# ABSTRACTS.



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The numbers refer to the Abstract Number.

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# Oilfield Exploration and Exploitation.

## Geology.

**242. West Edmond Opens Big Area for Hunton.** E. G. Dahlgren. *Oil Wkly*, 18.9.44, **115** (3), 31.—The West Edmond field of central Oklahoma provides the first important production on the west flank of the Nemaha granite ridge. It has the deepest and most westerly known Hunton limestone oil production. The most northerly and most southerly producing wells are 9 ml. apart. Parts of the field have been defined on the east and west. On the east, the Bois d'Arc producing section is missing. 126 wells have been completed on 40-acre spacing in the Bois d'Arc section of the Hunton (Devonian). Two wells produce from the Bartlesville, and one from the Oswego. There are six dry holes.

The drilling depth is 6700–7200 ft., and the average drilling time is about 70 days. Contract drilling prices range $6·75–7·50 per foot. Details of drilling and completion practices are given. 3,208,000 brl. of oil had been produced to 20th August.

The field was discovered in April 1943. The discovery well found the first and second Wilcox sands at 7508 and 7640 ft., respectively, and both were unproductive. The Hunton was tested at 6938–6956 ft. The bottom-hole pressure was 3130 lb./sq. in. The field may be 24 ml. long and 5 ml. wide.

The post-Mississippian erosion removed some of the Woodford shale and chert (Devonian or Mississippian), and much of the Mississippi limestone. The Bois d'Arc limestone of the Hunton averages 70 ft. in thickness, and is 150 ft. thick in parts. Portions of it are dolomitic and crystalline. Estimates place the porosity at 10–15%, and the saturation at 50%. An erosional channel has removed much of the Bois d'Arc section in one place. There is a similar gulley in the northern part of the old Edmond field. No wells have reached the Arbuckle.

The pressure drop appears to be 1 lb. per 16,848 brl. of oil withdrawn. Natural flow may continue until the pressure falls to 1000 lb./sq. in. or less. No evidence of a water drive has been noted. The gas seems to be coming out of solution.

Barrow has estimated West Edmond's reserve as 117,000,000 brl. in August 1944. Another estimate gave 144,000,000 brl.

A geological map, isopach map, and cross-section are included. G. D. H.

**243. Prospects Favourable for Deeper California Production.** A. Gregersen and F. S. Parker. *Oil Wkly*, 25.9.44, **115** (4), 34.—The risks involved in deeper zone exploration are less than in wildcatting for a new field, since the structural hazard is materially reduced. The main problems concern source and reservoir rocks.

Eocene formations appear to offer most of the untested prospects for deeper zone production in California. Commercial production has been obtained from the Eocene in the San Joaquin and Sacramento Valleys, and in the Ventura Basin, while there have been showings in the Santa Maria and Los Angeles Basins. Gas has been produced commercially from the Cretaceous in the San Joaquin and Sacramento Valleys, while oil has been obtained at Coalinga. The " basement " rocks also offer possibilities.

A number of fields in the Los Angeles Basin have not completely penetrated the

Miocene Section. The bulk of the production is from the uppermost Miocene. In two instances production is from the Middle Miocene. The north-eastern part of the Los Angeles Basin seems best for Eocene prospects.

On the east side of the San Joaquin Valley the basement has been reached in most fields. On the west side the recent discovery of Eocene production in the Antelope field has enhanced the deeper prospects for Eocene production in other fields on the west side.

In the Ventura Basin one of the most prominent untested possibilities is that of accumulation below the major thrust faults bordering the Santa Clara River Valley. Deeper possibilities in the Santa Maria Basin fields are largely concerned with accumulation below the Monterey (Upper Miocene), where oil from Miocene shales has had a chance to migrate into such older rocks.

Most of the gas fields in the Northern District have penetrated and tested beds of Upper Cretaceous age. In some of these fields only the uppermost Cretaceous sands have been found productive.

The possibilities of the various fields are briefly discussed, and tables give the producing horizons and the greatest depths attained in the different fields. A series of maps are included. G. D. H.

**244. Exploration Increased; August Record Good.** L. J. Logan. *Oil Wkly*, 25.9.44, **115** (4), 52.—During August, exploratory completions averaged 97 per week in U.S.A., and there were 91 successful exploratory wells, at least a dozen of which are of special interest. The Eylau field of East Texas (Bowie County) provided the State's first Smackover limestone production. In West Texas, the Crossett field was opened by the State's first Devonian producer. The Charlotte field of Atascosa County, South Central Texas, opened a new region of Edwards limestone production. The South Tyler field of Smith County, East Texas, appears to be a major find. Oil is obtained from the Rodessa at 9919–9929 ft., and there are four prospective pay zones between 9556 and 9961 ft. The Fullerton field of West Texas had a 1½-ml. extension, and a new deeper pay.

An important gas area was opened in Barlow County, Kansas. New oilfields in Clay and Richland Counties were among Illinois' dozen discoveries and extensions. The Fork field of Mecosta County, Michigan, was extended considerably. A gas discovery was made in Solano County, California, and a rich new zone was opened in the Rio Vista field.

An average of 81 wildcats per week have been completed in U.S.A. during the first eight months of 1944. In the corresponding period of 1943 the figure was 67. 18·5% of this year's completions have been successful, compared with 17·9% in the same period of 1943, but the increase in oil discoveries has been less than for gas and distillate discoveries.

The August new discoveries and extensions are listed with pertinent data. Tables summarize the exploratory drilling results by States and districts for August, and for the first eight months of 1944, and give some comparative totals for 1943.

G. D. H.

**245. Colombia Is Active both in Development and Exploration.** W. A. Sawdon. *Petrol. Engr*, October 1944, **16** (1), 78.—Despite equipment shortages, wildcat drilling has gone on in Colombia, and when the situation becomes easier exploratory work will increase. Production is obtained from La Cira, Infantas, Petrolea, Tres Bocas, Socuavo, Rio de Oro, Casabe, El Dificil, and Aguas Claras.

Shortage of tankers has caused the Colombian production to be seriously restricted during the past two years, but the output is rising, and was 13,000,000 brl. during the first half of 1944. The present potential of the producing fields exceeds export facilities. Two pipe-lines with a total capacity of nearly 30,000,000 brl./year serve the two main producing areas. A refinery at Barranca Bermeja has a capacity of 14,000 brl./day.

If oil is discovered in the Llanos region a considerable transportation problem will arise.

North of Petrolea, drilling is proceeding in the Tres Bocas and Socuavo pools. The structural conditions are not known with certainty, and there may only be one structure, with producing zones at 4500–5000 ft. and 8500–9000 ft. The Tibu area also produces. At present there is no activity at Rio de Oro. Twenty wells have been completed at Casabe at depths of 4000–7000 ft., and development is proceeding. Three wells have been drilled at El Dificil to depths of 5500–6000 ft. A well to the south obtained a little oil and gas. A little oil has been found in one of three wells drilled on the Las Monas structure, east of Aguas Claras. A producer, whose depth was about 6000 ft., has been completed on the Cantagallo concession, near Puerto Wilches. Shallow showings are reported in a wildcat near the Sinu River, 50–60 ml. from its mouth. G. D. H.

**246. The West Edmond Oilfield.** D. McGee. *Petrol. Engr*, October 1944, **16** (1), 227.—The West Edmond field lies on the west flank of the Granite Ridge, west of the Oklahoma City, Britton, and Edmond fields. The discovery well was brought in in April 1943, flowing 522 brl./day from the Hunton. The bottom-hole pressure was 3110 lb./in.$^2$

The surface beds are of Lower Permian age. The Pennsylvanian has several persistent limestones and a few thick sand bodies in a grey shale series. The post-Mississippian erosion did not remove the whole of the Mississippian beds at West Edmond, and Mississippian limestone is found. The Chattanooga shale is dark and bituminous. Production is found chiefly in the Bois d'Arc member of the Hunton. This, the topmost part of the Hunton, wedges out to the east. Few wells have gone right through the Hunton. Beneath are the Sylvan shale, Viola limestone, Simpson dolomite, and Wilcox sand.

The oil and gas are trapped by thinning of the producing zone to the east, with slight north–south arching. The dip is about 150 ft./ml.

The geological history of the area is briefly described and illustrated by a series of diagrams. An old stream channel cut through the Bois d'Arc member in part of the area.

Apart from the wells giving oil from the Bois d'Arc, three produce from a Pennsylvanian sand, and two from the lowest part of the Hunton.

After acid treatment the average initial production of the Bois d'Arc wells is 1200 brl./day. All except two of the 164 wells flow naturally. Recent completions have had gas–oil ratios ranging 515–1400 cu. ft./brl.

The Bois d'Arc has porous streaks.

The production practices are described, as are drilling practices, hazards, and conservation practices.

The principal source of energy for oil production seems to be dissolved gas, not water advance.

6560 acres have been developed to date; proved acreage amounts to 20,700 acres, and there is 8300 acres of possible production. It is expected that reserves will exceed 100,000,000 brl., and may possibly reach 175,000,000 brl.

The West Edmond discovery may lead to further examination of the east and north rims of the western Oklahoma basin, where the Hunton is similarly partly or wholly truncated. G. D. H.

**247.* Prospective Colombian Discovery Is Reaming.** Anon. *Oil Gas J.*, 28.10.44, **43** (25), 51.—The Colombian wildcat, 1 Floresanto, has had a shallow oil showing, and was reaming at 2218 ft. 5 Cantagallo, in the Magdalena Valley, was abandoned at 7059 ft.

On the Barco concession 10 Socuavo is testing at 5384 ft.

In Venezuela 8 Guario, in the San Joaquin area, is testing at 10,735 ft.

A test on Prince Edward Island, Canada, is drilling at 9775 ft. G. D. H.

**248.* Prince Edward Island Test Drilling at 10,000 ft.** Anon. *Oil Gas J.*, 28.10.44, **43** (25), 58.—The objective of the wildcat being drilled in Hillsborough Bay, off Prince Edward Island, is the Mississippian, expected at 12,000 ft. The well has now reached approximately 10,000 ft. G. D. H.

**249.* Wildcat Completions and Discoveries.** Anon. *Oil Gas J.*, 28.10.44, **43** (25), 131.—73 wildcats, 8 giving oil and 1 giving distillate, were completed in U.S.A. during the week ended 21st October, 1944. The completion results are summarized by States and districts. G. D. H.

**250. Willamar Field Becomes Major Development.** G. O. Ives. *Oil Wkly*, 30.10.44, **115** (9), 20.—The Willamar field of Willacy County, South-west Texas, is on an anticline, and will probably have a producing area of 10,000 acres. Production is from the upper 200 ft. of the Frio. The oil-sand is interbedded with shale, the effective sand totalling 50–60 ft. The gas–oil contact is at a depth of 7845 ft., and the oil–water contact at 7954 ft. The present known reserve is estimated to be 70,000,000 brl. 56 producing wells and a dry hole had been completed up to the end of September.

The structure was worked out by the reflection seismograph in 1935, and the discovery well was completed in November 1940, after drilling to 9002 ft. Completion was at 7620–7678 ft., after the well had almost been abandoned as useless.

The early oil outlet was by trucks, then by tank-car, and later by pipe-line.

One of the main difficulties in development has been that of suitable water supplies. Steam rotary rigs are employed. Wells take 40–45 days to drill and cost about $56,000 each. The entire sand section is perforated because permeabilities are low. Development is on a staggered 40-acre pattern, to allow 20-acre spacing if future performance requires it. The daily output allowed is about 5600 brl.

The Lower Frio has not really been tested, but 7 ml. to the west a wildcat found sandy beds at 4600 ft. in the Frio. G. D. H.

**251. Jarahueca Field Studied by American Companies.** Anon. *Oil Wkly*. 30.10.44, **115** (9), 58.—Twelve producing wells have been completed in the Jarahueca field of east-central Santa Clara Province, Cuba, since its discovery in October 1943. The well logs show an almost continuous section of serpentine down to the producing zone, where oil is in a fractured serpentine. The oil is essentially of distillate quality, and can be used as low-grade motor fuel without special processing. G. D. H.

**252. Pando Wildcat Abandoned.** Anon. *Oil Wkly*, 30.10.44, **115** (9), 58.—Pando 1, in central Anzoategui, has been abandoned at 6900 ft. It is 8 ml. from the main Oficina field and the undeveloped Areo discovery. G. D. H.

**253. Russians Negotiating for Iran Exploration Rights.** Anon. *Oil Wkly*, 30.10.44, **115** (9), 58.—Russia is negotiating for exploration rights in Iran near the Caspian. The Sainan area east of Teheran is of special interest, for a Russian company completed a discovery well there before the Revolution, but no further drilling has been done. The nearest commercial production is at Chikishlar, 150 ml. to the north, in Russia. A wildcat struck oil near Asterabad, on the Russian side of the border, several years later, but this also was not developed. G. D. H.

**254.* Wildcat Completions and Discoveries.** Anon. *Oil Gas J.*, 4.11.44, **43** (26), 147.—Seventy-six wildcats were completed in U.S.A. in the week ended 28th October, 1944; 11 of them found oil and 4 found gas.

The completion results are summarized by States and districts. G. D. H.

**255*. Postwar Section: Supply.** Anon. *Oil Gas J.*, 18.11.44, **43** (29), 58.—It is estimated that the world crude-oil output will total 2,504,525,000 brl. in 1944, nearly 200,000,000 brl. more than in 1943.

Venezuela's output may be about 925,000 brl./day at the end of 1944, if the demand continues, and it can be expanded to 1,000,000 brl./day. Colombia's production has increased to 66,000 brl./day, and can be raised to 80,000 brl./day when pipe-line facilities are completed.

Iraq is delivering 84,000 brl./day by the pipe-line system, and plans are being considered for doubling the pipe-line capacity after the war. Iran is estimated to be producing 285,000 brl./day. Construction is under way which will increase the refinery capacity to 400,000 brl./day. Bahrein refines 20,000 brl./day from the island, and a little imported from Arabia. The refinery capacity is to be expanded to 55,000 brl./day. The additional crude will be obtained from Saudi Arabia. A large new refinery is being built at Ras Tanaru, Saudi Arabia, and when this is completed the output of Bahrein and Saudi Arabia will be raised to 100,000 brl./day.

Kuwait and Qatar have large oil reserves, but are not producing commercially at present.

The U.S.S.R. output is generally estimated to be 600,000 brl./day. New fields are known to have been discovered in recent years. Rumanian production has ranged 100,000–140,000 brl./day in recent years, and is unlikely to be increased until there has been an opportunity for exploration and development in new areas.

