquids. R. A. E.

124. Construction and Operation of Mobile Petroleum Laboratories. C. Cramer and S. F. Mauney. *Nat. Petrol. News*, 13.9.44, **36** (37), 19–27.—A description is given of the development, technical features, and employment of a mobile petroleum laboratory, built in England for the U.S. Forces prior to the North African invasion, and also of one built for use in the invasion of France. Illustrations are given of the value of such a laboratory in control of quality of products used by the Forces to guard against contamination during distribution (as many as eight handlings may be involved), against sabotage, deterioration during storage, and as a check on quality and possible utilization of captured petroleum products. The mission of the unit may be summarized as: (*a*) Reception of tankers and inspection of bulk petroleum during storage and transfer. (*b*) Inspection of packaged petroleum products for quality and identification determination when required. (*c*) Inspection of captured enemy material to determine the extent of its utility in our own or captured material, and to assist Intelligence Service in gathering information on enemy petroleum products and distribution.

The laboratories are equipped to carry out specified tests on gasoline, kerosine, gas oil, lubricating oils, and greases. The principal source of power is electricity provided by a small generator set. Auxiliary heating was provided by alcohol burners, and later by bottled propane. Refrigeration is obtained by the use of salt and ice and also CO_2/alcohol and ether mixture. Provision was also made for a water-distillation unit and an ample supply of reagents. The laboratory was constructed in two units, each consisting of a standard 2½-ton long-wheel-base G.M.C. army truck, one housing the laboratory proper and the other the generator set, ice-box, CO_2 cylinders, and extra equipment. A detailed description is given of the lay-out of the units and of the improvements effected in the later laboratory. The unit was provided with detailed instructions on methods of sampling, handling, and testing in the field, and allowable expedients when operating under service conditions. A specimen of the standardized report form utilized is given. Diagrams and photographs of the complete units and sections thereof are provided. R. A. E.

125. A Method of Differentiation of Crude Oils Based on Chromatography, Capillary Analysis, and Fluorescence in Ultra-Violet Light. J. N. Mukherjee and M. K. Indra. *Nature*, 9.12.44, **154**, 734.—The fluorescence in ultra-violet light can be used to differentiate between refined oils and crude oils, but only shows minor differences between real and artificial crudes. The fluorescence of fractions separated by chromatographic and capillary analysis is shown to allow differentiation between different crudes and between artificial and real crudes. A chromatogram is formed on a column of Brockman alumina from a dilute solution of the oil in petroleum ether. Fractions are then obtained by successive extraction of the column with petroleum ether, benzol, and chloroform, the fractions after removal of solvent being dissolved in chloroform, and the fluorescence of the solutions compared at equal concentrations. Capillary analyses are then carried out. Marked differences are shown in the fluorescence colour of the fractions from chromatographic and capillary analysis from each of the four (artificial and natural) crude oils. C. L. G.

Crude Oils.

126.* Occurrences and Types of Crude Oils in Rocky Mountain Region. J. G. Crawford and R. M. Larsen. *Bull. Amer. Ass. Petrol. Geol.*, October 1943, **27** (10), 1305–1334.—The application of correlation numbers to analyses of Rocky Mountain crude oils indicates that these oils can be grouped into six major and four intermediate types, which correlate rather well with certain geological systems and geographical areas. The indices used are those evolved by Harold M. Smith (*U.S. Bur. Mines Tech. Paper 610*, 1939). These are based on the entire range of distillation fractions with reference to the boiling point and specific gravity of each. If a fraction were composed exclusively of normal paraffin hydrocarbons, the value of the index number would be zero. If the fraction be from a paraffin-base crude oil of the usual type, its index will not be zero, but will be small (under 15), while fractions from intermediate and naphthene base crudes will have increasingly greater values for the indices (15–50). Values above 50 show that aromatic rings predominate. The index represents the average characteristics of the fraction compared with a normal paraffin hydrocarbon of the same boiling point, and it should not be construed to mean that the fraction consists predominantly of a hydrocarbon having the same specific gravity and boiling point.

Oils in the Rocky Mountain region range in gravity from 75° to 11° A.P.I. (0·68–1·00 sp. gr.); the oils vary in colour from clear to glossy black through various shades of amber, green, and brown; some are solid at 90° F. and others liquid at −50° F.; the sulphur content varies from a trace to 4%.

Type I is represented from Tertiary deposits in Colorado and Wyoming. The index graph starts near index number 40 and falls to 30. The oils are of intermediate-paraffin base, green in colour, negligible sulphur content, and high pour points normally 70–90° F. At temperatures above the pour points they are very fluid and have low Saybolt viscosities. They range in gravity from 36° to 38° A.P.I. and contain 15–35% gasoline. Cyclic compounds (probably naphthenes) predominate in the low- and medium-boiling fractions, and paraffins in the higher. The cyclic compounds in the gasoline fraction point to a straight-run product of higher than average octane number. Considerable wax can be expected in the higher-boiling fractions.

Type II is the abundant type of oil found almost throughout the Cretaceous and Jurassic deposits in Colorado and Wyoming, but some pre-Jurassic samples from Utah and Lance Creek, Wyoming, belong to it. The graph starts with an index between 15 and 25, and progresses upwards to a number between 25 and 40, seldom higher. This type includes many paraffin-base and intermediate-base oils, nearly all green in colour, with low sulphur, low viscosity, low carbon residue, and pour points ranging from below 5° F. to 65° F. The gravity range is from 28° to 52° A.P.I., and averages 37°. Gasoline content is 15–60%. The low-boiling fractions vary, but medium- and high-boiling fractions are very constant, neither naphthenes nor paraffins dominating to any extent. Aromatics are absent or minimal. The octane rating of straight-run gasolines is ordinarily low, but they form good refining stock and are suitable for cracking.

Type III is from La Barge, Brenning Basin, Shawnee, in the Tertiary of Wyoming. It is also found in Cretaceous deposits at Wellington, Colorado; Mosser Dome, Montana; and in eight small fields, in Wyoming. Low-boiling fractions are absent.

Indices for the highest boiling fraction may be 50–70 or more. Sulphur content is low, the colour is green, in both of which characters Type III differs from Type VI. Type III oils are of intermediate, intermediate-naphthene, naphthene-intermediate, and naphthene base, with a gravity range from 17° to 33° A.P.I. They are rather viscous. From most of them little gasoline is obtained, but the octane rating is usually high, because of the cyclic content. They are valuable for lubrication, as many of the products are wax-free.

Type IV comes from the Cretaceous of Hidden Dome, and the Cretaceous and Jurassic of Lost Soldier, Wyoming. The index-graph has minima for low- and high-boiling fractions. The base is intermediate to intermediate-paraffin ; sulphur ranges from 0·15% to 0·36%. Gasoline content of the 43° A.P.I. Hidden Dome oil averages 45%, and that of the 28–31° Lost Soldier varies between 8% and 15%. Cyclic compounds predominate in the low- and medium-boiling fractions, and the high-boiling fractions contain sufficient paraffinic material to prevent the dominance of the naphthenes. These oils are valuable for refining. Cyclic compounds in the gasoline fraction result in a product of high octane rating, and the paraffinic high-boiling fractions crack well.

Type V is from Cretaceous at Lake Basin, Montana, North McCallum, Colorado, and Greybull, Wyoming, and from Jurassic deposits at Big Medicine Bow, Wyoming. These oils are paraffinic throughout their entire range, and the index numbers are mainly below 20. Sulphur is very low. Gravity stands among the highest in the Rocky Mountain region—from 63° to 75° A.P.I. at Big Medicine Bow to 44° at Lake Basin. Gasoline at the former locality is 80%, at the latter 32%, and is roughly proportional to the pour point. Aliphatic hydrocarbons indicate low octane rating. High-boiling fractions are small and waxy.

Type VI is widespread in the Jurassic of Bolton Creek, Poison Spider, Spindletop, and Steamboat Butte, Wyoming, and from pre-Jurassic at Soap Creek, Montana, and in most of the Wyoming fields. The index graph starts from 15 to 25, gradually increasing till there is a sudden sharp rise in the higher-boiling fractions to a peak of 55–70. These oils are of paraffin-intermediate and intermediate base, black or brownish-black colour, and include the black or heavy oils of Wyoming. Gravities rise from 11° A.P.I. at Red Springs, Wyoming, to 35° in the Sweetwater Basin of Wyoming. Gasoline varies from 0% to 30%. Viscosities vary from 40 secs. to as high as over 6000 secs. Pour points, ordinarily below 5° F., reach as high as 30° F. Asphaltic material 5–40%. Paraffins predominate in low- and medium-boiling fractions, but cyclic compounds in the higher-boiling fractions. In the high-boiling fractions aromatics are normally present, and may dominate these fractions in some oils. Sulphur varies from 1·0% to 4·5%, so that high-gravity oils have to be blended with sweet, whilst low-gravity oils, because of the corrosive effect of the sulphur, are topped for fuel and road oil.

Four-fifths of the oil of the Rocky Mountains region belongs to Types II and VI, or to an intermediate Type II–VI. Intermediate Types II–I, II–III, and II–V are relatively infrequent. A. L.

127.* Cracking of Latin American Crude Oils. 4. Cumarebo. G. Egloff. *Oil Gas J.*, 9.9.44, **43** (18), 72.—The Cumarebo oil-field is situated near the north coast of Venezuela, and is one of the fields which are not properly part of the Lake Maracaibo area. Cumarebo crude oil has a specific gravity of 0·7905, and a sulphur content of 0·11%, and contains 49% of 400° F. E.P. gasoline. It is a paraffinic crude, and has a cold test of 30° F.

The crude was fractionated in a semi-commercial unit to produce : (1) a 392° F. E.P. gasoline which had an octane number A.S.T.M. of 54, and a residue ; (2) a reduced crude, after the removal of the gasoline and kerosine. Both residua had relatively high A.P.I. gravities, low sulphur contents, and high setting points.

Single-coil recycle cracking was carried out on the residua to obtain 392° F. E.P. gasoline from : (1) at 300 p.s.i. and 925° and 980° F., respectively ; (2) at 250 p.s.i. and 940° F. The residues from all three operations conformed to the No. 6 A.S.T.M. fuel oil specification. The yields obtained were : gasoline, 62·7%, 64·9%, and 54% ; residuum, 20·4%, 19·5%, and 28·6%, respectively, the A.S.T.M. octane numbers of the gasolines being 61, 61, and 63.

Treatment of two of the cracked gasolines with 2 lb./brl., 93% H_2SO_4, neutralization with caustic soda, and fire and steam distilled with a maximum still temperature of 350° F., no plumbite being used, gave the following results :

	From topped crude.		From reduced crude.	
Untreated gasoline, vol.-% of charge	—	64·9	—	54·0
Treatment, acid	none	acid	none	acid
Gum, mg./100 ml. copper dish :				
Without inhibitor	123	13	251	32
With 0·025% inhibitor No. 1	13	8	111	5
Reid vapour pressure, p.s.i.	—	3	—	3·5
Induction period, min. :				
Without inhibitor	330	420	580	540
With 0·025% inhibitor No. 1	450	850	675	910
Octane number A.S.T.M.	61	59	63	60

The results show that to obtain satisfactory gasolines by acid treatment an average of three octane numbers is lost. Thermal reforming of the straight-run gasoline (50·9%) obtained by topping the crude was carried out in a one-pass operation at 500 p.s.i. and at the following temperatures, 935°, 950° and 975° F. The yields and properties of the products are :

Yield, per cent. of charge stock	1	2	3
Gasoline	86·2	83·0	71·5
Residue	0·6	2·1	3·6
Gas and loss	13·2	14·9	24·9
Octane number of gasoline, A.S.T.M.	61	66	70

The 70 octane reformed gasoline was refined with 1 lb. 93% H_2SO_4/brl. caustic washed and re-run as previously described. The properties of the untreated and treated gasolines are :

	Untreated.	Treated.
Octane number, A.S.T.M.	70	69
Gum, mg./100 ml. copper dish :		
Without inhibitor	54	13
Without 0·025% inhibitor No. 1	9	3
Induction period, min. :		
Without inhibitor	100	160
Without 0·025% inhibitor No. 1	375	1230

W. H. C.

128.* Engineering Fundamentals. Properties and Characteristics of Crude Oils. F. B. Plummer. *Oil Gas J.*, 7.10.44, **43** (22), 99.—The physical properties of crude oils in relation to production are outlined. The composition of Mid-Continent crude oil is given showing the amounts of the C_1–C_6 hydrocarbons and residue at 2000 and 12 p.s.i. Liberation of gas from the crude oil during production may be of two types : flash and differential vaporization. Usually a combination of the two types occurs, the latter predominating.

The properties vital to production are described ; they are : gravity and viscosity, for movement through the sand ; adhesion and surface tensions, for ease of recovery ; solvent power, for holding in solution the paraffin waxes ; pressure exerted by the gaseous components, for driving the oil into the wells.

The effect of gas-liberation on the properties of the oil is discussed, and the results of experimental work of several authorities are noted :

(1) at a pressure of 2400 p.s.i. and a concentration of 45 mol. % of gas, the viscosity of a crude oil was reduced 25% from its original value by the removal of gas ;

(2) the surface tension of oil is about one-third as much when saturated with gas at 2000 p.s.i. as for the oil at atmospheric pressure ;

(3) crude oils of lower specific gravity have lower surface and adhesion tensions ;

(4) maximum solubility of paraffin occurs in paraffin hydrocarbons of about the composition of hexane.

Paraffinic base oils are generally found in the geologically older and deeper strata ;

naphthanic base oils in the younger strata; asphaltic base oils from shallow depths and from limestone deposits.

A table shows the characteristics of crude oils in different rock formations.

W. H. C.

Gas.

129.* Variation in Composition of Natural Gases of Southern Ischimb Oilfield. G. D. Galpern. *Bull. Acad. Sci. U.S.S.R. (Div. Tech. Sci.)*, 1943, **8**, 26–34.—An investigation of the character of gases occurring in this oilfield, their distribution and origins. The composition of the gas varies regularly from the centre of the field outwards, the concentration of hydrogen sulphide, carbon dioxide, mercaptans, lower homologues of methane, dropping from the centre outwards, whilst the methane concentration rises. Tables of analyses of gases are given and maps of the oilfield showing the distribution of gases. The origins and modes of formation of the gases are discussed as well as the geological aspect of this oilfield.

D. A.

Engine Fuels.

130.* Mollier Diagrams for Theoretical Alcohol–Air and Octane–Water–Air Mixtures. R. Wiebe. *Industr. Engng Chem.*, 1944, **36** (7), 672.—In *Industr. Engng Chem.*, 1942, **34**, 577, the Mollier diagrams were presented for the above systems; Fig. 2 of this article is incorrect, and the corrected data are now presented. The change, however, does not affect any of the calculations or data previously presented.

J. W. H.

131.* Alcohol in Motor-Car Operation. E. W. Steinitz. *Petroleum*, November, 1944, **7** (11), 202–203.—Before the war, alcohol fuels were used extensively on the Continent, but only to a limited extent in this country, where about 1½ million gals. of alcohol p.a. was used in such blends. Political and economic reasons for the extensive Continental use are given. After the war, quantities of surplus synthetic ethyl and methyl alcohol may become available from plants constructed for war purposes. A carburettor, designed by the author, which enables an engine to be operated on methylated spirits once it has been warmed up sufficiently, is illustrated and described. Whilst fuel consumption on alcohol fuel was lower in relation to gasoline than expected on a calorific value basis, the additional gadgets required and the exhaust odour are admitted defects.

The use of 13–18% of water-free alcohol blended with petrol confers advantages in respect of anti-knock rating, cleanliness of combustion, and increase in power output obtainable, without loss of acceleration or ease of starting. Avoidance of spillage on paint work and initial cleansing of fuel system are points to be observed. Reference is made to the use of alcohol blends for racing purposes, and to recent tests which indicate advantages to be obtained by injection of alcohol into the mixture after leaving the carburettor.

R. A. E.

132. Patents on Engine Fuels. J. A. Chenicek (Universal Oil Products Co.). U.S.P. 2,346,662, 18.4.44. Appl. 8.4.40. The catalytic effect of metal compounds on hydrocarbon distillate is suppressed by adding to the distillate a small portion of a metal-free condensation product of an *ortho*hydroxy aromatic aldehyde and a primary alkane mono-amine.

J. A. Chenicek (Universal Oil Products Co.). U.S.P. 2,346,663, 18.4.44. Appl. 8.4.40. The catalytic effect of metal compounds on hydrocarbon distillates is suppressed by adding to the distillate a small amount of a condensation product of an *ortho*hydroxy aromatic aldehyde and a primary alkanol amine.

G. W. Orelup. U.S.P. 2,346,780, 18.4.44. Appl. 8.12.41. A fuel treating composition consists of an alkyl-substituted diphenyl and a dyestuff suitable for colouring petroleum products.

H. B. M.

Gas Oils and Fuel Oils.

133. Patent on Gas Oils and Fuel Oils. C. E. Hemminger (Standard Catalytic Co.). U.S.P. 2,346,754, 18.4.44. Appl. 9.12.39. An oil gas containing hydrogen is generated from heavy hydrocarbon residues in the following way. The residues are passed through a reaction zone into which steam and a free oxygen-containing gas are introduced. Thus partial combustion of the residues is effected, and the reaction zone is maintained at a sufficiently high temperature to decompose the unburned portion of the residue into gases rich in hydrogen and containing free carbon. The stream of gases and residue is passed through the zone at a velocity great enough to prevent substantial accumulation of carbon. Decomposition gases are removed, and after separation of free carbon therefrom they are returned to the reaction zone.

H. B. M.

Lubricants.

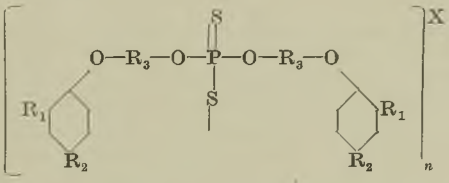
134.* Effect of Natural Sulphur Compounds and Peroxides on the Oxidation of Lubricating Oils. G. H. Denison. *Industr. Engng Chem.*, 1944, **36** (5), 477.—If the sulphur compounds are removed from a refined lubricating oil, it is shown that the oil has a negligible resistance to oxidation, and that the presence of sulphur compounds inhibits the oxidation. It is also shown that the oxidation rate is controlled by the concentration of organic peroxides and the latter are reduced by the naturally occurring sulphur compounds. The organic peroxides also control the rate of bearing corrosion, such corrosion being due to the ability of the peroxides to convert the metal into the oxide which readily dissolves in the acidic constituents developed during oxidation.

J. W. H.

135. Patents on Lubricants and Lubrication. E. W. Cook and W. D. Thomas (American Cyanamid Co.). U.S.P. 2,344,392, 14.3.44. Appl. 8.11.41. A crankcase lubricant consists of a heavy metal salt of the dicapryl ester of dithiophosphoric acid in lubricating oil.

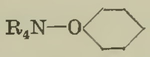
E. W. Cook and W. D. Thomas (American Cyanamid Co.). U.S.P. 2,344,393, 14.3.44. Appl. 18.2.42. A lubricating oil has incorporated in it not less than 0·1% by weight of a zinc salt of diamyl dithiophosphoric acid.

E. W. Cook and W. D. Thomas (American Cyanamid Co.). U.S.P. 2,344,395, 14.3.44. Appl. 16.6.42. A lubricating oil has admixed with it 0·1–3·0% of a compound of the general formula :—



R_1 and R_2 are members of the group consisting of hydrogen and alkyl radicals, at least one R being an alkyl radical. Total carbon atoms in R_1 and R_2 are at least 8. R_3 is an alkylene radical containing 2–4 carbon atoms inclusive. X is a member of the group consisting of hydrogen and metal salt-forming radicals, and n is the valence of X.

E. Lieber (Standard Oil Development Co., Delaware). U.S.P. 2,344,886, 21.3.44. Appl. 2.1.41. A lubricant is prepared from a hydrocarbon oil and a compound of the formula :—

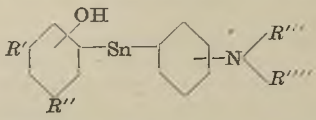


R is a hydrocarbon radical. The compound is present in sufficient amount to prevent deterioration of the oil in the presence of oxygen.

F. W. Kavanagh, B. B. Farrington, and J. O. Clayton (Standard Oil Co. of California). U.S.P. 2,344,988, 28.3.44. Appl. 21.11.38. A lubricant is prepared from a hydrocarbon oil, a metal phenate having an oil-soluble substituent in an aryl radical thereof, and a hydroxy ester having at least one hydroxyl group no more than 2 carbon atoms removed from a carboxyl group. The ester is present in sufficient quantity to stabilize the oil against oxidation, and the phenate in sufficient quantity to augment the action of the inhibitor.