The Dutch and British East Indies may now be producing only a third of their 1942 output of 175,000 brl./day and a considerable time will be required for rehabilitating their fields after the war.

Austria is credited with 30,000 brl./day, and Hungary with 15,000 brl./day.

Mexico requires exploration and development before the production can be materially increased. Poza Rica provides a large part of the present output. Trinidad's output of about 60,000 brl./day cannot be raised without the discovery of new fields. A similar state of affairs exists in Canada, except for the Fort Norman area.

G. D. H.

**256.* Postwar Section: Reserves.** Anon. *Oil Gas J.*, 18.11.44, **43** (28), 61.—The world's proven oil reserves are estimated to be a little over 50,000,000,000 brl. Rather more than half of this is allotted to the Western Hemisphere. Recent discoveries in Venezuela have raised the reserves from 5,600,000,000 brl. to 8,000,000,000 brl. The Persian Gulf reserves are estimated at 15,500,000,000 brl., with an equal quantity indicated in fields not yet fully explored. Russia's reserves are placed at 5,700,000,000 brl., but are likely to be two or three times this amount.

In the Persian Gulf area the rate of withdrawal is 1 brl. to 134·6 brl. of proven reserves; in North America the ratio is 1 brl. to 11 brl. of reserves, and in South America 1 brl. to 25 brl. of reserves.

In the post-war period much refinery construction will take place in Venezuela. Much rehabilitation will be necessary in central Europe and in some Asiatic areas.

G. D. H.

**257.* Postwar Section: Exploration.** Anon. *Oil Gas J.*, 18.11.44, **43** (28), 66.—14,000,000,000 brl. of oil must be found by exploration in U.S.A. before the end of 1950 if the ratio of reserves to current production is to be maintained. This rate of discovery has been attained in the past.

In the post-war period wildcatting in U.S.A. is expected to average 8% less than in 1944. A substantial increase in wildcatting is predicted elsewhere.

A considerable expansion in the practical applications of the theories of reservoir control is expected.

The use of geophysics will be expanded after the war and geophysical data will be more completely correlated with geological data. The reflection seismograph and gravimeter will continue to be the most widely used geophysical instruments. The best results will be obtained if they are employed in their respective fields of optimum service, detail, and reconnaissance. In both cases better interpretation rather than better instrumentation is required. In both fields the war has retarded normal progress. If the cost of surface surveys can be reduced gravimetric work will be much cheaper.

The mobile mud-logging unit will probably be more widely used after the war. It is claimed that this will detect one part of oil in 100,000 parts of mud, and gas in quantities as little as $\frac{1}{100}$ cu. ft. per hour released from the mud. Radioactivity well logging will be valuable in reworking old areas and in detecting pays in thick limestones where ordinary electrical logging is not particularly satisfactory.

It is generally agreed that all geological and geophysical data must be combined and intensively studied to facilitate the discovery of stratigraphic traps. There must be imaginative thinking and a willingness to risk many dry holes. G. D. H.

**258.* Centre of Production Shifting from U.S., Geologists Told.** L. P. Stockman. *Oil Gas J.*, 18.11.44, **43** (28), 190.—The centre of oil production is shifting from U.S.A. to the Far and Middle East, according to Mortimer Kline. With water transportation charges at 40–60 cents/brl., crude, refined oils could be delivered in U.S.A. from these regions at about $1·75/brl. These distant reserves will be all important in the event of another war.

Colombia has at least six petroliferous provinces: Magdalena Valley; south-west of Lake Maracaibo; the Llanos of the south-east; the Caribbean coastal area; the Goajira Peninsula, and the Pacific Coast region. At present the first two are the most important. Cretaceous limestones and shales are extensively developed east of the Central Cordillera, and are highly petroliferous. Oil seepages and mud volcanoes are common in the Goajira and Pacific Coast areas, but little is known of the structure. The Eocene and Oligocene are productive in the Middle Magdalena Valley. The Oligocene produces in the Lower Magdalena Valley area. The Cretaceous and Tertiary yield oil from faulted anticlines south-west of Lake Maracaibo. G. D. H.

**259.* Exploratory Activity, and Oil and Gas Discoveries in California 1944.** A. I. Gregersen. *Oil Gas J.*, 18.11.44, **43** (28), 193.—During the first nine months of 1944 California had 24 wildcat discoveries of oil, and 31 successful new pool tests and outposts. There were 6 wildcat gas discoveries, and a new deeper pay was found at Rio Vista. However, the amount of oil discovered was not impressive, and at present California is drawing on oil reserves at a rate five times as fast as new reserves are being discovered.

At Jacalitos North-west, Fresno County, an oil-well has been completed in the Temblor. In Kern County, a 1000-brl. well has been brought in in the Carneros sand (Middle Miocene) at 3456–3485 ft. Only 8 of the remaining 22 discoveries seem to be of commercial importance at present. These are enumerated.

A new pool has been opened in the San Miguelito field of Ventura County, in Pliocene sands at 7225–7700 ft.

The 6 wildcat gas discoveries are of commercial importance, and 4 may become major gas-fields. These discoveries are briefly described.

188 wildcats have been completed in California during the first nine months of 1944, whereas in the whole of 1943 186 wildcats were completed. During 1944 the new reserves discovered are estimated to be about 7,500,000 brl., while new pool tests and extensions may have proved five or six times the amount of reserves added by wildcats.
G. D. H.

**260.* Wildcat Completions and Discoveries.** Anon. *Oil Gas J.*, 18.11.44, **43** (28), 285.—During the week ended 11th November, 1944, 79 wildcats were completed in U.S.A., 11 found oil, 2 found distillate, and 2 found gas. The completion results are tabulated by States and districts. G. D. H.

**261. Wildcatting Falls Short of Indicated Need.** L. J. Logan. *Oil Wkly*, 27.11.44, **115** (13), 58.—There are indications that 4850 exploratory wells will be completed in U.S.A. during 1944, but the objective was 5000. Drilling generally is going according to plan, and 24,000 wells of all types should be completed. In the first ten months of 1944 the average of 83 wildcat completions per week was 18·5% above the 1943 level; for all drilling the increase was 27·5%.

Economic and physical factors have worked against the completion of the required amount of exploratory drilling. Insufficient incentive has had its effect, and the lack of new reserves is now forcing excessive, uneconomic, wasteful operation of many wells.

The deficiency of exploration seems likely to continue in 1945. P.A.W. has called for 5000 wildcats in 1945, and a total of 27,000 completions, against 24,000 in 1944. 5000 wildcats in 1945 may not be adequate to provide the required reserves.

Total oil discoveries in 1944 have been only 10·9% higher than in the same period of 1943, and oil-field extensions have risen by less than 1%. There are signs that it is becoming increasingly necessary to resort to the more risky and more expensive drilling of entirely new areas.

During October, 1944, one of the more important strikes was in Pratt County, Kansas. This possible major strike is along the Coats and Sun City trend.

Clear Fork production has now been discovered in New Mexico, in Lea County. There are possibilities that this pay will provide deeper production in or near other fields. Oklahoma had nearly a dozen discoveries and extensions. A new field in Lincoln County may cover 1800 acres. Hunton lime production has been found in the shallow Graham field of Carter County, and this may lead to deeper drilling in other fields of southern Oklahoma. West Edmond was extended 1 ml. south, and the Hugoton gas-field was extended 4 ml. north.

In Montague County, North Texas, production has been found in the Viola at 6715–6730 ft. A discovery in Ward County, West Texas, is expected to develop into a good field.

A table summarizes the exploratory completion results in the first ten months of 1944, and the new oil- and gas-fields, new pay horizons and extensions discovered in October, 1944, are listed, with location, producing formation, depth, method of discovery, and other data. G. D. H.

**262. Texas Halts Operations on Venezuelan Wildcat.** Anon. *Oil Wkly*, 27.11.44, **115** (13), 64.—The wildcat on a local structure along the Temblador–Caritos trend, north-east of Tucupita, in Delta Amacuro, has been stopped at 9244 ft. G. D. H.

**263. Wells on Qatar Peninsula Planned by Iraq Company.** Anon. *Oil Wkly*, 27.11.44, **115** (13), 64.—Tests are to be drilled near the west side of the Qatar Peninsula. The principal structure along the west coast is directly in line with the producing structure on Bahrein Island. G. D. H.

**264.* Wildcat Completions and Discoveries.** Anon. *Oil Gas J.*, 2.12.44, **43** (30), 113.—61 wildcats (8 finding oil and 1 finding gas) were completed in U.S.A. during the week ended 25th November, 1944. The completion results are summarized by States and districts. G. D. H.

**265. Colombia Floresanto Wildcat is Below 3600 feet.** Anon. *Oil Wkly*, 4.12.44, **116** (1), 62.—Floresanto 1 in western Bolivar Province, Colombia, has now reached a depth of over 3600 ft., after several unsuccessful fishing jobs. G. D. H.

## Geophysics and Geochemical Prospecting.

**266. Radon Emations Outline Formations.** E. Sterrett. *Oil Wkly*, 25.9.44, **115** (4), 29.—A radioactivity survey prior to drilling potential extension wells in shoestring fields may determine the limits of the sand within the allowable spacing by crossing the shoestring every 330 ft., and finding the radioactivity values across the sand. Within the producing area the values are uniform, but at the edge the values increase, often doubling. Wavering or termination of the sand may thus be discovered.

If basic data can be obtained from producing wells, radioactivity determinations can be used to locate the oil–water contact, since the values increase rapidly once the oil–water contact is crossed.

The Wilcox of Oklahoma has many " pimples," nearly all of which contain water. Radioactivity measurements have proved satisfactory in selecting the most favourable " pimples " for drill-stem tests. Uniformity of values across a " pimple " is evidence against drilling. If a change in value is observed, two holes should be drilled, one on each side, to test the significance of the change.

Radioactivity measurements may be employed to find the trend of a fault after it has been cut by a well. When the fault has been delineated by a radioactivity survey, a seismic line parallel to the fault will show any closure against the fault, with a minimum of effort.

While radioactivity surveys do not find oil, they are useful for deliminiting work, and for eliminating drilling for determining trends, faults, etc. G. D. H.

**267. Geophysics—Vanguard of South America's Future Oil Production.** W. A. Sawdon. *Petrol. Engr*, October 1944, **16** (1), 120.—Surface conditions vary widely in South America. The seismograph is more widely used than any other instrument for geophysical operations, but the gravity meter and the magnetometer are being applied in several areas. Most of the work aims at delineating large features.

In Venezuela, further exploratory work is being carried out in the producing area of the east, and to the west and south in the Orinoco basin.

Colombia is probably the most active country from the point of view of geophysical prospecting, the seismograph, gravity meter, and magnetometer being used. Much work is proceeding in the Middle and Lower Magdalena areas, and in other valleys extending from the coast. Work is also going on near the Ecuador boundary.

In the last few years extensive geophysical prospecting has been carried out in the areas of Brazil with the more favourable oil prospects. One of the best areas is in the extreme west near the Aguas Calientes field of Eastern Peru. Transportation is one of the major problems of this area. Some wells are being drilled near Bogota. Extensive geophysical surveys are being made, and exploratory wells are being drilled around Bahia and Maceio, along the Atlantic coast. There is also geophysical activity in the Parana area, south and west of the Amazon delta, and along the north-east coast.

Geophysical work is being done in Chile, and some years ago work was carried out in the Guianas. Geophysical work is proceeding in Argentina. G. D. H.

**268.* The Interpretation of Earth-Resistivity Measurements.** M. Muskat. *Petrol. Tech*, November 1944, A.I.M.M.E. Tech. Pub. No. 1761, 1–7.—R. W. Moore's method for determining subsurface interfacial depths by means of integrated curves of apparent resistivity is analysed theoretically. It is found that the only unique tangents that can be drawn to such curves are the asymptotes at infinite electrode spacing, and the tangents through the origin at vanishing electrode spacing. Explicit expressions are derived for the relationship between the electrode spacing at the points of intersection of these tangents and the thickness of the surface strata as a function of the conductivity parameters for the two-layer and three-layer earths. It is found that in all cases the electrode spacing at the points of intersection will exceed $\frac{2}{3}$ of the thickness of the surface layer, and may even become indefinitely large as the resistivity of the deepest layers increases as compared with that of the surface layer. These results do not agree with the empirical findings of Moore that the intersections of the tangent lines fall at an electrode spacing very approximately equal to the thickness of the surface layer. G. D. H.

## Drilling.

**269.* Heater is Essential Part of Butane Fuel System on Drilling Rigs.** H. F. Simons. *Oil Gas J.*, 25.5.44, **43** (3), 77.—This article describes the features of the design of a satisfactory butane fuel system for the drilling rig. It points out that by providing butane heaters for each engine, ample heating of the fuel is assured when one or more of the engines is shut down. These heaters may be permanently installed on the skids of the individual engines. A. H. N.

**270.* Cementing Method Developed to Seal Perforations in Deep Wells.** Anon. *Oil Gas J.*, 5.8.44, **43** (13), 53.—The method developed for cementing perforations is not direct. Typical is the history of one well in which casing was run through an irregularly saturated section of the Ellenburger. In this well a series of perforations was made in the saturated section, but on test there was an excessive volume of water with the oil. It was decided to squeeze these perforations and re-perforate higher in the well for further testing. After killing the well, a cement retainer, permitting the well to be tested prior to running the cement, was set between 20 and 30 ft. above the perforations. The mud in the tubing was displaced with water and the well swabbed back in. It was then allowed to flow, making whatever it would, for 18–24 hours. By this method the formation fluids clean the drilling mud from the pay areas exposed by perforations. After the well has been allowed to flow, a batch of 250–500 gal. of mud is lubricated to the retainer and into the formation. The action of the acid is to enlarge the avenues in the formation already cleaned of mud and cuttings and to provide an enlarged void space for the cement. Normal acid has been used in some of these operations, but best results appear to be with mud-acid type. Water is used to chase the mud-acid, displacing it into the formation. Following this a slurry of 50–100 sacks of cement is squeezed. Normally a pressure exceeding 6000 lb. is required. Drilling mud is used above the cement for adding weight. By using weighted mud instead of water, an additional pressure is exerted against the cement without changing the pressure to the depth of the formation. This is usually about 2000 lb. over normal hydrostatic pressure, with water weighing 8·3 lb./gallon. The procedure reduces the demands made on surface equipment. A. H. N.