S. M. Roberts (Texas Co.). U.S.P. 2,345,156, 28.3.44. Appl. 15.1.41. A lubricating oil has added to it a small proportion of polyvalent metal salt of an organic ester of a phosphorus acid. The ester is selected from the group consisting of alkyl and naphthenyl esters. A small proportion of a sulphurized fatty material is also incorporated in the compound.

E. W. Cook and P. H. Moss (American Cyanamid Co.). U.S.P. 2,345,239, 28.3.44. Appl. 28.8.43. Incorporated with a mineral lubricating oil there is an effective amount of a compound of the group consisting of those having the general formula :—



R' and R'' are radicals of the group consisting of hydrogen and alkyl radicals, at least one being an alkyl radical; R''' and R'''' are alkyl radicals of from 1 to 5 carbon atoms inclusive, and n is a whole number not greater than 2.

G. H. Denison and P. C. Condit (Standard Oil Co. of California). U.S.P. 2,346,155, 11.4.44. Appl. 23.2.42. A lubricating composition is prepared from a hydrocarbon oil, an ether of an element of group VI-B of the Periodic Table and selected from the class consisting of sulphur, selenium, and tellurium. The ether is present in sufficient quantity to stabilize the oil against oxidation. To enhance the action of the ether a small amount of a salt of an organo-inorganic acid is added.

B. B. Farrington, V. M. Kostainsek, and G. H. Denison (Standard Oil Co. of California). U.S.P. 2,346,156, 11.4.44. Appl. 16.2.42. A paraffin wax thiomer is added to lubricating oil to inhibit corrosion activity.

B. B. Farrington, V. M. Kostainsek, and G. H. Denison (Standard Oil Co. of California). U.S.P. 2,346,157, 11.4.44. Appl. 16.2.42. A lubricating oil has incorporated in it 0·1–2% by weight of a polyvalent metal salt of an organic acid, 0·1–2% by weight of a multi-bridged thioalkyl, and 0·05–2% of a metal salt of an inorganic acid containing an organic substituent.

R. E. Burk (Standard Oil Co., Cleveland, Ohio). U.S.P. 2,346,356, 11.4.44. Appl. 11.6.40. A heavy duty lubricant is manufactured from a hydrocarbon oil and small amounts of an inorganic phosphorus-providing agent from a group consisting of phosphorus and phosphorus sulphide, and a diaminodiphenylmethane derivative.

R. E. Burk and E. C. Hughes (Standard Oil Co., Cleveland, Ohio). U.S.P. 2,346,357, 11.4.44. Appl. 24.12.41. A high-temperature lubricant comprises a hydrocarbon oil and not more than 3% each of a salt of an organic acid of low volatility, and a nitrogen-containing diphenyl methane derivative. The lubricant promotes combustion of carbonaceous deposits and high stability in the crankcase of internal-combustion engines.

C. Winning and J. G. McNab (Standard Oil Development Co., Delaware). U.S.P. 2,346,808, 18.4.44. Appl. 7.5.40. A petroleum lubricant has added to it 0·01–5% of an aliphatic alcohol having at least 8 carbon atoms, and 0·02–2% of an oil-soluble metal salt of an alkylated phenol.

H. B. M.

Special Hydrocarbon Products.

136.* Petroleum and Coal Products in the Foundry. Anon. *Petroleum,* August 1944, 7 (8), 132.—Vol. 36 (1942–3) of the *Proceedings of the Institute of British Foundrymen* contains references to the use of petroleum and coal products in foundry practice. Some of the more important aspects touched on are given with page references. These include the use of oil-fired furnaces in cast-iron manufacture, the utilization of mineral oils in part substitution of vegetable, animal, or fish oils in the manufacture of core-binders, the use of coke-fired and oil-fired furnaces in brass and iron foundries, with hints on fuel conservation and methods of obtaining maximum efficiencies, and the use of creosote pitch and pitch as fuel. Tables show the iodine values and functions of various oils used as core-binders.

R. A. E.

137.* Wax Production. Anon. *Petroleum*, August 1944, 7 (8), 132.—According to information recently released by P.A.W., the output of all types of petroleum waxes by about 50 refineries in the U.S. in 1943 reached the record of 330,000 tons. Micro-crystalline waxes are in shortest supply, and are the only varieties subject to control and priority allocation. Output of such grades in 1944 is estimated at 60,000 tons, and investigations are in hand to ascertain the types of preparation in which a larger proportion of paraffin wax may be used. Applications of the micro-crystalline waxes are listed, and include special packings for Services, desensitizing bombs, de-icing dopes for aeroplanes, and proofing composition for boots against mustard gas. Improvements in the manufacture of waxed packing materials effected during the war are expected to result in a big expansion of the use of such materials in the future.

Modern waxed papers in a 24-hour test have shown a transmission of moisture as low as 0·2 gm. per 100 sq. in. at 100° F. R. A. E.

138.* Peat-Wax from Chatham Island. E. O. Macpherson and W. G. Hughson (N.Z. Dept. of Scientific and Industrial Research). *Petroleum*, October 1944, 7 (10), 186.—Fifty thousand acres, or three-quarters of Chatham Island, which lies 536 miles E. of New Zealand, is covered with peat of different ages and origins. To investigate possibilities of development, channels 6–8 in. deep were cut across representative sections, and samples taken from the bottom of these channels. Samples vary in colour from light brownish to almost black; texture varies with origin, but is usually of a well-humified cheesy consistency, and was probably largely derived from mosses. The peat is remarkable for its water-retaining capacity, and is very difficult to dry. The moorland deposits are the most widespread and important, and contain peat-wax. They are 10–14 ft. in thickness and laid on a variable but firm bedrock. The samples examined gave an average of 9·4% wax of m. pt., 73° C. compared with a Montan wax yield of 6–10% of m. pt. 75–80° C. from German lignite. Both German and Bovey Tracy Montan waxes are considered superior to Chatham Island peat-wax, though the latter could probably be improved by refining. Distribution of wax is patchy, so a detailed survey would be required to select suitable working areas, but Wisner's workings east of Kaingaroa have possibilities, as the average wax content is 12·9% and a bulk sample collected in 1944 showed 17·6%. The wax could be used for some of the purposes for which Montan wax is used, but since transport and power facilities are lacking, it is considered that New Zealand peat deposits merit prior consideration for commercial development. R. A. E.

139.* Peat-Wax from Chatham Island. Part II. E. O. Macpherson and W. G. Hughson (N.Z. Dept. of Scientific and Industrial Research). *Petroleum*, October 1944, 7 (10), 201.—The method of handling and drying the samples, the extraction of the wax by means of chloroform, and suggested means of improving wax quality by removal of the "asphaltic" constituent are described. Tables show loss on air drying, proximate analysis of air-dried peat, wax yield, and melting point of samples from various localities. R. A. E.

140.* Liquid Paraffin and Related Compounds. M. D. Beach. *Petroleum*, November 1944, 7 (11), 206.—Chemical inertness and the wide range of physical properties of the paraffin series of hydrocarbons enable their utilization for a wide variety of purposes—*e.g.*, the light variety used in nasal sprays, liquid paraffin for medicinal purposes and cosmetic manufacture, soft and hard paraffins for cosmetics, etc. Reference is made to modifications in the British Pharmacopœia specification in 1936 in respect of cold test, sulphuric acid test, and viscosity, and the reason for these changes are given. In applying medicinal oil for laxative purposes, it must be remembered that the oil not only is devoid of nutritive value, but will reduce the benefit obtained from food in the system at the time of application and remove fat-soluble vitamins, such as C, in solution.

The literature regarding carcinogenic properties of oils is surveyed, and reasons for suspecting that some of the positive results reported for medicinal paraffins may be due to use of samples not complying with the B.P. specification given. The conclusion reached is that liquid paraffin of a very high standard of purity is available, and if used with moderation and intelligence, is one of the safest and most satisfactory of laxatives. R. A. E.

141. Patents on Special Hydrocarbon Products. A. P. Anderson (Shell Oil Co., California). U.S.P. 2,344,016, 14.3.44. Appl. 25.2.42.—A corrosion protection composition for metals consists of a normally gaseous hydrocarbon oil, substantially free from asphalt, and a small amount of a hydrocarbon wax amine substantially free from chlorine. The amine is a reaction product of chlorinated paraffin wax and ammonia.

G. H. Denison and P. C. Condit (Standard Oil Co. of California). U.S.P. 2,346,153, 11.4.44. Appl. 2.8.40. A hydrocarbon oil has incorporated with it a high-molecular-weight dialkyl thioether oxidation inhibitor and an activator for the thioether consisting of a salt of an acid of phosphorus containing an organic substituent.

G. H. Denison and P. C. Condit (Standard Oil Co. of California). U.S.P. 2,346,154, 11.4.44. Appl. 2.8.40. A hydrocarbon oil has mixed with it a sufficient quantity of a metal phenate to inhibit deterioration, and a polyvalent metal salt of phosphoric acid containing an organic substituent.

H. B. M.

Derived Chemical Products.

142.* The Obtaining of Lubricating Oil Emulsions by Using the Sulphonation Products of Shale Tar as Emulsifiers. A. M. Berkengeim and E. F. Polunina. *J. Appl. Chem.* (*U.S.S.R.*), 1943, **16** (11–12), 345–350.—With a view to finding replacements for the salts of naphthenic and sulphonaphthenic acids as emulsifiers for cutting oils, investigations were made into the use of shale-tar fractions. For this purpose the 210–350° C. fraction of a high (6%) sulphur shale tar was sulphonated and subsequently neutralized. After numerous experiments the following emulsion base composition was finally recommended :

	%.
Mineral (spindle) oil	75–80
Sodium salt of sulphonated shale oil	5–10
Water	14·8
Caustic soda	0·2

Unlike previously used mixtures, the above is emulsifiable in the cold; the resultant mixture may be diluted with water as desired. Aqueous emulsions containing 5–10% of the above mixture were found to have considerably better resistance to electrolytes than normal cutting oils, thus up to 2% NaCl, 3% Na_2CO_3, 1% NaOH, and 5% H_2SO_4 may be added without resultant breakdown. The emulsions are also resistant to temperature (8 hr. at 190° C.); the base itself, however, has only a moderate stability, breaking down after about 35 days at room temperature.

Surface tension measurements on emulsions of varying concentrations gave results in the range 0·53–0·64. Cutting oils made as above exhibit slight corrosive properties, which may, however, be completely inhibited by the addition of 0·55% of Na_2CO_3.

V. B.

143.* Physical Properties of Alkylated Phenols. W. A. Pardee and W. Weinrich. *Industr. Engng. Chem.*, 1944, **36** (7), 595.—The alkylation of phenols with unsaturated hydrocarbons is becoming of increasing importance, and physical data for these compounds are essential for the design of production plants. Physical properties are given for 56 alkylated phenols; the data given include melting points, boiling points, densities, viscosities, refractive index, vapour pressure, thermal conductivity, latent and specific heats, heat of combustion, and heat of reaction for the alkylation process.

J. W. H.

Coal, Shale and Peat.

144.* Phenols in Shale Tar. V. A. Lanin and M. S. Gorokholinskaya. *J. Appl. Chem.* (*U.S.S.R.*), 1943, **16**, 47–49.—Examination was made of the phenols in cracked (liquid phase) tar obtained from Estonian shale. A phenol with melting point 108° C., after recrystallization, was, through its amine, identified as 2 : 6-dimethylhydroquinol.

V. B.

145.* Chemical and Technical Investigation of the Bituminous Shales from the Manturov Deposit. E. I. Kazakov, N. G. Edel'shtein and A. F. Chegis. *J. Appl. Chem. (U.S.S.R.)*, 1943, **16**, 72–77.—Examination of a number of shales from the Manturov deposit (Gorki area) showed these to be a possible source of liquid fuels. Analysis of the average and best (upper layer) shales gave the following results.

	Average, %.	Best, %.
Moisture	21·2	14·7
Ash	57·3	44·8
Sulphur (on dry)	4·6	5·6
Tar	12·9	18·2

The tar (*d* 0·966, S 6·3%, phenols 2·9%) yielded the following cuts :

	Vol. *d*-%.	*d*.	S, %.
Gasoline (end point 200° C.)	21	0·824	7·0
Intermediate cut (200–225° C.)	7	—	—
Diesel fuel (225–360° C.)	58	0·946	5·7
Residue	14	—	—

In addition, there is recoverable from the gas formed on retorting the shale a light casinghead type of gasoline, amounting to 0·36% on the dry shale of average quality. This gasoline has *d* 0·679, S 1·4%, boiling range 30–85° C. The high S and low Ca content of the shale ash render it unsuitable for use in the building industry. V. B.

146.* Oil from Shale. K. V. Knibb. *Petroleum*, October 1944, **7** (10), 180–181.—A historical survey is given of the shale-oil industries of Scotland, Esthonia, Sweden, Japan, and U.S.S.R., together with available data on oil production in the past and reserves of oil-shale available in these and other countries. Details are given of the experimental work on oil production from shale carried out in the U.S. Improvement in quality of some of the fractions (*e.g.*, gasoline) obtained by straight distillation of the crude shale oil is desirable, and may be achieved by modern petroleum processes. To date, oil production from shale involved two principal operations—mining and retorting—thus rendering production expensive. Recently a process for electrical heating and extraction of oil from shale in the beds without mining has been invented by Dr. Lungstrom, and erection of an experimental plant is proceeding in Sweden. Oil shale in the U.S. is regarded as a reserve against dwindling oil supplies, and may be utilized at a later date, when perhaps some new technique, such as the Lungstrom method, and new treatment processes have been evolved. R. A. E.

147.* The Science of Coal-to-Oil Conversion. Part VI. Summary and General Conclusions. W. D. Spencer. *Petroleum*, October 1944, **7** (10), 184–185.—Yields of saleable gas, coke, motor spirit, diesel oil, tar acids, and pitch obtainable per ton of coal carbonized by low-temperature carbonization (also coupled with hydrogenation or synthesis) and by high-temperature carbonization in coke-ovens, horizontal and vertical retorts, are compared and discussed. Comparison is also made between raw-material requirements and product yields obtainable from synthesis and hydrogenation processes. The use of both processes in Germany for military requirements arises from the diversity of products obtainable and the fact that raw-material requirements are non-competitive. The possibility of linking a modified Fischer process with the carbonization and petroleum-refining industries with a view to providing a large range of products for the chemical industries in this country is discussed.

There is little possibility of much increasing oil yields from carbonization processes. Development of coal processing as a means of producing chemicals is considered to be of immediate importance, but development with a view to oil production, should demand and prices increase considerably, is also needed for the future. R. A. E.

148.* Oil Shales of Central Texas. F. B. Plummer. *Oil Gas J.*, 7.10.44, **43** (22), 66.—Oil-shales of the Llano region of Central Texas are confined to the Barnett formation of the Upper Mississippian age. The extent and geological aspects of this formation are described and shown in a map. Sections of the shale pits of the San Baba outcrop show the oil concentration in the shale. The Barnett shale is described as a black and brownish-black, extremely thin-bedded, soft, petroliferous, somewhat carbonaceous shale which weathers to a yellowish-brown or yellowish-grey colour. Its minerological character and the methods of sampling and testing are described. The results from the retorting tests indicate: (1) that the oil content varies greatly in different parts of the section, and from locality to locality; (2) usually the richest shale was the least weathered, and the least oxidized portion was found near the bottom of the pit; (3) the richest shales were found in the bottoms of valleys.

The average yield of oil from 63 samples was 13·61 gallons per ton, the highest being over 40 gallons per ton. The oil from four samples has specific gravities of 0·908–0·952.

It is concluded that the shale is of little commercial value as a source of crude oil unless large deposits of the richest shale can be located, and unless petroleum becomes largely exhausted. However, the shale is worthy of research from the point of processing and production of by-products. W. H. C.

149.* British Research on Petroleum Substitutes. Part I. Basic Materials. R. M. Bridgwater. *Petroleum*, November 1944, **7** (11), 190–192.—The series of articles of which this is the first part is designed to summarize progress made prior to 1939 on researches directed towards the production of petroleum substitutes from indigenous sources. The shale deposits in Dorset, Norfolk, and near Edinburgh are considered as direct sources of petroleum products.

Raw materials considered for production of substitutes include peat, natural gases from coal and oil borings, sewage gas, lignite, cannel coal, bituminous coal, and anthracite. The availability of these materials in the U.K. is indicated.

Coals are classified according to type, and analyses and production data of the various classes are given.

Results obtained by thermal decomposition, solvent extraction, and chemical degradation of coal with a view to ascertaining its chemical constitution are summarized and discussed. R. A. E.

Miscellaneous Products.

150.* Plastics from Petroleum Hydrocarbons have had Spectacular Growth. A. L. Foster. *Oil Gas J.*, 10.6.44, **43** (5), 55.—A brief review is given of the development of plastics and of their increasing production from petroleum, with particular respect to the alkyl celluloses and polyvinylidene chloride. Ethyl cellulose is obtained by treating cellulose with ethylene or with ethyl chloride, producing a range of products of melting points 165–195° C., which may be colourless, transparent, translucent, or opaque. They are used in the manufacture of plastic kitchen ware and other commercial articles, in refrigeration units, and in high-altitude plane installations (owing to their high shock resistance at low temperatures), and in protective wrappings and coatings. Methyl cellulose is obtained by treating cellulose with methyl chloride and dimethyl sulphate, and is a water-soluble product used as an emulsifier, detergent, thickener, etc., in pharmaceutical and similar preparations, and as an adhesive, and in dyeing and printing. Polyvinylidine chloride plastics from chlorine and ethylene are available in two types, one being black and opaque, used for heavy tubing, and the other a light, translucent, yellowish-white product for small tubing and fabricated products. It withstands heating to 240–280° F., is self-extinguishing on ignition, unaffected by ageing or contact with metals or water, and is used largely for tubing and tank linings to resist corrosion. It is also used for wear-resistant fabric impregnation and as a packaging film to protect metal equipment from rust.

C. L. G.

151.* Synthetic Rubber. Part II. Bibliography and Survey. Anon. *Petroleum*, September 1944, **7** (9), 158–160.—A table shows the trade names of various types of synthetic rubber, the first available literature reference, the country of manufacture, scale of production, chemical structure, and brief details of the method of manufacture of each type listed. An extensive bibliography of the subject is also provided.

R. A. E.

152. Heat Stability Features New Group of Synthetic Resins. Anon. *Chem. Met. Eng*, August 1944, **51** (8), 109.—A very brief discussion of a new series of silicone products is given. Silicone products include water-like fluids that remain as fluid as water at the temperature of dry ice. Other fluids are available that retain the consistency of honey over a wide temperature range. Also, there are varnishes and resins for use in electrical equipment where high-temperature operation is desired, and lubricating greases for uses involving high temperatures, low temperatures, and chemical resistance. All the group of silicones are characterized by their temperature stability, inertness, water-proofness, and excellent dielectric properties.

The same issue of *Chemical and Metallurgical Engineering* contains further description of the properties of different series of these products on pages 135 and 136. Greases that function at −40° F. or at 500° F. are described. A. H. N.

153.* The Outlook for Synthetic Rubber. Anon. *Petroleum*, August 1944, **7** (8), 135.—Planning Pamphlet No. 32 issued in New York, 1944, entitled "The Outlook for Synthetic Rubber," by M. A. Brenner, an economic analyst of War Production Board, is reviewed. The probable competitive post-war position of the synthetic rubber industry is summarized as: (1) Neoprene, Buna-N, and Thiokol will probably hold their position as special purpose rubbers; (2) Buna-S may equal or surpass natural rubber for tyre usage; (3) butyl will probably be able to compete with natural rubber on a price basis and to surpass it for inner tubing manufacture; (4) new varieties may combine the desirable properties with fewer limitations. Possibilities of converting butadiene and styrene plants to other uses are discussed. Economic adaptation of polymer plants to other purposes is unlikely.

Post-war supply and demand, Government policy, and the outlook for conversion of existing facilities are discussed, and much statistical data included. A table of comparison of properties of natural and various synthetic rubbers is extracted from the original pamphlet. R. A. E.