**271.* Horizontal Drilling from Vertical Hole Pioneered in California.** L. P. Stockman. *Oil Gas J.*, 12.8.44, **43** (14), 58–59.—The Zublin method of drilling side holes in any direction from a vertical hole is described. The drilling of side-hole wells is accomplished by the use of a $6\frac{1}{2}$-in. hydraulically driven gyratory bit, one or more lengths of helically slotted, flexible, resilient drill-pipe, a limited amount of auxiliary equipment, a conventional string of drill-pipe, and surface power equipment. The helically slotted members consist of 4½-in. o.d. drill-pipe of straight and curved sections. The drill-pipe is orientated into the hole, and the inventor sees no reason why inclination readings cannot be taken, if so desired. Circulation is maintained through this spirally slotted pipe by the use of an internal rubber member. Use of the rubber member is necessary, as the bit is actuated by a hydraulic turbine working on pressure applied against the drilling-fluid column at the surface, and also because of the necessity of jetting drilling fluid at the point of bit contact with the formation. The turbine, shanks, and bit assembly are compact, as the peculiar cutting action of the high-speed bit permits the use of a short turbine. The internal rubber member is inserted in the flexible section of the drilling string and securely anchored. In order to insert this member, both ends of the drill-pipe are cut out and subsequently streamlined and welded. The rubber internal section is adequately anchored inside the welded sections containing the male and female ends. One section of drill-pipe threads directly into another. The flexible section of the drilling string is fabricated out of conventional drill-pipe by cutting a spiral slot along the length of each section. The number of spirals made in a given 20-ft. section of drill-pipe determines the degree of flexibility : the greater the number of spiral slots, the greater the amount of flexibility and resiliency. Several degrees of flexibility are necessary in a single operation if a combination straight and curved hole is desired. In order to enable the bit assembly and turbine to drill laterally from a vertical hole, or get through a window in a cased wall, a curved section of flexible slotted pipe is used. This section, which has been bent and slotted after heat treatment, and is therefore not under tension, is introduced into the well as a straight section by use of a mandrel. When the point is reached at which the side-hole drilling is to be started, the mandrel is removed with an overshot run inside the drill-pipe on a line. When the mandrel is removed, that portion of the flexible pipe resumes its normal curved condition. It is this curvature in the flexible pipe that permits the bit and turbine assembly to depart from the vertical hole in an arc.

An experiment was made in which a rat-hole continued in an arc so that the bit appeared at the surface again, 60 ft. away and within 10 ft. from a predetermined point.

A. H. N.

**272.* Use of Cylinders in Directional Drilling Important Contribution to Technique.** L. P. Stockman. *Oil Gas J.*, 16.9.44, **43** (19), 77.—The method described consists of drilling within an imaginary cylinder projected from the surface to the final predetermined subsurface point. This method has two particular advantages which are becoming more pertinent with each new deflected well in areas of concentrated drilling. (1) By controlling the directionally drilled hole within a prescribed cylindrical radius, the operator runs little risk of damaging neighbouring wells. (2) Confinement of the directionally drilled hole within a projected cylinder creates a permanent record for future guidance, showing operators the subsurface zones of danger to be avoided in order to prevent damage to or from previously completed wells.

The outline of the cylinder, which may have any reasonable radius, is plotted from the surface to the completion point before drilling is started. These cylinders outline the course of the projected hole within a given radius, usually 100 ft., and operators require that drillers or contractors keep the hole within the limits of the cylinder. Thus the drift, direction, and degree of inclination are defined and regulated within prescribed limits. In addition to the outline of the cylinder from a vertical and horizontal standpoint, some operators outline the periphery of the cylinder and check closely to see if the drift is in any special direction. When the hole is surveyed, the reading is placed at the proper point in the pre-plotted cylinder. Thus, operators may determine whether the hole is following the predetermined course as drilling progresses. A record recently established by a California prospector is indicative of the advance in directional drilling and the almost unlimited possibilities of applying this technique to exploratory operations. This record was established in a wildcat well which showed a deflection of 5072 ft. in a measured depth of 7027 ft. and a vertical depth of 4327 ft. The drift angle was approximately 60°. It is believed that this is the first hole to show a deflection in excess of 5000 ft. Deflection was started at 300 ft., where the first whipstock was employed. A second whipstock was used at 870 ft., and the third and last was set at 1221 ft. A brief study of the method of controlling the deviation of directionally drilled wells is given. The practices of operators and contractors in specifying cylinders for drilling are outlined. A. H. N.

**273.* Abnormal Pressures Create Drilling and Completion Problems in Deep Test.** E. H. Short, Jr. *Oil Gas J.*, 30.9.44, **43** (21), 70.—The recent drilling of I. A. H. Gray in Webster Parish, Louisiana, by the Cotton Valley Operators Committee presented a number of difficult problems which required considerable engineering ingenuity to surmount. Drilling of the well to a depth of 7600 ft. was of a routine nature. However, from this point on to total depth of 10,681 ft., the frequent loss of circulation, combined with abnormal gas pressures, present hazards which, at times, threatened successful completion. The paper describes the precautions taken and practices adopted to overcome these troubles. A. H. N.

**274.* Modern Drilling. Salient Features of Wilson Super Titan Rotary Rig.** Anon. *Oil Gas J.*, 30.9.44, **43** (21), 84–85.—This is a new series in the *Oil & Gas Journal*, which deals with the newest developments in rotary rigs. This paper gives photographs and specifications of the Titan and Super Titan mechanical rotary rigs. A. H. N.

**275. Plastics Promise More Aid to Oil Industry.** A. R. McTee. *Oil Wkly*, 2.10.44, **115** (5), 30–32.—The most direct application of plastics in the oil industry is in its use in plug-back work (see paper by E. B. Miller, *Oil Wkly*, 19.6.44). The plastics used for plug-backs can be controlled in temperatures ranging from 80° F. to 280° F. Catalysts control the setting time. Qualities of neat cement are approached by the plastics which has a tensile strength of 240 lb./sq. in. and a compressive strength of 1900 lb. The solid plastic is also chemically inert and insoluble in crude oil, brine, fresh water, and other materials usually found in oil-wells. It is suggested that future uses may include selective plugging in lime-fields for acidizing, using the electric pilot; selective plugging for gas–oil ratio control; shut-off for water-sands in cable-tool areas to eliminate extra strings of pipe; tamp for nitro-glycerine shots; sealing bridge plugs; sealing annulus between two casing strings to protect from corrosive waters; place plastic around shoe-joint when cementing casing; setting blank liners; repair leaks in casing; selective control of injection zones.

Other present-day uses of plastics are discussed, in connection with pipes, valves, etc., where liners may be of advantage. A. H. N.

**276.* Independent Electric Rotary Drive for Steam Drilling Rig.** N. Williams. *Oil Gas J.*, 7.10.44, **43** (22), 63–65.—Electrical equipment is described which possesses the following advantages: (1) The drive bushing on the rotary never bounces. This substantially reduces wear and tear on both the bushing and the kelly as compared with the bouncing usually occurring when the rotary is driven by an engine and chain. (2) The pipe can be turned at any speed that the condition of the pipe and kelly will permit without the usual extreme vibration present when the rotary is driven by a reciprocating engine. (3) Where fuel is an item, considerable saving is effected by the lower water rate on the turbines as compared with that of a reciprocating engine. The turbine operates with 29 lb. steam pressure/horse-power hour, or 40 lb./kilowatt hour. (4) Chain and sprocket wear on the draw-works is saved as the drive from the draw-works to the rotary is eliminated. (5) The mental hazard to the drilling crews caused by the extreme noise of chain and sprockets is removed.

Disadvantages of this type of equipment are: (1) Initial investment is greater than with an engine or engine and chain drive. (2) Additional transportation is involved in moves owing to the two units, and also the extra auxiliary equipment, such as the ventilating ducts and conductor and wiring. (3) Slightly increased time also is required for installation. A. H. N.

**277.* Modern Drilling. Emsco J-1000 Drilling Rig.** Anon. *Oil Gas J.*, 14.10.44, **43** (23), 84.—The rig specifications are given, followed by a short description and illustration. A. H. N.

**278. New World's Depth Record Spotlights Efficiency of Drilling Technique.** W. A. Sawdon. *Petrol. Engr*, November 1944, **16** (2) 87.—The third well to be drilled to a depth greater than 15,000 ft. and the second to break the world's depth record during the year, Standard Oil Company of California's well KCL 20–13 in the South Coles Levee field of the San Joaquin Valley, Kera County, California, is still drilling ahead of 15,845 ft. Of particular interest in this operation is the use of equipment that is available at this time, little, if any, of which can be considered new either from the standpoint of design or purchase date. The well, spudded in on 31st July, 1943, was intended from the beginning to penetrate to great depth in order to explore deep-zone possibilities, and it was therefore known that good drilling technique would be a vital factor in reaching the objective. None of the equipment is of the exceedingly heavy or " super " type that has been employed in drilling a number of wells in California, but is of the same type and size as the other so-called heavy steam outfits being operated by the company for its deeper drilling throughout the State. Details of equipment and technique are given and illustrated. The hole has been kept in exceptionally good shape throughout its entire depth. Verticality is controlled by frequent checks of inclination made by running an inclination recorder capable of measuring small angles accurately, and thus determining any inclination in fractions of a degree. The hole has at no time been off vertical more than 3°. The drilling-control instrument is a bobtailed " sealtite " type of weight indicator with mud-pump gauge, torque gauge, and tachometer, but it is hooked up according to the company's own plan. The mud-pump pressure, steam pressure, and rotating speed of the table, as well as the weight being carried on the bit, can therefore be controlled at all times, and the ratio between weight and table speed varied intelligently to obtain most efficient drilling in the different kinds of formation.

Mud weight has been maintained by addition of weight material, and at the shallow depths it ranged 78 to 80 lb./cu. ft. While drilling through the Stevens zone it was maintained at 82–84 lb./cu. ft., but at the present time, while drilling below 15,000 ft., it is kept at 90–93 lb./cu. ft., with a viscosity of 45 seconds. The returns are screened by two shakers set in parallel, both of which are belt driven by 3-h.p. explosion-proof electric motors. The mud is tested at desired times for wall-building qualities, water loss, viscosity, pH, etc. At one point where oil and gas were found in the returns, the mud was treated with quebracho and tetrasodium pyrophosphate to control viscosity. To remove gas from the mud it is passed over a " fisher-ladder " type degassing tower made in the company shop. A. H. N.

## Production.

**279.* Function and Operation of Submergible Electric Pumps.** J. Zaba. *Oil Gas J.*, 25.5.44, **43** (3), 108.—A submersible electrical centrifugal pump installation consists essentially of three parts : the subsurface production unit, the cable transmitting electric power from the surface to the unit, and the surface controls. The production unit consists of three parts : the pump, the protector section, and the motor. In standard design, the motor is located on the bottom of the unit and the pump on the top. In pumps used in wells with extremely low fluid level the positions of motor and pump are inverted, the pump being placed below the motor. Such arrangement permits operation of the unit very close to the bottom of the well, or even in a sump-hole. In this type of design the motor is provided with a jacket through which the fluid produced by the pump is delivered to the production tubing. The motor is the two-pole, three-phase, squirrel-cage induction type. The windings are continuous through the length of the stator ; the rotors are short, with bearing between each to guide the shaft and maintain centering in the field, and the motor is enclosed in a steel housing filled with oil of high dielectric qualities. The oil serves as a lubricant and cooling agent. Voltages from 325 to 850 volts are used, a majority of the units using 440 volts.

The purpose of the protector section is to maintain in the motor a pressure slightly higher than the external pressure due to submergence and to eliminate the possibility of pumped fluid entering the motor. It contains a spring-backed piston, a grease-chamber, and an oil-chamber. Supply of grease, sufficient for six months' operation, is contained in the grease-chamber over the piston and backed by a spring exerting the required pressure. The pump itself consists of centrifugal impellers and diffusers, assembled vertically. Rotation of impellers develops pressure on the liquid in each impeller. The sum of these pressures, its magnitude depending on the number of stages, furnishes the pressure required for pumping of the desired volume against the required head. The production unit is suspended on tubing, to the outside of which is clamped the cable. Characteristics of typical pumps are shown graphically and described. A. H. N.

**280.* Multiple Sands Complicate Completion Problems in Eucutta Field.** N. Williams. *Oil Gas J.*, 5.8.44, **43** (13), 43–45.—Multiple, thin, broken sands having relatively small individual productivity and little or no pressure are characteristic of the producing sections in the Eucutta field, Wayne County, eastern Mississippi. The situation is creating a number of difficulties and complications in the completion of wells. Chiefly, these complications concern the extent of casing perforations and isolation of water-bearing zones. The various sands encountered are described. Sands are tested individually. The great care taken in testing sands is illustrated by describing the procedure adopted in one well. A. H. N.

**281.* Unit Compressors as Boosters on Low-Pressure Gas Wells.** F. B. Taylor. *Oil Gas J.*, 12.8.44, **43** (14), 71.—Production of natural gas from the Texas Panhandle area has resulted in some wells losing their rock pressure to an extent that it is lower than the pressure in the lateral feed-lines. There are three logical answers to the question of low-pressure wells. The first of these is to locate a main-line station near the field, in order that its suction reduces the lateral-line pressures to such a level that the weak wells will feed by their own energy. A second solution is to construct a miniature version of the main-line booster plant on the laterals themselves, not only to reduce the pressures of feeders, but also to increase the normal flow into the main systems. The third solution is to set an individual power-plant and compressor between the weak well and its connection to the lateral. A majority of the natural gas carriers have already been obliged to construct major compressor plants in or immediately adjacent to the gas-producing areas, so this effort towards solution has already been adopted. Lateral construction of plants has been widely considered. One has been built and is now operating. The third method—that of building unit compressor installations—has been resorted to by Panhandle Eastern Pipe Line Co. at the Bivins 1–91, Carson County. The installation has proved highly satisfactory mechanically, and is proving to be entirely practical economically. Other weak production of the firm has been similarly and effectively handled, and additional installations are contemplated.

The system is described in some detail. A. H. N.

**282.* Paraffin Problem in Panhandle Overcome by Water, Steam, and Pressure.** Anon. *Oil Gas J.*, 12.8.44, **43** (14), 83–84.—Paraffin troubles in producing Texas Panhandle wells are described, together with some of the successful methods used to combat them. A very successful method appears to be that of the steaming of wells. The steam line is connected at the well-head as, in operation, the steam is injected into the annulus. Lead lines are laid normally with a valve-controlled blowdown near the well, to check the pumped fluid during steaming. In practice, on an average well that is not " salting " up severely, boiler pressure is built up to between 40 and 125 lb., depending on past experience on that particular lease or well. Production is normally continued unless the well has been allowed to go the extreme and must be pulled. Steam is injected into the annulus under boiler pressure with the volume controlled by the steam-line valve, and water is added to the steam. Practice is to produce a flushing action as much as possible through the addition of considerable volumes of water to the steam. Between 50 and 75 brl. of water are pulled through the boiler during a normal treatment of from 2 to 3 hours. This has been found far more effective than dry steam. The water and steam in the annulus, plus the heat, flush the face of the pay and break down the formation of paraffin. With the well still on the pump, the fluid is produced through the lead line into the lease-tanks, where it is treated in the normal manner. The fact that the method actually cleans the face of the dolomite or lime is substantiated by increased production obtained from some wells in which it was known that the tubing and pumping equipment were free of paraffin. Details of the method are given. Use of pressure is also found successful, and the method is briefly described. A. H. N.

**283. Analysis of Decline Curves.** J. J. Arps. *Petrol. Tech.*, September 1944, A.I.M.M.E., Tech. Pub., No. 1758, 1–20.—Since production curtailment for other than engineering reasons is gradually disappearing, more and more wells are now producing at capacity and showing declining production rates.

After reviewing the development of decline-curve analysis during the past three or four decades, several of the commoner types of decline curve are discussed in detail, and the mathematical relationships between production rate, time, cumulative production and decline percentage for each case is examined.

The well-known loss-ratio method is an extremely valuable tool for statistical analysis and extrapolation of various types of curves. A tentative classification of decline curves, based on their loss ratios, is suggested. New graphical methods are described for facilitating estimation of the future life and future production of producing properties where curves are plotted on semi-logarithmic paper.

A graphical construction is described for extrapolation of hyperbolic-type decline curves, plotted on semi-logarithmic paper. This method is based on the three-point rule, which is a mathematical connection between the production at three equidistant points on the curve.

Straight-line decline charts are introduced for hyperbolic decline. These charts have vertical scales arranged in such a manner as to make straight lines out of both rate-time and rate-cumulative curves belonging to the hyperbolic type. Use of these charts greatly facilitates extrapolation of this type of production curve. G. D. H.

**284. Application of the Electric Pilot to Well Completions, Acidizing, and Production Problems in the Permian Basin.** P. J. Lehnhard and C. J. Cecil. *Petrol. Tech.*, September 1944, A.I.M.M.E. Tech. Pub. No. 1759, 1–10.—Permeability surveys with the electric pilot are made to determine the thickness of the various permeable sections encountered in a borehole, the vertical positions of these zones, and their relative capacities for transmitting fluids. Permeability surveys aid in planning selective acid treatment jobs, and indicate the effects of acid treatment.

The results of numerous electric pilot surveys in the Permian Basin are described. These surveys show that generally there are several permeable zones in the limestones, and that usually the total thickness of the permeable zones in a borehole is much less than the total thickness of saturated section, as determined by sample analyses. There appears to be good horizontal communication, possibly over whole fields, but very little vertical communication.

On comparing permeabilities by core analysis with capacity by the electric pilot, there was good agreement with regard to vertical distribution, but no direct relationships between the numerical values of the permeabilities and the capacities. Laboratory permeability measurements do not take into account connate water, free gas, etc.

The electric pilot permeability survey cannot replace or detract from the value of well-logging methods that show saturation or fluid content throughout the producing horizon. A knowledge of the relative capacities of different zones is of value in controlling production.

A number of examples of the use of electric pilot surveys are given, and the results are discussed. G. D. H.

**285. East Kansas Water-flooding.** F. B. Taylor. *Oil Wkly*, 11.9.44, **115** (2), 17.—Eastern Kansas has currently become the most active water-flood development area in the Mid-Continent. Starting in 1935, when two projects were initiated, the number of operations increased to 20 in July of 1940, and by July of 1944 had further increased to 46, with additional applications in preparation and numerous other potential prospects being given preliminary examination. It was originally thought that flooding Eastern Kansas fields would prove impracticable. Three main reasons were advanced in support of this thought, the first being that gravity of the crude in place, being generally below 36° and in some cases as low as 24°, would prevent movement of the oil effectively by the water-front. A second suggestion was that the nature of many of the sands, due to their laminations and broken character, would allow excessive by-passing. The third reason was that owing to shallowness of the sands, they could not be subjected to the pressures required successfully to carry on the operations. These possible obstacles have since been found not to be as serious as some anticipated. While gravities in the area are somewhat lower towards the north and east, a survey indicates that the majority of projects are making gravities between 35° and 40°, and in the Chanute-Humboldt area, where the gravity varies between

28° and 32°, flooding is successful. Laboratory and practical field work in advancing the art of selective shooting of sands in proportion to their compactness and permeability, largely determined from core analysis and examination of sand cuttings, has provided better water-fronts. This is despite the fact that some of the first efforts were anything but successful. There still remains a difference of opinion as regards the most desirable weight shot, but this is apparently due to the differing conditions between properties rather than to a difference in fundamental theory. General practice is to shoot with from ½–2½ quarts/foot, with the input wells sometimes being given a smaller load than the producers. Some wells have been re-shot after input rates levelled, and by so doing it was ascertained that the wells could have been shot more heavily at first, with consequent increased injection rates and apparently no harmful effects. This method of shooting as a control over the variable character of the sands vertically has proved to be a practical solution to the question of irregular permeabilities.

Details of the drilling, producing, and flooding systems used are given.

A. H. N.

**286. Soap Offers Answer to Many Tough Production Problems.** G. Leffingwell and M. A. Lesser. *Oil Wkly*, 11.9.44, **115** (2), 19–20.—The use of soaps in water-flooding and in precipitating insoluble plugs in formations to reduce permeability to water is discussed. More recently Dow and Grebe described methods, based on the use of soap solutions, for increasing the efficiency of the acid treatment of wells. They pointed out that with the acid methods for increasing oil- or gas-well productivity, the acid may also open up passages through which water or brine may flow. In order to overcome this possibility, these workers proposed the preliminary injection of soap solutions to form plugging deposits. Using a solution containing from 10 to 40% of soap, they obtained fluids that flowed readily for substantial distances into the formations. By the methods described in the patent it is possible not only to prevent the flow of the acid into the brine-bearing earth, but also to prevent the formation of clogging precipitates with the spent acid in the oil-bearing passages.

The use of soaps to prevent wax deposition and in other production problems is briefly discussed. Occasionally soaps find useful application in the preparation or treatment of well drilling muds. Harrison, for example, has suggested the improvement of oil-well weighting materials for use as a drilling mud by the incorporation of barites to which small quantities of wetting agents have been added. Various fatty acid soaps, among other materials, are suggested as suitable wetting agents. More recently, Mazee has recommended the employment of special fatty acid soaps as stabilizing agents in the production of non-aqueous drilling fluids. These special soaps, he noted, were somewhat superior as stabilizing agents to potassium stearate and potassium oleate frequently used in making such fluids. A. H. N.

**287.* Factors Controlling Oil-Well Completions in the Illinois Basin.** C. A. Bays. *Oil Gas J.*, 16.9.44, **43** (19), 79–82.—Drilling-in may be accomplished with either cable or rotary tools. The greater part of this work in the Illinois basin has been done with cable tools, although rotary completions have been used with about the same degree of success by many operators. In most wells, rotary pump pressure and heavy viscous muds have already been on the formation under pressure during coring, reaming hole conditioning for and during pipe-setting, and frequently also the cement slurry has been on the formation. Therefore drilling-in with a rotary would seem to make little difference on a theoretical basis. A string of tubing is commonly used instead of drill-pipe for drilling in. In practice it has been found that with good wells results are about the same in drilling in with a rotary as with cable tools, but the former is quicker. In poorer wells it sometimes seems better to drill in with cable tools, because of the pressure situation, but in most cases rotary tools will do as well. Details of the two methods of drilling in are briefly indicated, followed by a study of cleaning-out methods. Completion by gun perforating, ripping or slotting ordinary or special alloy strings is reviewed. Shooting and acidizing practices in Illinois are given.

A. H. N.

**288.* Electrification of Salt Creek Field Embraces Approximately 1000 Wells.** N. Williams. *Oil Gas J.*, 16.9.44, **43** (1), 107–108.—Electricity is generated for the whole field at 33,000 volts and stepped down to 4000 volts at main stations, and finally to 440 at substations. Most of the wells are pumped with standard rig fronts requiring individual motors, but a few back-crank installations are in use. Pumping loads are not heavy, and 2-h.p. or 3-h.p. motors are adequate in most cases. Loads are minimized by the fact that, generally, no water is present. The main producing horizon (second Wall Creek sand) definitely has only a gas drive and although small quantities of water have appeared in a few wells in this sand, it is probably of connate origin. There is some evidence of a slight water drive in several of the sands, but even from these, few wells make any water. Depths of the wells also are comparatively shallow, ranging from 1200 to 2700 ft. in the two principal horizons, and first and second Wall Creek sands. Fluid levels are low, however, and most wells are pumped from or near bottom, some from rat-hole sumps at bottom. Electrically powered pulling units and cable-tool workover rigs also are used in the field. The pulling units are truck mounted, consisting of a conventional winch driven by a variable-speed 40-h.p. motor. Each unit carries sufficient electrical cable to plug into a convenient connection provided at each well for this purpose. The advantages of the system are briefly discussed.

A. H. N.

**289.* Control of High-Pressure Salt Water and Heaving Shale in Deep Gulf Coast Well.** N. Williams. *Oil Gas J.*, 23.9.44, **43** (20), 283–286.—Heaving shale, abnormal gas pressures, and hot salt-water flows constitute major obstacles to deep drilling in many areas on the Gulf Coast. The combination of the three hazards in a single well presents complications that are exceptionally difficult to combat, so that the successful overcoming of these conditions in the deep test discussed in this article represents an unusual achievement.

Precautions taken were mostly centred around mud control. These included use of a depth measuring gauge in the mud-pits by which constant watch was kept of the mud level. Since any rise in the level would indicate salt-water flows coming into system or gas breaking in to aerate and lighten the column, immediate steps could be taken to correct the trouble. In the same way, any loss of mud into the formations would be reflected by a lowering of the mud level in the pits. Also, the displacement of the drill-pipe in the hole was accurately determined at all times, so that when pulling the pipe any abnormal variations in the volume of mud in the pits could be noted instantaneously. To ensure uniform control the system was equipped with a continuous mud-weight recorder. Trips had to be made slowly, to forestall any swabbing action. Prior to coming out of the hole, the system could be circulated and mud thoroughly conditioned. When pulling up a short distance, the hole would be " slugged," and at intervals the trip might have to be halted to circulate and condition the mud, and possibly dump and slug additional quantities of weighting material and mud. On some occasions it was necessary to go back and re-circulate and condition the bottom of the hole before finally coming out. Equal caution had to be exerted when going back into the hole, particular care being taken not to disturb the walls more than necessary. Return trips were made slowly, sometimes taking 3 or 4 days to get back on bottom, due to tight places and bridges which had to be reamed and cleaned out. On a few trips so much hole had to be reamed that when bottom was reached another trip had to be made for a new bit before making any additional hole. Frequent stops had sometimes to be made to circulate and condition mud, with pressures constantly threatening to come in, due to lowering of the mud consistency in the hole by the gradual infiltration of water flows and gas while the hole was standing. A. H. N.

**290. Practical Design of Water-Flood Projects.** Anon. *Oil Wkly*, 25.9.44, **115** (4), 48.—The problems of maximum and optimum values of pressure and injection rates are discussed. Yuster combined a theoretical flow equation derived by Muskat with field data to arrive at the following equation, which is sufficiently accurate for prediction of plant capacity and water supply necessary for development, rate of water input, and rate of oil recovery. Although it is common knowledge that injection rates will not remain constant during the life of a flood, the use of this equation should afford fairly accurate predictions of average rate :

$$Q = \frac{0 \cdot 000158KHP}{\log_{10} D - 1 \cdot 6}.$$

Where $Q$ = water input in brl./day, $K$ = average permeability of formation in

Millidarcies, $H$ = sand thickness in feet, $P$ = pressure at sand face in lb./sq. in. and $D$ = water to oil well distance in feet.

Next to the problem of assuring ample supplies of water at the required pressure, the quality of water is considered. A typical analysis, as an illustration, will give in parts/million: (1) Suspended matter. (2) Turpidity. (3) Total dissolved solids. (4) Sodium salts. (5) Iron as Fe. (6) pH. (7) Silica. (8) Iron oxide. (9) Free carbon dioxide. (10) Hydrogen sulphide. (11) Total hardness (as $CaCO_3$). (12) H(Comp.) (as $CaCO_3$). (13) Calcium hardness (as $CaCO_3$). (14) Magnesium hardness (as $CaCO_3$). (15) Alkalinity (M) (as $CaCO_3$). (16) Alkalinity ($P$) (as $CaCO_3$). (17) Hypothetical combination. These items are briefly explained.

There are as a rule probably seven major items determined by analysis which are of importance from a flooding standpoint. They are: (1) corrosive properties, (2) organic growths, (3) iron, (4) suspended matter, (5) corrosive gases, (6) manganese, (7) pH value. Important items in corrosion are dissolved oxygen, dissolved salts, and hydrogen-ion concentration. Corrosion of a metal occurs in presence of water if the metal is capable of replacing any of the positive ions in the chemical compounds present in the water. This would mean simply the iron in pipes and the hydrogen in water. Dissolved salts are important, since their increased concentration require greater alkalinity to inhibit corrosion. Dissolved oxygen increases corrosion action. Acidic corrosion is minimized by increasing alkalinity to form a protective coating on pipe, and a pH value of 7·2 should accomplish this. The exact amounts of alkali required should be determined by trial. pH control is required, limestone beds or lime being used for alkalinity or pH increase. Spacing is briefly discussed. A. H. N.

**291. Novel Cut-off Prevents Pumping Unit Damage.** Anon. *Oil Wkly*, 25.9.44, **115** (4), 65.—The short paper describes a novel way of placing a weight on the horsehead of the pumping jack in order to cut off the engine, when sudden acceleration of the head takes place due to breakage of rods or other causes. The weight on falling closes a switch, by means of a string attached to an insulator placed between the switch electrode contacts, and thus shorts the magneto of the engine. A. H. N.