154. New Insecticides and the War Effort. R. C. Roark. *Chem. and Eng. News*, 10.9.44, **22** (17), 1464.—A review is given of the insecticides and fumigants being developed to replace pyrethrum, rotenone, and inorganic arsenical and copper compounds, which are in short supply. Greater use is being made of fluorine compounds—sodium fluoride for control of cockroaches and lice, sodium fluosilicate for mothproofing and grasshopper baits, and cryolite for codling moth, cotton boll worm and leaf worm, bean beetle control, and to some extent for cotton boll weevil, against which it is less effective than calcium arsenate. New preparations of nicotine, which is in good supply, are being developed—nicotine bentonite for codling moth and cornborer control and nicotine aerosols for greenhouse work. Fumigants such as methyl bromide are being more widely used for pest control in stored vegetables, cereals, for delousing and bed-bug control, and, when mixed with chlorinated hydrocarbons, for grain fumigation. Acrylonitrile, trichloracetonitrile, the nitroparaffins, and 1 : 1-dichloro-1-nitroethane are also promising fumigants. D. D. Mixture (1 : 2-dichloropropane and 1 : 3-dichloropropylene derived from petroleum) gives good control of soil nematodes and wire worms. Many hundreds of synthetic contact insecticides have been patented, particularly thiocyanates and *iso*thiocyanates, the latter being more irritant to man and more injurious to fruit and foliage. The most widely used pyrethrum substitutes include Lethane 384 (2-butoxy-2'-thiocyanodiethyl ether), Loro (dodecylthiocyanate), and Thanite (largely *iso*bornylthiocyanoacetate). One of the most promising synthetic insecticides is D.D.T. (2 : 2-bis-(*p*-chlorophenyl)-1 : 1 : 1-trichloroethane), which may be used in dusts, aqueous dispersions, solutions or emulsions for the control of a large variety of agricultural and horticultural pests. Very many synthetic stomach poisons have been patented, largely for moth control—*e.g.*, the Eulans (one of these is a pentachlorodihydroxy triphenylmethanesulphonic acid). These have possibilities in the agricultural field. As lead-arsenate substitutes, phenothiazine controls codling moth, but interferes with colour formation in apples and affects the skin of operators. It is also useful for the control of worms in sheep, horses, etc. Phenothioxin is a useful rotenone substitute, and xanthone is toxic to codling moth. Pyrethrin activators developed include IN 930 (*iso*butyl undecylene amide) DHS (ethylene glycol ether of pinene), sesame oil, piperine, and certain benzamide derivatives. Organic fungicides of value include 2 : 4-diaminodiphenylamine, phenothiazone, dimorpholine thiuram disulphide, and ferric dimethyl dithiocarbamate. The most important development in the application of insecticides is

the use of aerosols (solutions of the insecticide in a low-boiling liquid such as Freon, under pressure), the fine particle size of which is claimed to enhance toxicity. Similarly, very finely divided phenothiazine and Paris Green is claimed to be more effective, but there is a limiting size.
C. L. G.

155. Insecticides and Fungicides. Some Recent Developments Surveyed. Anon. *Chem. Tr. J.*, 10.11.44, **115** (2999), 491.—See Abstract No. 154.
C. L. G.

156.* The Synthetic Rubber Programme Plant Investment and Production Costs. Anon. *Nat. Petrol. News*, 13.9.44, **36** (37), 28.—The investment and production costs for synthetic rubber, based on figures supplied by the Rubber Reserve Company as supervisors of the Government-owned synthetic rubber plants, are given. Dewey introduced the report with a statement on the place of rubber in the war effort, and estimates that the post-war world demand will use all the crude rubber which present plantations can provide, together with that from the low-cost producers of synthetic rubber. The report deals with the general situation, and gives a review of the chief synthetic rubbers, from which Buna-S, Neoprene-GN Butyl rubber were chosen as the real basis of the synthetic rubber programme. A table gives the comparison of the present programme with the Baruch Committee Recommendations, and shows a considerable difference between the rated capacities of the programme and those recommended by that Committee, but it is thought that the present programme corresponds to probable consumption. Charts are provided to show the estimated direct costs of butadiene from alcohol and petroleum, and for the costs of styrene for typical prices of benzene and ethylene; and of GR-S for typical prices of butadiene and styrene. Operating costs of neoprene-GN and butyl plant and of butadiene, styrene, and co-polymer plant are given. There is a summary of the rubber programme capacities, giving production and investment for the various plants.
G. A. C.

157.* Rubber Director's Final Report Forecasts Huge Post-War Demand for Crude and Synthetic. Anon. *Nat. Petrol. News*, 13.9.44, **36** (37), 28–56.—At the request of the Rubber Director, reports have been prepared by responsible Government officials on: (*a*) Plant investment and production costs relating to the U.S. Government synthetic rubber programme, (*b*) estimated costs and sales realizations of natural and synthetic rubber as of June 30th, 1944, (*c*) pre-war costs of production for plantation rubber. Reports (*a*) and (*b*) are included in the present article.

In an introduction to the reports, the Rubber Director expresses the opinion that the demand for rubber after the war will be far greater than the capacity of the world's plantation before the war, and that, in consequence, there will be a large demand for Buna S as well as speciality synthetic rubbers, the extent of which is estimated at 400,000–600,000 tons. Anticipated cost of synthetic production will tend to control world prices of crude rubber.

Report (*a*) details the synthetic-rubber programme, the changes made to the original plan, current and estimated ultimate annual capacities of plants, and the quantities of butadiene produced from various sources. Tables give detailed information on the location, capacity, and cost of the plants concerned. For Buna S production, Government-owned butadiene factories have a rated annual capacity of 626,000 tons, and represent an estimated investment cost of $347,000,000; corresponding figures for styrene are 188,500 tons and $83,000,000, and for copolymer plants 705,000 tons and $162,000,000. Including neoprene and butyl rubber plants, the total U.S. Government investment cost is about $700,000,000, and rated annual capacity of the plants is 827,000 tons. Ultimate capacity is estimated to be about 25% greater. Much information is also given on present and estimated post-war direct operating costs of butadiene, styrene, copolymer, neoprene, and butyl rubber plants. Owing to the high cost of alcohol, butadiene from this source is five times as expensive as from petroleum sources at present, and it would appear that butane and butylene dehydrogenation plants are likely to be the low-cost producers of the future. Assuming certain values for raw material it is considered that in the post-war period production costs as low as 6–7 c. a lb. for butadiene, 4–5 c. a lb. for styrene, and 10·7 c. a lb. for Buna S are possible, in the cheapest producing plants. These figures exclude amortization and interest charges, selling expenses, and provision for profit, which it is estimated may add 2–4 c. a lb. to the costs. Direct costs at present are around 35 c. a lb. from Report (*b*), and are doubtless due in part to high cost of butadiene and the fact that production was not then in full swing. R. A. E.

Engines and Automotive Equipment.

158.* Water Cooled Bearings : The Problem of Corrosion. A. H. Stuart. *Petroleum,* August 1944, 7 (8), 140–145.—An investigation has been carried out to ascertain conditions governing the corrosion of steel shafts in contact with graphite in the presence of water, with special reference to the employment of water-cooled resin-bonded bearings incorporating graphite. This corrosion is due to electrolytic action, and the conditions which govern incidence of corrosion in the system are described. Important factors which control these conditions are particle size and presence of impurities in the graphite. The use of a pure colloidal graphite will tend to reduce corrosion, especially where the particles are bonded with a resin. Inclusion of such graphite in the cooling water will also tend to reduce corrosion, as well as reducing coefficient of friction. Control of pH value of the cooling water is also of great importance. R. A. E.

159.* Motor Vehicle Power Plants and Transmission Line Units. R. Cass. *Refiner,* August 1944, **23** (8), 305–306.—This article is an extract from a paper presented before the Los Angeles Chapter of the Society of Automotive Engineers. Only that part of his paper dealing with fuels has been used. It is significant that the manufacturer of the diesel engine is concerned about the quality of fuel indicated for the post-war period, the refiner is concerned about the number of diesel engines that will be available for consuming fuel. The indications are that outstanding advance in diesel engines will be noticed as a consequence of the war. A. H. N.

BOOK REVIEWS.

Kurs Eksploatatzii Neftyanuikh Mestorozhdenii (Course on the Exploitation of Petroleum Deposits). Part I. The Physical Basis of the Obtaining of Petroleum and the Principles of the Development of Petroleum Deposits. By I. M. Murav ev and F. A. Trebin. Pp. 352. Moscow, 1937.

The book is based on a series of lectures delivered to students at the Moscow Petroleum Institute. After a very brief discussion of the main geological features of oilfields, there is a somewhat more detailed treatment of the nature of oil bearing structures, and of porosity. A short survey of the properties of crude petroleum, with particular reference to surface tension, follows.

Natural gas is touched upon, including an elementary treatment of the gas laws. Oilfield waters are given a chapter, which includes analytical data on waters from several U.S.S.R. fields. Pressure and temperature conditions in natural oil reservoirs, including the pressure effects of edge waters, are next considered.

The physics of oil and gas movement within the oil-bearing structure is fairly throughly dealt with, particularly with regard to its influence on reservoir drainage.

The productivity of wells is discussed, and a short account given of the methods of estimating underground reserves. The book concludes with a consideration of oilfield development principles—namely, factors such as well spacing, and the like.

The work as a whole is a not unsuccessful attempt to produce a compact account of the practical aspect of the production side of the industry, addressed to the reader without previous oil experience or technical training (although a certain slight knowledge of mathematics is assumed). Each section has a bibliography of original sources, almost exclusively Russian or Russian translations of American work.

V. B.

A Review of the Literature on the Oxidation of Bituminous Materials with Special Reference to Road Tar. By R. Preston, M.Sc., F.R.I.C. (Chemical Research Laboratory, Teddington, Middlesex.)

The failure of bituminous carpets is often determined by the development of brittleness of the binder, described generally as " weathering " or " ageing," and ascribed by many observers to loss of volatile matter by evaporation. It is now believed that other factors, and particularly oxidation, are responsible for the notable increase in viscosity observed on the exposure of road tar to the action of weather for long periods ; for example, in one case as much as 93% of the increase in viscosity that occurred in road-tar on indoor exposure was found to be due to changes other than volatilization. By making a suitable allowance for oxidation in interpreting certain laboratory durability tests of road tar, the Road Tar Research Sub-Committee of the D.S.I.R. were able to establish a degree of statistical correlation between these results and the durability of the tars on the road.

Observations on the effects of the exposure of tars to the atmosphere, heat, light, and oxygen have been reported by several investigators, notably in recent years by J. G. Mitchell, working at the Chemical Research Laboratory under the aegis of the Road Tar Research Committee of the D.S.I.R., and it is reasonably established that tars undergo chemical changes on exposure to oxygen under various conditions of light and heat, which result in considerable increases in viscosity and free carbon content. Light accelerates the reaction with oxygen, but in its absence, the rate of oxidation falls off with time—*i.e.*, is auto-retardant. Heat and pressure increase the rate of oxygen absorption, and the increase in free carbon content is roughly proportional to the amount of oxygen absorbed.