**292.* Precipitation of Asphalt from Crude Oil by Flow Through Silica.** H. Dykstra, K. Bleu, and D. L. Katz. *Oil Gas J.*, 30.9.44, **43** (21), 79.—Crude oils have been shown to contain asphaltic substances in a finely divided state approaching true solution. Dilution with solvents, submission to an electrical potential, and flow of oil through sand have each caused asphaltic particles to appear. The precipitation of asphaltic constituents during flow of crude oil through the sand and up the tubing from wells in the Greeley field, California, has been attributed to the electrical effects of flow. This paper verifies that asphalt particles are formed by the flow of the Greeley crude oil through silica. Electrical potential measurements were taken across a section of silica through which oil was flowing. No asphalt particles were found in the Greeley crude oil which was passed through silica while a counter-potential was impressed on the flow system. The possibility that asphaltic particles precipitated by flow contribute to the paraffin and tank-bottom problems is discussed.

Experiments are described and electron photomicrographs are reproduced, demonstrating those minute particles, which are a few microns in diameter. A. H. N.

**293. Salt-Water Disposal in East Texas.** Anon. *Petrol. Engr*, October 1944, **16** (1), 181.—This is the second instalment in a series representing vocational class proceedings on the subject of salt-water disposal in East Texas. This part deals mainly with electrical logging for resistivity and self-potential of formations traversed by a borehole. Electric logs have been run on about 1500 wells in the East Texas field, and additional surveys of the sand section are currently being made on some wells when they are worked over. As the stratigraphic section from the surface down to the top of sand is reasonably uniform, most operators make a detailed survey of the Woodbine section only. These surveys are initially made on a scale of 1 in. = 2 ft., and are subsequently reduced to one-half to a scale of 1 in. = 40 ft. These logs indicate shale breaks in the Woodbine section, and also provide data relative to the water level if the hole is bottomed below the oil–water contact. This is particularly valuable information, especially in guiding workover operations. In the case of salt-water-disposal wells drilled within the producing area of the field, it indicates the oil–water contact and the shale-breaks in the water section. The selection of the casing seat is made on the basis of the electric log, it being necessary to establish the casing seat below a substantial shale-break and below the original oil–water interface. Recognition of sand zones as identified by electrical logs is relatively simple, because sand is the most common porous sediment encountered in wells in this area, and the only other porous sedimentary bed with which it may be confused is limestone. On electrical logs, sand-beds are recorded by an increase in value on the self-potential curve. Maximum values are generally recorded where relatively clean sand-beds are penetrated. Between minimum self-potential values (shales) and maximum readings, sands may be represented by any intermediate values as influenced by impurities such as shale. These impurities may be present as separate beds within the sand, or may be mixed more or less uniformly throughout the sand-bed. Thus, a sandy shale-bed may show only a slight increase in value on the self-potential curve, whereas a sand zone with streaks of shale will be developed on the electrical log as an alternating series of high and low self-potential values.

Porous limestones may sometimes be confused with sand-beds when interpreting electrical logs; however, limestone zones are invariably characterized by the presence of some dense non-porous beds, which are represented on electrical logs at intervals of decreased self-potential, whereas the resistivity curve generally reflects an accompanying increase in value. By comparison, shales, which often occur in sand zones, exhibit minimum values on both self-potential and resistivity curves. The presence of oil or gas in a sand will cause an increase on the resistivity curves, while salt-water sands record low or minimum values. If a well penetrates a sand that is saturated with oil, or gas that is underlain by salt water, corresponding high resistivity values will be recorded in the upper part of the bed, with low values in the section saturated with salt water. The break in the resistivity curve will then indicate the water level in the reservoir. Typical curves are given. A. H. N.

**294. Characteristics and Quality of Water Important in Flooding Work.** Anon. *Oil Wkly*, 9.10.44, **115** (6), 60.—The chemical properties and treatment of waters for flooding are given. Corrosion by water is also briefly analysed. The pH value is important, and should be controlled in flood water. If water is acidic or has a pH value less than 7, specific amounts of alkali must be added to inhibit corrosion, by forming a protective coating in a pipe and equipment. As a rule a pH value of 7·2 or over is required to maintain a protective coating on material. Lime is generally used to raise pH to a safe alkaline value, but careful control must be exercised to prevent over-dosage. As an alternative to this the water may be passed through beds of broken limestone. As a general rule the pH value should be somewhat above 7·2, and alkalinity should exceed 20 parts/million to prohibit corrosion.

A. H. N.

**295.* Studies Indicate Water Drives in Illinois Pools Increase Ultimate Recovery.** K. B. Barnes. *Oil Gas J.*, 14.10.44, **43** (23), 89.—The Illinois water-drive potentialities fall into two rather dissimilar categories. The first covers the shallower pools, which may range from about 300 to 1600 ft. in depth, where intensive or pattern-type water-injection well spacing is more feasible and can be economically employed. Currently there are a number of such projects in operation, with that in the Patoka pool of Marion County showing unusual prospects. The other category covers the deeper pools, where water injection on the flanks of the structure could be done to maintain or support reservoir pressure and obtain the recovery benefits possible from the water-drive process. This flank-water-injection procedure might be considered a relatively new and promising petroleum-production technique. The current outstanding and probably first substantial effort in such direction is the Midway operation in the Smackover lime, Lafayette County, Arkansas.

The paper summarizes the most recent detailed studies of the Illinois State Geological Survey on natural and accidental floods, and those of the U.S. Bureau of Mines on applied water-drive projects, together with other data on the subject.

A. H. N.

**296.* Core Analysis: Methods and Applications.** K. B. Barnes. *Oil Gas J.*, 21.10.44, **43** (24), 98.—A summary is given, with appropriate references to the literature, of the available methods of measuring and interpreting porosity, saturation with oil and water, chemical analysis, permeability, and oil-recovery tests of cores. Core sampling and handling and the construction of core graphs are outlined. A. H. N.

**297.* Choke Control of Gulf Coast Wells.** J. E. Loeffler. *Oil Gas J.*, 21.10.44, **43** (24), 105.—The problem of pressure control while producing through chokes has two distinct bases. The first is concerned with the flow of fluid through the reservoir formation to the well; the other pertains to the behaviour of fluid flow from the bottom of the well to the surface. These two phases of the flow problem are different, yet one set of applied conditions must always and simultaneously control both. The problem justifies detailed engineering supervision to ensure efficient operations, since oil production secured by natural flow through chokes is the cheapest oil produced. The chokes are used: (1) to control physically the rate of flow to a set amount, (2) to use the gas energy to best advantage in prolonging the life of the well, (3) to reduce the tendency to sand up or bridge, (4) to reduce sand cutting of screens, perforations, well-head, and flow-line fittings, etc., (5) to assist in prevention of premature water encroachment.

These items are discussed. A. H. N.

**298. Producing Dual Completion Oil-Wells.** C. C. Pryor. *Petrol. Engr*, November 1944, **16** (2), 59.—Production of dually completed oil-wells is often a difficult operation when the upper zone cannot be produced successfully through the annular space. This difficulty, which results in lost lifting power, is caused by the large cross-sectional area of the annulus reducing the velocity of flow, and by gas breaking out of solution with the oil due to expansion in the annular space and the friction on the outside of the tubing and inside of the casing. The cooling effect that results from the gas breaking out of solution is also a direct cause of paraffin formation in the low-temperature area, and thus requires the use of paraffin knives, chemicals, or heated oil for removal. These problems facing the operators have been largely overcome by the developments in dual completion production methods and equipment, whereby the upper zone is produced through the annulus. A description is given of a well in which two packers were set and a change-over flow-tube installed to achieve this purpose. The lower packer was an ordinary retainer production type, set in the usual manner of applying pressures and tension on the setting tubings. The upper packer was of a similar type, but as the tripping ball seat unit could not be allowed to drop and obstruct the tubing later run in the well, this packer was modified. The modification introduced and the manner of setting are described and illustrated.

After the packers had been set, the change-over flow-tube was made up on the string of production tubing with a side-door choke nipple in the string 30 ft. above the top packer. The tubing string, 5748 ft. in length, was run into the well through the two packers, and landed with the fluid ports of the change-over flow-tube, just above the upper packer packing sub. After the tubing had been landed, the well was washed in with water and cleaned and the side-door choke set in the choke nipple. Preparations were then made for testing. The change-over flow tube provides for production of the two zones simultaneously. It consists of a welded tee in the upper portion of the outer tube, with the vertical leg of the tee or inner tube extending down the inside of the outer tubing section with a seal near its lower end. The outer tubing section is perforated above and below the seal around the inner tube. Production from the lower sand enters the fluid ports near the bottom end of the outer tube, and flows up through the inner tube to the tee and out into the annular space. Thus production from the lower sand is flowed around the two packers to the annulus, and then to the surface. Fluid from the upper sand, which is the weaker sand, and will not flow through the annular space, enters the outer tube through the perforations above the inner tube seal above the interzone packer, and flows up through the annular space between the inner and outer tube, around the tee, and thence to the surface through the tubing. A. H. N.

**299. Deep-Well Pumping.** W. A. Sawdon. *Petrol. Engr*, November 1944, **16** (2), 70.—The artificial lifting of oil by means of rod or hydraulic pumps and by plunger lift from very deep wells in California is discussed. The deepest rod-pumping in California (but not the deepest pumping) at present is in the Rosecrans field near Los

Angeles. Total depth of this well is 8708 ft., and the pump is set at 8625 ft., which is probably the greatest depth of rod pumping in the world. The tubing is $2\frac{1}{2}$-in. EU and the pump is $1\frac{1}{2}$ in. The rod-string consists of 4545 ft. of $\frac{3}{4}$-in. and 4080 ft. of $\frac{7}{8}$-in. rods. The fluid is being pumped with a 120-in. stroke at from 5 to $5\frac{1}{2}$ strokes/min. Production is 86 brls./day gross, 52 brls./day net. The installation has been in service for about one year, and to date no rods have parted. The deepest pumping well in the State (and probably in the world) is 10,034 ft. This well is being pumped by a hydraulic pump and is producing approximately 260 brl./day net.

The deepest California wells being produced by plunger-lift installations range from 800 to 8500 ft., there being several within that range at the present time. The lifting force in this type of installation is provided by gas, but because the oil is actually raised to the surface by a plunger, it is here included as a pumping method. This plunger travels the entire distance from the bottom to the top of the tubing and back again at each stroke, but it does not lift a column of fluid extending the full length of the tubing. The plunger acts more or less as a swab, without a line, and produces the fluid in short heads that are usually less than 300 ft. in length. It brings up at each stroke all that comes into the hole during the time it is making the trip, this including oil, water, gas, froth, and sand. In some cases the plunger lift has handled as much as 10% of sand. The plunger operates in tubing which is drifted as it is run into the well, and which is supported from a flow-head at the surface. This head is adapted to receive the slug of oil lifted by the plunger and direct it to the flow-lines. A foot-piece at the bottom of the tubing stops the plunger and closes a valve in the plunger at the end of the down-stroke. The valve and cage of the plunger are so designed that neither gas nor liquid will close the valve; it must be closed by the valve stem landing on the foot-piece. The valve is opened at the top of the up stroke to permit the plunger to return to bottom by gravity. The operating pressure/brl. of production for any given size lift rises as the depth increases. With the 3-in. size, for example, this increase is approximately 0·1/brl./1000 ft. A. H. N.

**300. Salt Water Disposal in East Texas.** Anon. *Petrol. Engr*, November 1944, **16** (2), 221.—In this, the third of the series, the production history of the East Texas Field is given in tabular and graphical forms and discussed in some detail. A. H. N.

**301. Complete Solution for Salt-Water Problem in Texas.** A. M. Brenneke. *Petrol. Engr*, November 1944, **16** (2), 236.—The problem of contamination of fresh water-courses with salt water from the Texas oil-fields is discussed. A method of safeguarding the waters by regulations is outlined. A. H. N.

**302. High Slip Electric Motors Used for Oil-Well Pumping.** K. N. Mills. *Petrol. Engr*, November 1944, **16** (2), 248.—The per cent. slip expresses the amount the speed of the motor drops below the synchronous speed when it is carrying its full load. Normal slip motors have a full load slip of 2–3% and high-slip motors a full load slip of 8–10%. The high-slip-type motor was originally developed for applications using heavy flywheels where it was desired to store energy in the flywheel during periods of minimum load and remove this energy from the flywheel during periods of peak load. The high-slip motor accomplishes this result by shirking the load, *i.e.* by slowing down during periods of maximum load and permitting the flywheel to give up some of its kinetic energy. The energy lost by the flywheel is restored by the motor during periods of low load. Some typical applications of this type of motor are punch presses, shears, forging presses, etc., where its principal advantage is a material reduction in the peak power demand. When the high-slip motor is applied to conventional pumping units it offers numerous advantages from both the electrical and mechanical viewpoints. From the electrical viewpoint its advantages are: (1) lower peak power demand; (2) lower average power consumption; (3) less motor heating due to lower r.m.s. current; (4) less fluctuation in power demand on distribution system; (5) easier starting due to high starting torque characteristics of high-slip motor. From the mechanical viewpoint its advantages are: (1) lower peak load on pumping unit driving system (belts and speed reducers); (2) reduced polished rod load (not found in all applications).

The results of tests on a particular well are given and analysed in some detail.

A. H. N.

**303. Patents on Drilling and Production.** A. Boynton. U.S.P. 2,352,612, 4.7.44. Appl. 17.9.41. Bottom hole regulator and choke in combination.

F. C. Kelton, Jr., assignor to Core Laboratories, Inc. U.S.P. 2,352,638, 4.7.44. Appl. 24.10.40. Connate water determination.

A. T. Ferris, assignor to Halliburton Oil Well Cementing Co. U.S.P. 2,352,700, 4.7.44. Appl. 28.1.42. Open hole removable packer.

A. D. Stoddard, assignor to Halliburton Oil Well Cementing Co. U.S.P. 2,352,744, 4.7.44. Appl. 14.4.41. Cementing and floating equipment for well casing.

L. N. Scheurmann and G. B. Pecot. U.S.P. 2,352,805, 4.7.44. Appl. 23.3.43. Method and article for cleaning oil-wells and the like.

R. G. Taylor, Jr., assignor to the Guiberson Corporation. U.S.P. 2,352,812, 4.7.44. Appl. 27.1.40. Swab-cup assembly or packing element.

N. E. Gunderson, assignor to Layne-Northern Co., Inc. U.S.P. 2,352,832, 4.7.44. Appl. 15.10.41. Method for preventing deposits within water formations and on well-screens.

G. L. Hassler, assignor to Shell Development Co. U.S.P. 2,352,833, 4.7.44. Appl. 24.4.42. Choke-valve borehold indicating system.