Accelerated laboratory tests similar to Standard tests for the oxidation of lubricating oils, and employing considerably higher temperatures than are met on the road, are not satisfactory for classifying road-tars in order of susceptibility to oxidation; they have indicated, however, that basic constituents of tar appear to be primarily attacked, and that free carbon increased considerably under these conditions of oxidation.

Other materials of the bituminous class, asphaltic bitumen, mineral oils, etc., suffer changes on exposure to oxygen, producing insoluble products—asphaltenes, etc.—analogous to the free carbon portion of tars, but, in spite of the amount of work that has been carried out, there is still much scope for further research in this field. The increase in "insolubles" resulting from the oxidation of this class of materials is apparently due to the increased molecular sizes arising from polymerization, condensation, and intramolecular reactions. The importance of oxidation as it affects the serviceabilty of mineral oils has called for much research work in this sphere, the results of which have established certain generalizations of restricted scope. Generally speaking, the aromatic types of unsaturated hydrocarbons, and particularly those of the polynuclear kind, give auto-retardant oxidation–time curves; aliphatic hydrocarbons, particularly if unsaturated, and naphthenes are autocatalytic in their reaction with oxygen. In consequence, the deterioration of coal-tar from oxidation would be expected to be less than that of petroleum products containing more of the paraffinic and naphthenic class of compounds. The susceptibility to oxidation of mixtures of different chemical groups is not found to be a simple function of the oxidation of the component groups of the mixture, and better resistance to oxidation may therefore be obtained by suitable blending of components.

The oxidation reaction is catalyzed by certain metals and their salts, of which iron is the most important of the commoner metals. Conversely, oxidation can be inhibited in the case of mineral oils by the addition of certain compounds, many of which are derivatives of the aromatic class. Such compounds are already present in coal tar as major constituents, and therefore determine its rate of oxidation rather than control it, as in the case of small proportions of inhibitors in mineral oils.

Copies of the report are available on application to the Superintendent, Chemical Research Laboratory, Teddington.

BOOKS RECEIVED.

Developments and Trends in American Industries. Oil Mining and Refining: High Octane Gasoline. Pp. 9. United States Office of War Information, American Embassy, 1, Grosvenor Square, W. 1.

Excerpts from trade magazine articles and other sources giving a broad survey of important technological and scientific developments and trends in U.S. oil-mining and refining in recent years.

Science and Technology in the Oil Industry. M. A. Kapelyushnikov. Society for Cultural Relations with the U.S.S.R., 98, Gower Street, W.C. 1.

Statutory Rules and Orders, 1944. No. 988. Emergency Powers (Defence). **Benzole and Coal Spirit (G.B.)** Pp. 10. H.M.S.O., York House, Kingsway, W.C. 2. Price 3*d.* net.

Polish Fortnightly Review. 15.11.44, No. 103–104. Pp. 8. Polish Ministry of Information, Stratton House, Stratton Street, London, W. 1.

This number of the Review contains articles on the following subjects:—

Polish Petroleum and Natural Gas Production.
Polish Natural Gas Industry.
Organizational and Financial Structure of the Polish Oil Industry.
Poland's Oil Problem.

The Purpose of an International Oil Agreement. Address by Joseph E. Pogue, Vice-President of the Chase National Bank of the City of New York, before the Interstate Oil Compact Commission.

La Economia del Petroleo en Colombia. E. Ospina–Racines. Pp. 107. Editorial Antena, S.A., Bogota, Colombia.

Report of Conferences on Standardization of Screw Threads and Cylindrical Fits. Pp. 38. Combined Production and Resources Board. London, August–September 1944.

Proceedings, 24th Annual Meeting of the American Petroleum Institute. Section IV. Production. Vol. 24, 1943. Pp. 482. American Petroleum Institute, 50 West Fiftieth Street, New York 20, U.S.A. Price 50 cents.

This section includes papers on Production, a Symposium on Corrosion of Pipe-Lines, a Symposium on Secondary-Recovery Methods, Bibliography on Secondary Recovery, a paper on the Standardization of Electric-Log Headings and Standing-Committee Reports of the Division of Production.

INSTITUTE NOTES.

JANUARY, 1945.

A NEW DEPARTURE BY THE INSTITUTE.

When the inner history of the present war comes to be told, one of the most impressive chapters will concern the contribution of the petroleum industry in this country to the prosecution of the war. Much of what has been and is being done is necessarily still on the secret list, but the way in which the industry has co-operated with the Services and Government Departments is no secret. Not least of the industry's co-operative efforts has been in the direction of researches in the applications and testing of fuels, lubricants, and other products.

The Institute of Petroleum has been quick to grasp the opportunity of carrying this co-operative spirit in research into the era which lies ahead of us, and has now taken a sound lead in establishing the machinery to sponsor work on this basis for the benefit of the industry and those it serves.

In March of this year the Council set up an *ad hoc* Committee to examine the best means of undertaking fundamental research under I.P. sponsorship. This committee reported back to the Council, and its recommendations were embodied in the Council's decision along the following lines :—

PRINCIPLES.

It was decided that the methods of tackling research of a cooperative nature can be classified as follows :—

1. Fundamental scientific research which can be conducted better in university laboratories than in industrial laboratories.

2. Co-operative research in industrial laboratories on problems of general interest to the petroleum industry.

3. Co-operative research in which the oil industry as a whole is interested jointly with another industry or body.

4. Applied research on problems of interest to the petroleum industry, but falling outside the normal professional and scientific interests of those engaged in the industry. Possible examples are the medical problems connected with the use or handling of petroleum products and agricultural research connected with the use of petroleum products or derivatives in agriculture.

RESEARCH COMMITTEE.

A strong committee of the Council, to be known as the Research Committee, was set up to be responsible for carrying out the policy determined by the Council from time to time in regard to problems involving co-operative research.

The Research Committee was constituted as follows :—

F. H. Garner.
S. J. M. Auld.
G. H. Coxon.
E. A. Evans.
V. C. Illing.
J. S. Jackson.
J. A. Oriel.
C. A. P. Southwell.
H. C. Tett.

Mr. Tett was elected Chairman, and subsequently Dr. D. A. Howes and Mr. S. M. Blair were co-opted as members of the Committee.

As financial and accounting questions are obviously involved, the Chairman of the Finance Committee is an *ex officio* member of the Research Committee.

The functions of the Research Committee are to decide whether any project submitted is suitable for the Institute's sponsorship, and to ascertain whether such research will be supported by members of the industry. This decision will be taken in line with the Institute's view that it is not concerned with *ad hoc* problems, but only with fundamentals of general interest in the field of petroleum technology.

Method of Operation.

Having agreed that a piece of research is suitable for sponsorship by the industry, the Research Committee will establish a Group, and appoint from its members a Chairman of the Group. The Group will include only representatives of those interests or companies whom the Research Committee has ascertained agree to support the particular project and who have experts actively engaged on similar work. In addition, recognized experts in the field of work concerned may be co-opted. This Group then becomes responsible for initiating, organizing, and directing the research, and is also responsible for determining how any expenditure involved shall be apportioned among the contributing members. The Group is required to report to the Main Research Committee at regular intervals on the general progress of the project, but not necessarily on the scientific results obtained. It is also required to have regular progress reports prepared for the benefit of its own members, and such reports are available, for an agreed period, only to members of the sponsor companies. After the lapse of this period the reports will normally be published by the Institute.

First Project—The Hydrocarbon Research Group.

The first project undertaken by the Research Committee is one concerned with physical properties of hydrocarbons, with particular reference to spectroscopy. A Group consisting of the following members, was set up to get this project going under the sponsorship of the organizations represented :

D. A. Howes (Anglo-Iranian Oil Co., Ltd.) (*Chairman*).
S. M. Blair (Trinidad Leaseholds, Ltd.).
R. Holroyd (Imperial Chemical Industries, Ltd.)
R. I. Lewis (Asiatic Petroleum Co., Ltd.).
E. B. Evans (Anglo-American Oil Co., Ltd.) (*Secretary*).

In addition, the M.A.P., who are interested in certain aspects of this project, are represented by Dr. le Fevre. This Group is known as the Hydrocarbon Research Group. The members of the Group all belong to companies or departments who contribute to the project and themselves have extensive experience and facilities in the field of spectroscopy. A programme of work was submitted to the Group by Dr. Sutherland and Dr. Thompson of Cambridge and Oxford Universities, respectively, who have a long experience in this work.

While the programme has special reference to spectroscopy, it will involve the preparation of a number of pure reference hydrocarbons, and the opportunity will be taken of studying certain physical properties which will undoubtedly be of general interest. The companies concerned in this project, together with the Ministry of Aircraft Production, have contributed something in the order of £6000 between them for the first year's work, which is now being carried on at several of the university laboratories.

FORTHCOMING MEETINGS.

Wednesday, 14th March, 1945, at 5.30 p.m. Original papers by Sub-Committees of the Standardization Committee.

PERSONAL.

Mr. W. E. Aylwin, M.C. (Fellow), has been appointed a director of Midland Tar Distillers, Ltd.

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 Members.

Cree, John A. Cook.
Davies, Gilbert Marr.
Edwards, Francis Dare.
Ellis, Percival Francis.
Green, Joseph Albert.
Paysant, Charles Jules.
Perry, Richard Gilbert.
Richardson, Ernest Frederick.
Sawdy, Alfred Eustace.

Transfer to Member.

Smith, Norman Wilson.

As Associate Members.

Batchelor, Clifford Henry.
Clarke, John William.
Hardman, Eric.
Simmons, Thomas Mortimer.

As Students.

Baxendell, Peter Brian.
Boyle, Russell I.
Caston, John E. F.
Farmer, Michael H.
Jacques, David F.
Malpas, William E.
Pearson, Peter Dennis.
Rogers, Derek A. J.
Tadayyon, Jamal.
Tennant, Frank E.
Wall, Colin G.

APPLICATIONS FOR MEMBERSHIP OR TRANSFER.

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

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

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

Membership.

Braybrook, Frederick Houghton, Manager, Technical Products Dept., Asiatic Petroleum Co., Ltd. (*J. Kewley ; F. H. Garner.*)
Braybrook, William Adam Robert, Production Superintendent, Cannar Oils, Ltd. (*J. M. Penney.*)
Klimkiewicz, Wladyslaw Jan, In charge Mining Section, Institute of Technical Research, Polish Army. (*D. Wandycz ; W. de J. Piotrowski.*)
Laurie, Thomas Franklin, General Sales Manager, Petroleum Board. (*F. H. Garner ; E. B. Evans.*)
Mason, John, Inspector of Fuels & Lubricants (I.N.M.3) D.A.I. (*F. N. Harrap ; E. B. Evans.*)
Matthews, Thomas Henry, Development Chemist, National Oil Refineries, Ltd. (*D. A. Howes ; P. Fleming.*)
Olley, Norman Maxwell, Asst. Chief Engineer, Manchester Oil Refinery, Ltd. (*H. Moore ; H. E. Charlton.*)
Quayle, Joshua Creer, Engineer in charge of Condenser Research Laboratory, British Insulated Cables, Ltd. (*J. C. Wood-Mallock ; J. S. Parker.*)
Tuft, Theodore Cecil, Foreman in charge, Manchester Oil Refinery, Ltd. (*E. J. Dunstan ; E. S. Sellers.*)
Williams, Thomas Leslie, Superintendent, National Oil Refineries, Ltd. (*R. B. Southall ; E. Thornton.*)

Wilson, George Noel, Deputy General Manager, Shell-Mex & B.P., Ltd. (*John A. Oriel ; G. H. Coxon.*)

Winning, W. Carl, Technical Adviser, Standard Oil Co. of New Jersey. (*H. C. Tett ; F. H. Garner.*)

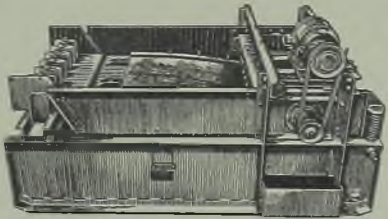
Transfer.

Hodgson, William Ronald Penrose, Manager, " Shell " Central Laboratories. (*John A. Oriel ; J. S. Jackson.*)

DIESEL ENGINE USERS ASSOCIATION.

Owing to illness, Mr. E. W. Johnston, who as Joint Honorary Secretary has for a considerable time past dealt with the secretarial work connected with the Diesel Engine Users Association, is resigning the honorary secretaryship. An Honorary Member and Past-President of the Association, Mr. Johnston has for twenty-six years taken a prominent part in its affairs, earning the esteem and gratitude of members throughout the world. He is succeeded as Secretary by Mr. Hamish Ferguson, who for some months has been assisting him in the work. Mr. Johnston's many friends will be glad to know that he is making a good recovery.

ARTHUR W. EASTLAKE,
ASHLEY CARTER.
Joint Honorary Secretaries.



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The Institute as a body is not responsible for the statements of opinion expressed in any of its publications.

Copyright.—Publication of abstracts of Papers and articles appearing in the Journal is permitted, provided that acknowledgment is made to the Institute of Petroleum.

Papers and Articles.—The Council invites Papers and Articles both for reading at Ordinary Meetings of the Institute and for publication in the Journal. All Papers, whether for reading or publication, will be submitted to a referee appointed by the Publication Committee.

The Institute has published a brochure " Instructions for the Guidance of Authors " containing details of recommended practice in the preparation of Papers for publication. Copies of this brochure will be supplied on request.

Pre-Prints.—If available, advance proofs of Papers to be read at Ordinary Meetings can generally be obtained about a week before the Meeting. Members wishing to be supplied with these pre-prints are requested to notify the Secretary.

Abstracts.—Members and Journal Subscribers desirous of receiving the Abstracts printed on one side of the paper only, can be supplied with these at a charge of 10*s*. per annum per copy, payable in advance.

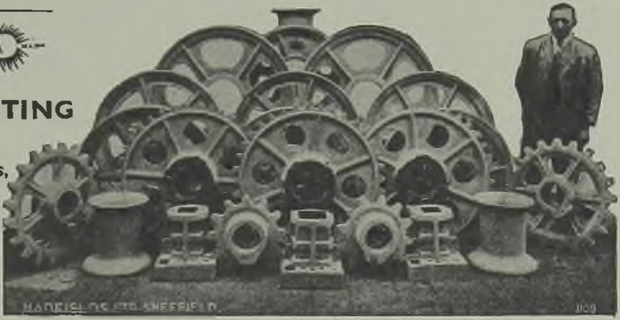
Issue of Journal.—Members whose subscription is not in arrears receive the Journal free of cost. A member whose subscription is not paid by March 31st of the year for which it is due is considered to be in arrears.

Changes of Address.—Members are requested to notify any change of address to the Secretary.

Benevolent Fund.—The Benevolent Fund is intended to aid necessitous persons who are or have been members of the Institute, and their dependent relatives.

The Fund is raised by voluntary annual subscriptions, donations, and bequests, and all contributions should be sent to the Secretary of the Institute at 26, Portland Place, London, W.1. The Fund is administered by the Council through the Benevolent Fund Committee.

Library.—The Institute's Library may be consulted between the hours of 9.30 a.m. and 5 p.m. daily, excepting Saturdays.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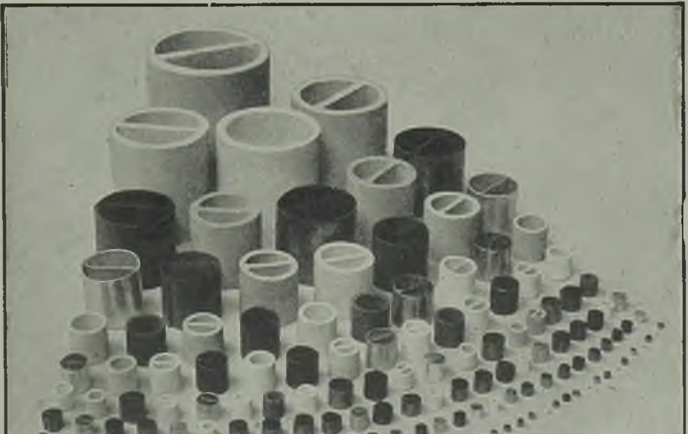