G. L. Hassler, assignor to Shell Development Co. U.S.P. 2,352,834, 4.7.44. Appl. 9.5.42. Method of and means for adjusting flow rates of fluids through formation traversed by boreholes.

M. M. Albertson, assignor to Shell Development Co. U.S.P. 2,352,993, 4.7.44. Appl. 20.4.40. Radiological method of logging wells.

H. C. Lanze, Jr., and D. H. Larsen, assignors to National Lead Co. U.S.P. 2,353,166, 11.7.44. Appl. 25.5.42. Treatment of well-drilling fluids.

A. D. Garrison and K. C. ten Brink, assignors to the Texas Co. U.S.P. 2,353,230, 11.7.44. Appl. 1.7.39. Conditioning of drilling fluids.

J. B. Stone, assignor to the Dow Chemical Co. U.S.P. 2,353,372, 11.7.44. Appl. 17.6.40. Method of preventing fluid loss from well-holes into the surrounding earth.

W. J. Miller. U.S.P. 2,353,412, 11.7.44. Appl. 26.8.41. Oil saver.

W. J. Barnhart. U.S.P. 2,353,435, 11.7.44. Appl. 16.6.41. Side sampler for deep wells.

H. H. Greene. U.S.P. 2,353,458, 11.7.44. Appl. 3.8.40. Deep-well dump-can.

L. Yost, assignor to A. O. Smith Corporation. U.S.P. 2,353,534, 11.7.44. Appl. 1.5.41. Oil-well drilling unit.

P. Coonrod, assignor to Production Supply Co. U.S.P. 2,353,652, 18.7.44. Appl. 20.4.42. Removable bottom-hole choke.

W. St. Maur Elmore Crake, assignor to Shell Development Co. U.S.P. 2,353,881, 18.7.44. Appl. 7.12.42. Oil-well liner screen.

A. D. Garrison, assignor to the Texas Co. U.S.P. 2,354,203, 25.7.44. Appl. 30.1.41. Method of treating wells.

W. B. Noble, assignor to Reed Roller Bit Co. U.S.P. 2,354,399, 25.7.44. Appl. 4.5.42. Side-hole coring device.

C. H. Benckenstein. U.S.P. 2,354,570, 25.7.44. Appl. 28.3.41. Process of increasing permeability of sands and strata.

D. C. Bond, assignor to The Pure Oil Co. U.S.P. 2,354,648, 1.8.44. Appl. 16.11.39. Drilling mud.

G. Annesley. U.S.P. 2,354,656, 1.8.44. Appl. 5.1.42. Drill-bit.

D. U. Shaffer. U.S.P. 2,354,709, 1.8.44. Appl. 1.4.42. Pressure-regulated, straight-pull jar mechanism.

L. L. Rector and L. D. Hilton. U.S.P. 2,354,929, 1.8.44. Appl. 13.5.40. Means for landing and supporting well tubings.

R. Bassinger. U.S.P. 2,355,199, 8.8.44. Appl. 6.5.40. Well-plug.

C. C. Bancroft, and J. W. Frain, U.S.P. 2,355,259, 8.8.44. Appl. 27.3.41. Apparatus for cleaning subterranean wells.

C. W. Van Wormer. U.S.P. 2,355,342, 8.8.44. Appl. 13.6.42. Drilling apparatus.

J. Moser, assignor to Vickers, Inc. U.S.P. 2,355,669, 8.8.44. Appl. 15.3.41. Operating piston for oil-wells.

R. M. Otis, assignor to Lane-Wells Co. U.S.P. 2,356,082, 15.8.44. Appl. 26.5.43. Method of and apparatus for firing gun perforators.

C. M. Blair, Jr., W. Groves, and S. Lehmann, Jr., assignors to Petrolite Corporation, Ltd. U.S.P. 2,356,205, 22.8.44. Appl. 21.10.42. Process for increasing productivity of subterranean oil-bearing strata.

J. J. Fitzpatrick. U.S.P. 2,356,232, 22.8.44. Appl. 13.3.43. Packing device.

S. Lehmann, Jr., and C. M. Blair, assignors to Petrolite Corporation, Ltd. U.S.P. 2,356,254, 22.8.44. Appl. 21.10.42. Process for preventing and/or removing accumulation of solid matter in oil-wells, pipe-lines, and flow-lines.

T. S. Chapman, assignor to Standard Oil Development Co. U.S.P. 2,356,302. 22.8.44. Appl. 11.7.41. Drilling fluid.

E. F. Raymond. U.S.P. 2,356,430. 22.8.44. Appl. 21.6.43. Gun perforator.

E. F. Raymond. U.S.P. 2,356,431, 22.8.44. Appl. 21.6.43. Retrievable gun perforator.

R. L. Chenault, assignor to Gulf Research and Development Co. U.S.P. 2,356,504, 22.8.44. Appl. 20.3.44. Oil-well pump and the like.

L. A. Layne. U.S.P. 2,356,769, 29.8.44. Appl. 4.12.39. Washing gravel out of perforate well castings.

G. Miller, assignor to Demont G. Miller. U.S.P. 2,356,776, 29.9.44. Appl. 16.6.42. Composition for preparation of oil-base drilling fluid.

W. W. Wilson. U.S.P. 2,356,805, 29.9.44. Appl. 16.5.42. Pipe elevator.

A. O. Edwards. U.S.P. 2,356,921, 29.8.44. Appl. 5.2.43. Drill.

R. B. Standefer, assignor to Shell Development Company. U.S.P. 2,357,145, 29.9.44. Appl. 15.1.43. Full-hole cementing device.

H. G. Doll, assignor to Schlumberger Well Surveying Corporation. U.S.P. 2,357,178, 29.9.44. Appl. 13.12.39. Method and apparatus for investigating boreholes.

A. H. N.

## Development.

**304. August Completions Lag Behind Record Rate Maintained During Previous Month.** Anon. *Oil Wkly*, 18.9.44, **115** (3), 29.—An average of 489 wells per week were completed in U.S.A. during the five weeks ended 2nd September. In the preceding four weeks of July the average was 520 per week. In the first eight months of 1944 25·9% more wells have been completed than in the same period of 1943, the weekly average for 1944 being 437.

Excepting Arkansas, Iowa, North Louisiana, and Nebraska, practically all States and districts have had more drilling this year than last. G. D. H.

**305. Oil Production and its Global Aspects.** W. A. Sawdon. *Petrol. Engr*, October 1944, **16** (1), 63.—Petroleum will play an important rôle in the highly mechanized era which will arise after the war, but in order to provide sufficient oil adequate and suitable drilling equipment must be available.

At present the U.S. oil output is nearly 4,700,000 brl./day; the average in 1943 being 4,113,000 brl./day. In producing oil for war and other purposes, U.S.A. has considerably depleted its reserves. Canada's 1944 production may exceed 10,000,000 brl., and Mexico's production may be over 33,000,000 brl.

In 1943, Venezuela averaged 491,500 brl./day—considerably less than in 1941. The present output is over 800,000 brl./day. Much of Eastern Venezuela is in the development stage, and so a high rate of production can probably be maintained. The post-war demand will depend largely on exports.

In 1940, Colombia produced 25,600,000 brl. of oil, and in 1943, 13,261,000 brl. The output should improve with increase in available transport. There is much exploratory and development work in progress, and future prospects are bright.

Ecuador's production of 2,378,000 brl. in 1943 was slightly higher than ever before. There is little activity in the proved fields. Exploratory work is in progress or in prospect near the Colombian border, near Zapatat (55 ml. from Guayaquil), and in the north-east.

In 1943, Peru produced 14,654,000 brl. of oil. Its peak production was 17,500,000 brl. in 1937. The main development continues to be in the Talara area. Exploratory work is expected to be carried out in the south.

24,707,000 brl. of oil was produced in Argentina in 1943, but the country has not yet attained self-sufficiency in oil. Lack of equipment has hindered development and exploratory work in recent years.

Trinidad's production of 21,385,000 brl. in 1943 was 16% below the 1942 peak, the fall being ascribed to lack of man-power and equipment.

The present production of the Near East does not reflect its productive capacity. The potentialities are great, and the production can be much increased when equipment is available. In 1943, Iran produced 73,766,000 brl. of oil, slightly less than in 1942. Iraq gave 27,000,000 brl. in 1943; its 1938 production high was 32,600,000 brl. Saudi Arabia's production fell from approximately 6,000,000 brl. in 1942 to 4,865,000 brl. in 1943. Bahrein's output may have been 7,500,000 brl. in 1943. Egypt's production fell slightly to 8,953,000 brl. in 1943.

Estimates of Burma's output in 1943 give 1,000,000 brl. Before the war the production averaged 7,000,000–8,000,000 brl./year. India's production in 1943 reached a high of 2,748,000 brl.

The Kansu field of China is reported to be producing over 3000 brl./day, from several relatively shallow wells. Transport is the great problem with this field. During 1943, the Sakhalin production is reported to have been 5,000,000 brl.

The 1943 oil output of the East Indies is estimated at 24,500,000 brl. This is a considerable increase over the estimate for 1942.

About 36,500,000 brl. of oil is estimated to have been produced in Rumania in 1943, and 23,500,000 brl. in the rest of Europe, while Russia's output is placed at 200,750,000 brl., 9,000,000 brl. below the 1942 estimate. G. D. H.

**306. Canadian Oil Situation.** F. K. Beach. *Petrol. Engr*, October 1944, **16** (1), 102.—A brief summary is given of the leasing conditions in the different provinces of Canada, with a note on income tax.

Forty-nine producing wells, 3 marginal wells, 1 producer abandoned, and 1 dry hole have been drilled at Norman Wells. The field now covers 4260 acres, 2670 acres being under the Mackenzie River. Edgewater has appeared in down-dip wells. The original production was in the Upper Fort Creek shales, from joints, but deeper drilling has shown the main oil to be in an Upper Devonian reef limestone, which ranges up to 400 ft. in thickness. The dip is about 4° to the south-west, and pinching out provides closure. The 38° A.P.I. oil is produced with a gas–oil ratio of 590 cu. ft./brl. During the first half of 1944 the output was 569,784 brl. The reserves are estimated at 30–60 million barrels.

In 1943, Turner Valley provided 98% of the Canadian oil output, excluding the North-west Territories. In August 1944 there were 246 wells producing, 114 of which had been drilled before July 1940. Recent completion depths range 6271–10,238 ft. The central portion of the field, formerly thought almost barren because of low porosity and permeability, has now provided several good wells.

Up to the end of 1942, Turner Valley is estimated to have produced 1,250,000,000,000 cu. ft. of gas with the oil and distillate. Of this only about 20% has been fully used for its heat value, and about 50% has been wastefully employed in field operations. An organization has been created to cause the gas to be used more satisfactorily.

Wartime Oils, financed by the Canadian Government, has drilled 12 wells, and will drill 10 more.

In July, 45 wells were producing in the Vermilion field, and its aggregate output averaged 708 brl./day. Fine sand, salt, and water are produced with the oil.

The Taber field was discovered in 1942. In May it had 7 producers in an area of 250–300 acres, with 6 dry wells round it. The 19° oil is produced with very little water. Another pool seems to be developing 3–4 ml. to the west, but the thin sand makes it difficult to separate the gas-cap from the oil-zone. 21 ml. south and 7 ml. east is the Conrad pool.

The Red Coulee field has been abandoned after producing 329,000 brl. of oil in 15 years.

In October 1943, a 12,056-ft. well on the Jumpingpound location reached the Rundle limestone, finding water. Farther north, Ram River 2 found a little oil.

The Princess field structure was confirmed by the seismograph, and has oil beneath the gas-cap. The producing zone is just above the Palæozoic. Separation of the oil, gas, and water is poor. A Devonian test has found oil after successfully penetrating the high-pressure gas horizons.

A number of tests have been and are being drilled in Saskatchewan. A few wells have given a little oil in Quebec, and a test is under way on the Gaspe Peninsula.

Further plant is being constructed for working the Athabaska tar sands.

A new refinery has been completed at Clarkson, Ontario. It produces motor and aviation spirit, and lubricants. A synthetic rubber plant has been erected at Sarnia, Ontario. It is hoped to keep the rubber price at about 20 cents a lb. G. D. H.

**307. Venezuela Moves Ahead.** Anon. *Petrol. Engr*, October 1944, **16** (1), 130.—In August 1944, Venezuela was producing over 800,000 brl./day. Most of the rise in production has come from intensive development of existing fields, for no major discoveries have been brought into production during the war period. Several promising areas are being studied.

The enactment of the new petroleum law in 1943 has put new development on a satisfactory basis, and will accelerate refinery construction in Venezuela.

The main producing companies are Creole, various Shell subsidiaries, and Mene Grande.

Quiriquire, Jusepin, and Santa Barbara are on a N.E.–S.W. trend in Monagas, Eastern Venezuela. Their drilling problems are not serious, and dual completions are made at Jusepin and Santa Barbara in the two major producing zones. Pressure maintenance is applied at Quiriquire, where some of the wells are pumped. Oil from Quiriquire and Jusepin goes by pipe-line to Caripito, while the Santa Barbara oil goes to Puerto la Cruz. Temblador crude is piped to Boca de Uracoa.

In Anzoategui are the Oficina, San Joaquin, Leona, Santa Ana, and El Roble fields. All have multiple producing sands, sometimes with oil gravity ranging 15–50° A.P.I. Producing depths range 5000–10,000 ft., and distillate is obtained in some cases. High pressures and temperatures up to 275° F. are met. Some of the deeper beds are very hard. A 16-in. pipe-line runs from Oficina to Puerto la Cruz.

Prolific new deep production was reported to have been found at Jusepin early in 1944.

Preliminary operations are proceeding in Guarico, and in the Apure River area.

The major oilfields of Western Venezuela are on the eastern shore of Lake Maracaibo, and extend off-shore. Operations have been conducted in 80 ft. of water, and 8–10 ml. from land. Dips are lakeward, and the producing horizons lie 1000–5000 ft. deep. Special pile foundations are used for off-shore drilling, in addition to caisson-type foundations. The off-shore drilling technique is described in some detail. Twin well locations are now being drilled where there are two producing horizons. There are possibilities of deeper developments. Interest is being shown in the western and central mid-lake areas. G. D. H.

**308. The Oil Industry in Mexico.** W. A. Sawdon. *Petrol. Engr*, October 1944, **16** (1), 158.—In 1942, Mexican oil production fell to 32,955,000 brl., some 21% below the average for the preceding three years. There was a rise in 1943, as more shipping became available, and in 1944 the output will probably exceed 40,000,000 brl.

Pemex proposes to modernize existing plants and to build new refineries after the war, as well as to develop present fields and to carry out exploratory work. Some geophysical work, mainly seismic, is proceeding. Favourable areas occur along the coast from Texas into the Yucatan Peninsula, and there are possibilities in the southern part of Lower California, and in Sinora and Sinaloa, east of the Gulf of California.

85% of the country's production comes from the Tampico area, which includes the Northern District, the Southern District, and Poza Rica. Poza Rica is responsible for 63% of the Mexican output. There are several fields in the Isthmus of Tehuantepec area.

Much gas is produced, and increased attention is being paid to its utilization for gasoline extraction and for repressuring. A considerable number of wells have been shut in in recent years.

North and east of Monterrey in north-east Mexico there are 19 gas wells. Oil-seeps have been reported east and west of Monterrey, and between Monterrey and Tampico.

G. D. H.

**309. Wells Being Completed at Highest Rate Since Sharp Curtailment in Early 1942.** Anon. *Oil Wkly*, 16.10.44, **115** (7), 76.—In the four weeks ended 30th September, completions in U.S.A. averaged 532 per week. More than 4000 rigs were in operation, compared with just over 3000 at the beginning of 1944. If the September rate of completions is continued to the end of the year, the P.A.W. goal of 24,000 wells in 1944 should be exceeded.

During the first nine months of 1944, the weekly average rate of completing wells has been 26·8% above that for last year. Above average increases have occurred in California (42·5%), Texas (44·4%), Kentucky and Mississippi (over 100%), Montana (50%), New Mexico (47·1%), and West Virginia (46·4%).

The U.S. September completions are summarized by States and districts, and totals are given for the first nine months of 1944, with 1943 figures for comparison.

G. D. H.

**310.* Colombian Oil Production Maintains Steady Rate.** Anon. *Oil Gas J.*, 28.10.44, **43** (25), 60.—Recently the Colombian crude oil production has been fairly steady: May, 2,050,693 brl.; June, 1,916,800 brl; July, 2,052,475 brl.; August 1,962,893 brl.

G. D. H.

**311.* Summary of September Completions.** Anon. *Oil Gas J.*, 28.10.44, **43** (25), 130.—2520 wells were completed in U.S.A. in September. 1357 of these gave oil and 289 gave gas. The completion results are summarized by States and districts, and the numbers of wells in different depth ranges are given. G. D. H.

**312. Wells Completed in United States in Week Ended October 28, 1944.** Anon. *Oil Wkly*, 30.10.44, **115** (9), 61.—368 field wells (250 giving oil and 29 giving gas) and 70 wildcats (7 giving oil) were completed in U.S.A. during the week ended 28th October, 1944. The completion results are summarized by States and districts. G. D. H.

**313.* Estimates Raised 85,000 brl. on Maximum Rate of Efficient Production.** Anon. *Oil Gas J.*, 4.11.44, **43** (26), 50.—P.I.W.C. has been advised that the current crude-oil output exceeds the maximum efficient rate, regardless of the upward revision made possible chiefly by discoveries and developments at Elk Hills, California, and West Edmond, Oklahoma. Current estimates of the maximum efficient rate of production during 1945 are: 1st quarter, 4,610,000 brl./day; 2nd quarter, 4,600,000 brl./day; 3rd quarter, 4,585,000 brl./day; and 4th quarter, 4,570,000 brl./day.

The 1945 projected rates are 85,000 brl./day above the previous computations, and will require 22,000 new development wells and 5000 exploratory wells in 1945.

286 seismic crews, 130 gravity crews, 21 magnetic crews, 47 core-drill crews, and 1 Elflex crew are reported active.

A number of war-time secondary recovery operations are now beginning to show returns. G. D. H.

**314. Eleven Wells Completed in Tibu Area, Colombia.** Anon. *Oil Wkly*, 27.11.44, **115** (13), 64.—Eleven producing wells have been completed in the Tibu area, north of the Petrolia field. All but 3 are shut in pending further development of the two-dome structure, and decisions regarding pipe-line facilities. G. D. H.

**315. Hungary's Oil Production Rises During War Period.** Anon. *Oil Wkly*, 27.11.44, **115** (13), 64.—Hungary's oil production is said to have risen from a little over 1,000,000 brl. in 1939, to nearly 7,000,000 brl. in 1942. Commercial production was first obtained in the Lispe area in 1937. Other production has since been found in the Tisza River

Valley, north and north-west of Szentes, and near Miskole on the southern flank of the Carpathians. G. D. H.

**316. Wells Completed in United States in Week Ended November 25, 1944.** Anon. *Oil Wkly*, 27.11.44, **115** (13), 71.—During the week ended 25th November, 1944, U.S.A. had 417 field completions and 74 wildcat completions. 263 of the former and 12 of the latter found oil, while 42 of the former found gas. The completion results are summarized by States and districts. G. D. H.

**317. Wells Completed in United States in Week Ended December 2, 1944.** Anon. *Oil Wkly*, 4.12.44, **116** (1), 63.—During the week ended 2nd December, 1944, U.S.A. had 423 field completions and 65 wildcat completions. 278 of the former and 7 of the latter found oil; 38 of the former and 1 of the latter found gas. The completion results are summarized by States and districts. G. D. H.

## Transport and Storage.

**318. Contamination by Successive Flow in Pipe-Lines.** F. C. Fowler and G. G. Brown. *Petrol. Engr*, August 1944, **15** (12), 121–134.—In recent years the transport of a number of different petroleum products through the same pipe-line without a separating medium has become common practice. The extent to which succeeding fluids are contaminated by one another has been previously examined, but reported conclusions are not entirely consistent or capable of exact interpretation. From theoretical considerations it can be deduced that for viscous flow, assuming negligible diffusion, the amount of contamination is proportional to the length of the pipe. For turbulent flow a mixture of the two fluids separates the pure fluids after they have moved successively a certain distance through the pipe. This mixture layer serves as a buffer decreasing the amount of contaminated portion delivered by the pipe. Increase in turbulence would be expected to decrease the amount of contamination.

In order to study effects during turbulent flow a glass apparatus was constructed, tubes of varying diameter and length being employed. As working fluids a dilute salt solution and water were used, the second stream passing through the apparatus being coloured with the indicator (Potassium Chromate) used in the subsequent titrations. The fluids were held in constant head tanks to which air pressure could be applied for high velocities. A three-way stop-cock enable easy introduction of the second fluid, approach of which to the end of the tube was indicated by the coloration. A cart containing 23 beakers was moved past the end of the tube at constant velocity just prior to the arrival of the second fluid at this point. Recording of the temperatures of the fluids, time of collection, and determination of salt content of the beakers, and estimation of the average content of each beaker provided the necessary data to permit mathematical analysis and extrapolation of the curves obtained. Graphs show the volume of contaminated portion collected between certain instantaneous composition limits, *e.g.* 98%/2% mixed portion is the volume of mixture flowing from the pipe during the time that the composition changed from 98% of the leading fluid to 2% of the leading fluid. These instantaneous composition limits are expressed as a percentage of total pipe volume and plotted against Reynolds number. The experiments covered a range of Reynolds numbers up to 20,000 and extrapolation is made to 1,000,000.

The results confirm the theory, as in the region of viscous flow the contaminated portion is independent of Reynolds number except with short tubes, where end effects come into play. The quantity of contaminated material is most sensitive to change in Reynolds number at the commencement of turbulent flow, *i.e.* in the region of about 2200, and falls off more rapidly with increase in the Reynolds number in this region. As similar fluids were used, no effects were noted on changing the order of the leading fluid, but with fluids of dissimilar composition this would probably not be the case.

It was found that for each Reynolds number $\text{Log}_{10}$ (contaminated portion) = $\text{Log}_{10}$ (pipe volume) $- 0{\cdot}4\,\text{Log}_{10}\left(\frac{L}{D}\right) + C$ where $\left(\frac{L}{D}\right)$ is the ratio of length to diameter of the pipe and $C$ is function of the Reynolds number, and of the range in instantaneous composition covered by the contaminated portion. Values for $C$ for turbulent flow

(Reynolds numbers 2300/1,000,000) and a range of instantaneous compositions are given in a supplementary table. Some calculations of contamination on a 98%/2% and a 95%/5% mixture basis are compared with actual pipe-line measurements of the contaminated portions obtained during operation. R. A. E.

**319. Post-War Uses of the War Emergency Pipe-Lines for Petroleum Transportation.** T. E. Swigart. *Petrol. Tech.*, September 1944, A.I.M.M.E. Tech. Pub. No. 1757, 1–28.—After making certain assumptions about the post-war demand, supply, and movements of petroleum, transportation costs by pipe-lines, tankers, and barges are analysed.

No attempt is made to offer recommendations regarding the disposition of the War Emergency lines. Even if the Government were willing to consider its investment returned by savings during the war, or were to regard any unreturned part of its investment as money spent for the war programme, the 20-in. pipe-line could only compete with tankers for Gulf to East Coast products transportation on a marginal or out-of-pocket basis. The 24-in. line could meet tanker costs only if enough East Texas crude or combined East and West Texas crude (by direct pipe-line haul) were tendered for transportation to give it a high load factor. It is within the realm of probability that enough total petroleum business could be obtained to give one segment of one line an economic load into District 2, and it may be possible for industry to utilize a segment of one line for this purpose.

The Government would doubtless not consider the subsidizing of these lines prudent or justifiable, as such action would not only harm business, but could reduce the American tanker fleet, and thus conceivably prove more detrimental to the national safety in the future than even the abandonment of the pipe-lines. G. D. H.

**320. Soil Corrosion Studies, 1941. Ferrous and non-Ferrous Corrosion Resistant Materials and non-Bituminous Coatings.** K. H. Logan and M. Romanoff. *Bur. Stand. J. Res., Wash.*, September 1944, **33** (3), 145–197.—The results are given of a detailed examination of a series of ferrous and non-ferrous pipe-line materials and coatings removed from fourteen corrosive soils in 1941 after exposure for 2–9 years, in connection with the Bureau of Standards soil corrosion investigation started in 1922. In view of the relatively limited number of specimens of each type, no very definite conclusions can be drawn from the widely varying results, but some useful generalizations can be made.

*Ferrous Materials.* The incorporation of considerable quantities of nickel, chromium, and other elements into ferrous materials is necessary to withstand the action of severely corrosive soils.

*Copper and Copper Alloys.* These are very resistant under most corrosive conditions, the corrodibility increasing with the amount of zinc in the alloy. The addition of arsenic to Muntz metal does not prevent dezincification.

*Zinc and Lead.* Rolled zinc specimens were better than die-cast zinc alloy. Tellurium lead and antimonial lead did not show any improvement over chemical lead.

*Metal Coatings.* Coatings of lead, tin, or copper did not provide serviceable corrosion protection.

*Non-metallic Products.* Asbestos cement pipes tend to soften on the outside, but tend to increase in strength, possibly due to curing, over an indefinite period. Coatings of vitreous enamel, thick rubber, a china-wood oil (mica and a baked bakelite) greatly reduced corrosion over periods of from four to nine years, but the thinner coatings deteriorated. C. L. G.

**321.* Underground Reinforced Concrete Tank for Aviation Gasoline Storage.** G. P. Collier. *Oil Gas J.*, 28.10.44, **43** (25), 66.—The U.S. Government Departments have constructed various concrete tanks, generally of pre-stressed concrete hoop-steel with linings of sprayed enamel or synthetic rubber. The tank described is a conventional type of unlined reinforced concrete erected by the U.S. Army for 100-octane gasoline. It measured 30 by 10·5 ft. and had a 14-in. bottom and 12-in. walls, with a 10-in. roof supported by four 18-in. columns.

A site was selected with high ground, so that any gasoline seepage due to the porosity of the cement concrete would be counteracted by the ground-water pressure and the interior walls would be kept wet. The water film would also materially aid in reducing any chemical reaction between the free alkali and the aromatic mixture present in the gasoline. The tank was finally covered with 8 ft. of earth.

A sectional drawing and diagrams of the tank and its pump and various connections and centrifugal filter are shown, and the excavations and shoring and the mixing and pouring of the concrete are fully described and discussed. The construction at various stages is shown by photographs, and the final inspection and test discussed.
W. H. C.

**322.* The Refiners Notebook. No. 16. Corrosion Protection of Tanks.** W. L. Nelson. *Oil Gas J.*, 4.11.44, **43** (26), 75.—Corrosion in tanks takes place mainly in the following positions: (1) the vapour space, (2) the water-ring and bottom, and (3) the outside ring near the soil. Some methods used to reduce corrosions are briefly described, and details are given for the protection of the inside bottom plate and wall to the water level by a 6 × 1-in. coal-tar sealing compound ring enclosed in a waterproofed concrete and a waterproof mortar.

Gunite can be used on the structural members and roof, shell and bottoms of tanks, especially where sour crudes are stored, the cost being 35–40 cents per square foot for the bottoms and roof respectively.

A table is given showing the storage required by a large modern refinery in terms of the number of tanks; sizes; total capacity for the various products and crude oil; and storage capacity per barrel of plant capacity. W. H. C.

# Refinery Operations.

## Refineries and Auxiliary Refinery Plant.

**323.* Principles of Electrolytic Corrosion of Metals.** G. E. Coates. *Chem. and Ind.*, 1944, 306–309.—A lecture reviewing the present-day conceptions of the electrochemical principles involved in wet corrosion with 11 references. T. C. G. T.

**324.* Plastic Tubing Coating.** Anon. *Oil Gas J.*, 30.9.44, **43** (21), 108.—A plant has been completed for applying a phenolformaldehyde resin to many types of oilfield equipment, including pipes. Briefly, after cleaning the metal with NaOH, and sandblasting, the material is dipped in a vessel of the plastic, drained, and baked at 225–250° F. for 1 hour. This procedure is repeated four times, and then a fifth coating is given, and the material with the five layers of plastic is then fused at about 400° F.

The coating adheres well, is tough, and withstands abrasion; it is not affected by most solvents or acids. Its surface has a coefficient of friction as low as that of glass. It is flexible and does not chip when hammered, and will stand up to temperatures of up to 350° F. Severe laboratory tests on coated metal pieces are described. The following illustrates the advantages over uncoated piping: normally the life of uncoated tubing in a flowing West Texas well was 2–6 months. Plastic-covered tubes were installed, and inspected at 3 monthly intervals for a period of 15 months, and no corrosion was observed, neither did the coating show any change. Uncoated tubes in a Californian well normally required cleaning every 45 days to remove the paraffin accumulation, but when plastic covered, the tubes showed no signs of any deposit after 7 months operation. W. H. C.