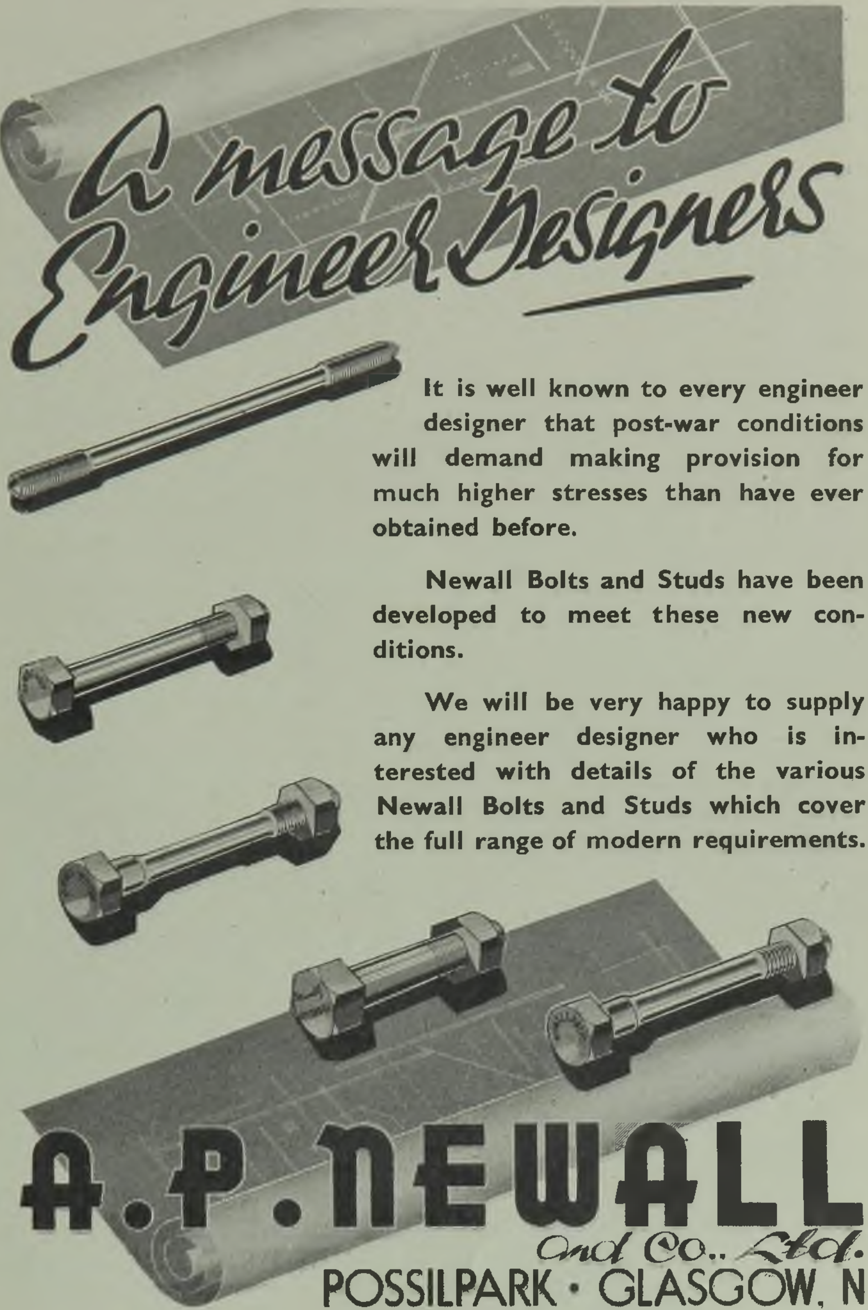

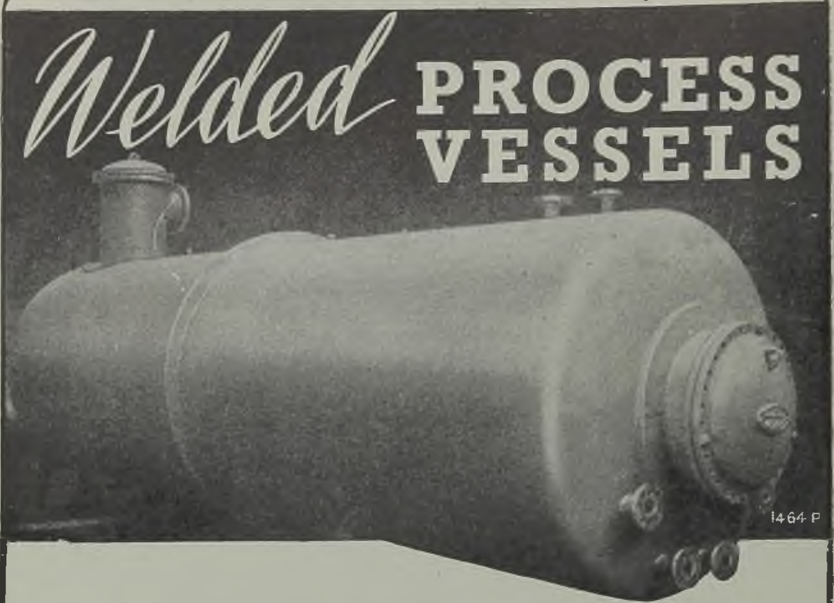
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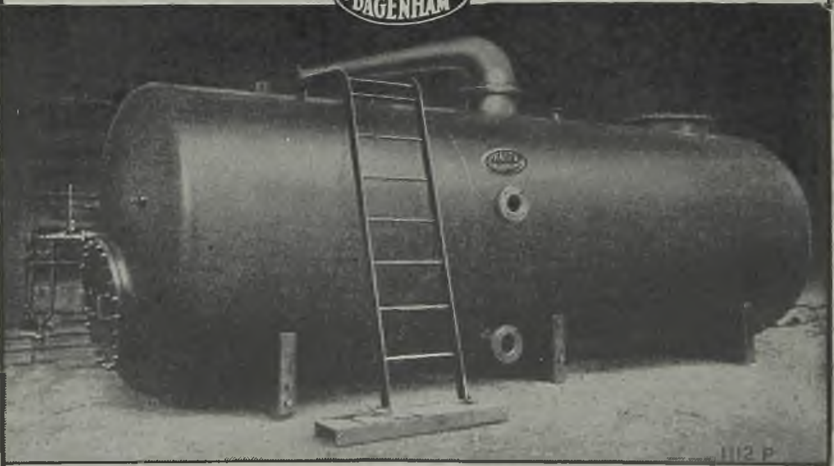
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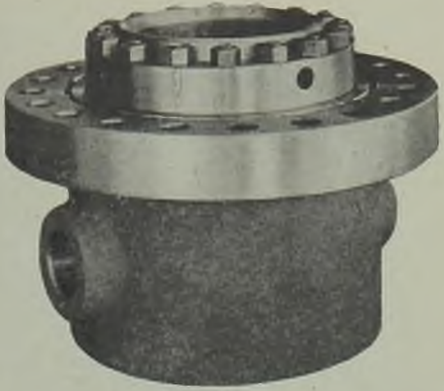
Type JH-1 Casing Heads to support and pack off long strings of Casings against high pressure.



Type EH-3 has a flange at the upper end permitting the attachment of blow out preventers or flanged tubing or casing heads.

NATIONAL CASING HEADS

Type KH-1 is for medium pressure service.

Types JH and KH Casing Heads are of the slip suspension type permitting setting casings at any depth without cutting special nipples. Packing is located above slips and is independent of the weight of the casing.

Type EH Casing Head is of the mandrel suspension type. In the patented packing arrangement a single gland compresses two rows of narrow asbestos packing.

NATIONAL OWECO

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FOR A MODERN LUBRICATING OIL PLANT
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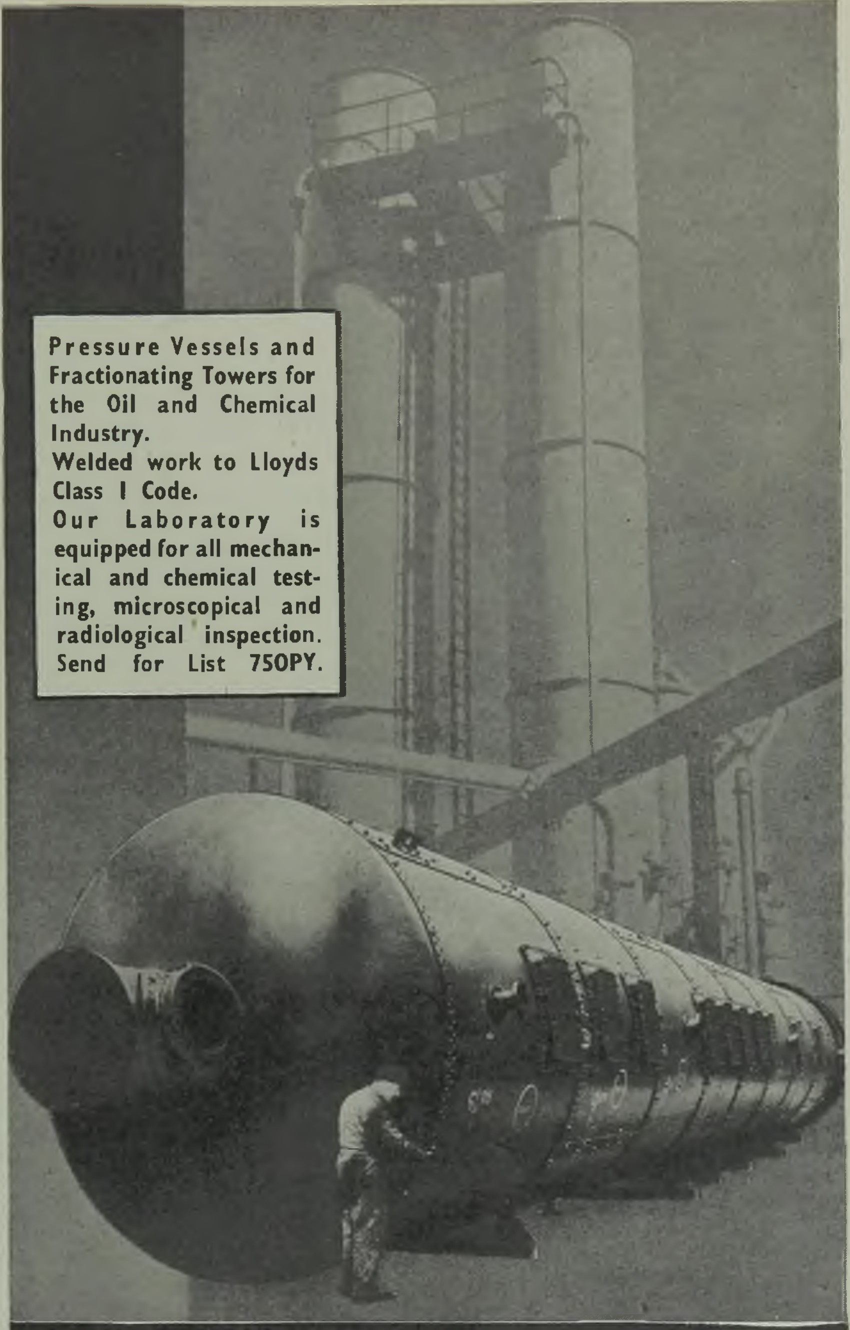
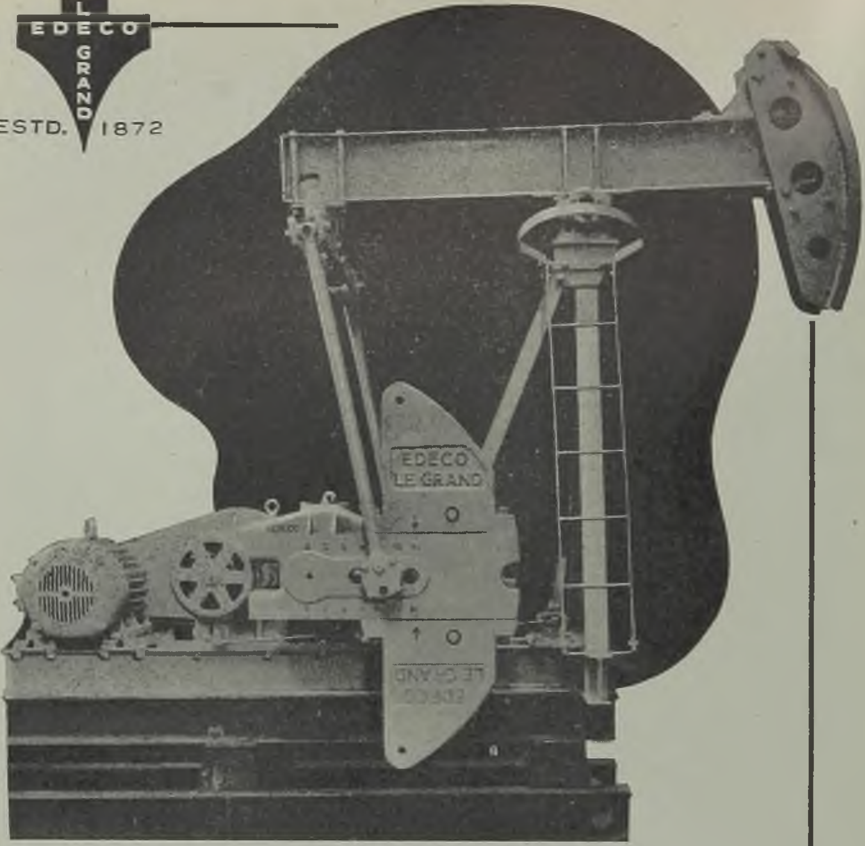
RAYMOND
RAYMOND LABORATORY MILL

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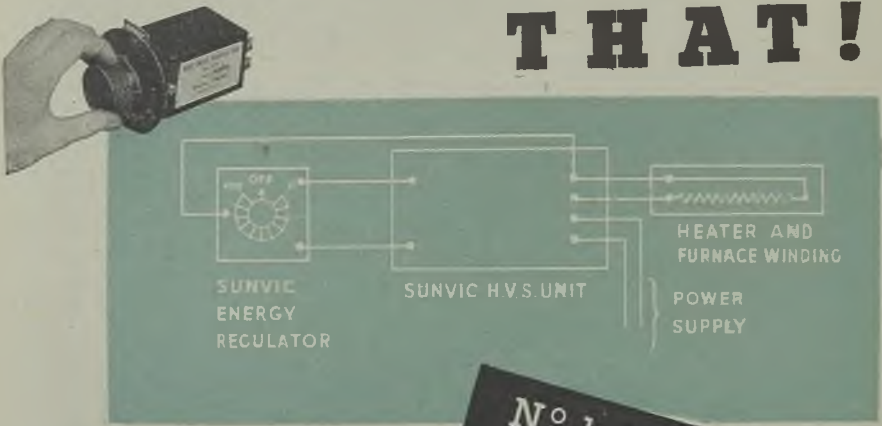
OFF
SUNVIC ENERGY REGULATOR
SUNVIC H.V.S. UNIT
HEATER AND FURNACE WINDING
POWER SUPPLY