**325. Venezuela Refinery Capacity 70,000 Barrels Crude Daily.** L. R. Kirsheman. *Petrol. Engr*, October 1944, **16** (1), 84–86.—By acquisition and absorption of the properties and activities of other companies, the activities of Creole Petroleum Corporation in Venezuela have been greatly extended. They are mainly concerned with production, and during the first quarter of 1944 the average daily production of Creole was 334,000 brl. out of a total of 566,000 brl. for the whole of Venezuela. The types of crude handled by Creole range from asphaltic of 17·5° A.P.I. grav. to paraffinous of 49° A.P.I. grav.

At the present time refinery facilities in Venezuela total 70,000–75,000 brl. a day of crude, mainly divided between Creole and Caribbean Petroleum Co. Creole operates plants at Caripito and at Cabimas. The former, completed in 1939, consists of a combination crude topping and visbreaker unit with gas-absorption and stabilization facilities. It normally operates on 19° A.P.I. Quiriquire crude, capacity for which is about 40,000 brl. a day. Alterations are in hand to permit simultaneous operation on 33° A.P.I. Jusepin crude. Products manufactured include gasoline, kerosine, diesel, and heavy fuels, and special light cuts to augment aviation production at other refineries to which they are shipped. A large power-house supplies electricity to the refinery and adjacent fields.

The La Salina refinery at Cabimas was originally constructed in 1926–1927 to meet the needs of the local market. In 1939 a Foster Wheeler unit of 5000-brl.-a-day capacity when operating on crude of 25° A.P.I. grav. was installed, and is now the only unit. This pipe-still also operates on Lagunillas crude of 17·5° A.P.I. grav. for asphalt production. The total outlet for petroleum products in Venezuela at present amounts to 11,800 brl. a day, of which Creole has a substantial share. Developments expected in the Venezuelan market are discussed, and a considerable expansion in the refinery capacity of Venezuela is expected when materials for construction become available.

R. A. E.

**326. Aruba Refinery a Source of Many Petroleum Products.** W. W. Damm. *Petrol. Engr*, October 1944, **16** (1), 92–95.—During the last 20 years the Aruba refinery, now operated by Lago Oil and Transport Co., has been considerably extended, and just prior to the entry of the U.S. into the war the capacity was nearly 300,000 brl. crude a day. The crude is transported to the refinery by shallow-draught tankers from Venezuela and ocean-tankers from other sources. Total storage capacity aggregates 13½ million brl. The number of employees is approximately 6500. Prior to the war the refinery was designed to manufacture all major petroleum products with the exception of finished lubricants; an unfinished base-stock for lubricating oil manufacture was, however, also exported for final processing elsewhere. The plants include crude stills, thermal cracking units, Edeleanu plant for kerosine treating, acid treating and sweetening units, polymerization and hydrogenation units for hydrocodimer production and alkylation units. Since then a fluid catalyst cracking unit has also been installed to increase 100 octane aviation gasoline production. Motor gasoline is, however, still produced in greater quantity than any other single product.

R. A. E.

**327.* Practical Refinery Engineering. No. 17. Factors in Design and Operation of Heat Exchangers.** P. Buthod and B. W. Whiteley. *Oil Gas J.*, 21.10.44, **43** (24), 135. —The various factors influencing heat exchange and economy have been dealt with in the sixteen earlier papers of the series. In any heat exchanger the flow of heat is retarded by several individual resistances. One of these may be comparatively large, and thus becomes the controlling resistance. For example, in an oil-to-water exchanger the major resistance is usually on the oil side, neglecting any fouling conditions. Thus the heat-transfer rate cannot be increased to any great extent by increasing the water velocity. It can be increased, however, by varying the factors which control the oil-side resistance. In selecting a system the most efficient design is usually accomplished by calculating all the various combinations which can be used, and determining which of these will give the best heat-transfer rate. The methods of routing the fluids through the exchanger may greatly affect the heat-transfer rate. Generally :

(1) The more viscous material is routed through the shell, where greater turbulence can be accomplished by the use of baffles.

(2) The smaller volume of fluid is routed through the shell, where increased transfer rates can be attained by the use of close baffle spacing.

(3) If one fluid is under appreciable pressure, it is routed through the tubes, since high-pressure shells are relatively expensive.

(4) If appreciable scaling may occur, the fluid is routed through the tubes, in order to facilitate cleaning operations.

Choice of the material to be routed through the tube side and its effect on the heat transfer-rate is illustrated by an example. W. H. C.

**328.* "Liqui-jectors" Remove Condensate.** Anon. *Oil Gas J.*, 4.11.44, **43** (26), 79.—The Liqui-jector is a simple apparatus for automatically and continuously removing condensate from compressed air and gas lines. The essential parts are two ceramic tubes of greatly different porosities, one being water-repellent and the other water-permeable. These function as follows :—

Compressed air entering the apparatus passes through the first (water repellent) tube, where it is stripped of moisture. The action is by coalescence of droplets on the surface of this tube—a coarse ceramic material with an average of 50,000 pore openings per square inch, each so small that the pressure drop across the tube is insufficient to permit water passage against the resisting diaphragm action of its surface tension. The coalesced moisture drops to the bottom of the unit, where it passes through the second tube (without loss of air) to the outside atmosphere. The second tube has an average of 720 million pore openings per square inch, and, being constantly wet, constitutes a perfect air-seal up to the rated limit working pressure of the unit.

Pilot-plant operations are being carried out for producing separations such as water from oil, and condensed liquid fractions from refinery gas. W. H. C.

## Distillation.

**329. Patent on Distillation.** W. A. Schulze (Phillips Petroleum Co.). U.S.P. 2,348,931, 16.5.44. Appl. 10.12.40. To separate butadiene from a $C_4$ hydrocarbon mixture containing *iso*butane, butene-1, *iso*butene, and butadiene, the mixture is fractionally distilled to separate *iso*butane. The de-*iso*butane mixture is contacted with an isomerization catalyst to convert butene-1 into butenes-2, and *iso*butene is selectively removed from the isomerized mixture. Sufficient *n*-butane is added to provide a concentration substantially in excess of the *trans*-butene-2 content, and the resulting mixture is fractionally distilled to produce an overhead fraction free from butene-2 and comprising butadiene, *n*-butane, and unconverted butene-1, and a bottoms fraction free from butadiene and comprising *n*-butane and butenes-2. The overhead fraction, admixed with sulphur, is distilled to produce an overhead fraction comprising the sulphur dioxide azeotropes of *n*-butane and butene-1, and a bottoms fraction comprising butadiene. H. B. M.

## Absorption and Adsorption.

**330. Patents on Absorption and Adsorption.** A. M. McAfee and E. E. Dunlay (Gulf Oil Corp.). U.S.P. 2,347,274, 25.4.44. Appl. 25.4.41. Highly paraffinic synthetic oils are prepared by subjecting olefin-containing gases and non-residual hydrocarbon oil, high in non-paraffinic and non-asphaltic constituents and substantially free from hydrocarbons boiling within the gasoline range, to contact with each other in the presence of an aluminium halide catalyst.

R. C. Gunness (Standard Oil Co., Chicago). U.S.P. 2,347,682, 2.5.44. Appl. 24.4.41. In the conversion of low molecular weight hydrocarbon gases into high molecular weight hydrocarbons, the gases are mixed with carbon dioxide, recycled gas from a synthesis process, and steam in such proportions as to provide an atomic proportion of hydrogen, carbon and oxygen of about 4 : 1 : 1. The mixture is contacted with a reforming catalyst to convert it for the most part into hydrogen and carbon monoxide. In this way a gas is produced having a hydrogen to carbon monoxide ratio of about 2 : 1. A catalyst is suspended in the gas for a sufficient length of time to effect synthesis and afterwards suspended catalyst is separated from gases and reaction products. Unreacted gas and low molecular weight hydrocarbon gases are separated from higher molecular weight reaction products and unreacted gases are then recycled to the mixing stage of the process. H. B. M.

## Solvent Extraction and Dewaxing.

**331. Patents and Solvent Extraction and Dewaxing.** O. L. Polly and A. C. Byrns (Union Oil Co. of California). U.S.P. 2,347,432, 25.4.44. Appl. 13.5.41. To separate a mineral oil into fractions it is contacted with a mercapto-substituted carboxylic acid. The raffinate and extract phases thus formed are separated.

D. G. Brandt (Cities Service Oil Co.). U.S.P. 2,347,809, 2.5.44. Appl. 20.12.40. An improved method is described for dewaxing petroleum-oil stocks which are dissolved in and diluted with a liquefied normally gaseous hydrocarbon diluent which is liquid at dewaxing temperatures. The solution is first chilled by passing it through a series of connected zones maintained at progressively lower pressures by the hydrostatic head of the mixture. Portions of the diluent are vaporized in each zone and passed upwards through succeeding zones in intimate contact with the oil mixture to effect agitation thereof.

D. G. Brandt (Cities Service Oil Co.). U.S.P. 2,347,810, 2.5.44. Appl. 20.2.41. In a method for dewaxing mineral oil stock involving production of a cold mixture of mineral oil and diluent containing distinct separable particles of wax, the following improvement is incorporated. A continuous stream of the oil mixture is passed into a relatively large settling chamber provided with a number of vertical, interconnected zones. The oil-stream is directed intermittently and alternately into each of the zones for a specific length of time, and in such a manner that settling in the other zones of the chamber is undisturbed. The wax which settles out in each zone is collected in the lower portion of the chamber, while dewaxed oil is collected in the upper portion.

L. B. Goodson, J. V. Montgomery, and R. W. Henry (Phillips Petroleum Co.). U.S.P. 2,349,038, 16.5.44. Appl. 10.8.42. To remove wax, mineral oils are mixed with a dewaxing solvent comprising amyl mercaptan and a wax anti-solvent in which the anti-solvent is methyl ethyl ketone. Subsequently the mixture is chilled to precipitate wax, which can then be removed.

L. B. Goodson, J. V. Montgomery, and R. W. Henry (Phillips Petroleum Co.). U.S.P. 2,349,039, 16.5.44. Appl. 10.8.42. In a process for dewaxing mineral oils, the oils are mixed with a dewaxing solvent consisting of diamyl sulphide and a wax anti-solvent in which the anti-solvent is acetone. Subsequently the mixture is chilled to precipitate wax and the wax is removed. H. B. M.

## Cracking.

**332.* Paulsboro T.C.C. Unit Features Solid Catalyst Bed.** J. P. O'Donnell. *Oil Gas J.*, 11.11.44, **43** (27), 82.—The new Thermafor plant at the Paulsboro Refinery, New Jersey, is the first T.C.C. unit of many under construction or alteration to use the solid-bed principle in both reactors and regenerators. Formerly these vessels enclosed angle structures, as they were designed to handle the granular catalyst. The introduction of the pellet or bead catalyst has enabled a solid catalyst bed to be used, and has simplified design, reduced internal structures, and increased flexibility. The latter is due to the fact that the depth of the catalyst bed can be increased or decreased by lengthening or shortening the distribution pipes. This alters the space velocity—a function of the depth of catalyst bed in relation to the volume of oil charged—usually 1·8 for cracking and 0·4 for treating operations. The depth of catalyst used for cracking is 7–8 ft., for treating 35 ft.

The rate of catalyst flow through the 16-ft.-diameter reactor at Paulsboro is maintained at 100 tons per hour, the volume of catalyst for cracking being 1400 cu. ft. for treating 7000 cu. ft.

The regenerators are provided with 10 burning zones, with alternate cooling zones. Air for regeneration enters through channels situated in the centre of each burning zone, and passes upwards and downwards through the catalyst and through outlet channels to the flue-gas system. The residence of the catalyst in each zone, except the bottom, is 5–7 minutes, in the bottom zone the period is 20 minutes.

A list of T.C.C. units completed and under construction is given. W. H. C.

**333. Patents on Cracking.** A. G. Peterkin (Houdry Process Corp.). U.S.P. 2,347,216, 25.4.44. Appl. 27.3.41. A process is described for the production of motor fuel of improved resistance to oxidation from sulphur-bearing gasoline containing unstable unsaturated hydrocarbons produced by decomposition reactions. The fuel is subjected to the action of a siliceous splitting catalyst at a temperature above 750° F. but below thermal decomposition temperature. Cracking conditions are designed to effect decomposition into coke of at least 1% by weight of the gasoline without substantial alteration of anti-knock rating. After the cracking operation sulphur-bearing components are removed.

B. M. Vanderbilt (Standard Oil Development Co.). U.S.P. 2,347,527, 25.4.44. Appl. 27.12.40. During pyrolysis of gaseous hydrocarbons in metallic apparatus the treatment is interrupted when the effectiveness of the apparatus becomes reduced. Carbonaceous deposits are removed, and the metal surfaces are subsequently treated with an acidic substance having an ionization constant greater than $10^{-6}$. Finally, the metal surfaces are treated with hydrogen before re-use.

C. L. Thomas and E. C. Lee (Universal Oil Products Co.). U.S.P. 2,347,648, 2.5.44. Appl. 30.11.38. In a conversion process, hydrocarbon oil is subjected at cracking temperature to the action of a calcined mixture of precipitated silica, alumina, and zirconia.

G. Egloff (Universal Oil Products Co.). U.S.P. 2,348,531, 9.5.44. Appl. 16.12.40. In a process for thermally and catalytically cracking and coking a hydrocarbon oil to produce a substantial yield of high anti-knock gasoline, the charging oil consists of a hydrocarbon oil having relatively heavy and high coke-forming fractions and relatively lighter fractions comprising those within the gasoline boiling range. The charging oil is mixed directly with cracked oil and gas obtained from thermal cracking of a relatively heavy reflux condensate fraction, and a mixture is separated which consists of non-vaporous cracked and uncracked oil containing the relatively heavy and high-coke-forming fractions, and a vaporous oil and gas. The non-vaporous oil is treated to produce coke and a distillate oil. The vaporous oil and gas are fractionated to separate high anti-knock gasoline and gas from a relatively light reflux condensate fraction and from the relatively heavy reflux condensate fraction. The gasoline and gas are condensed, cooled, and separated. The heavy reflux condensate is directed to the thermal cracking zone, where cracked oil and gas are produced. The light reflux condensate is catalytically cracked to form products containing substantial yields of gasoline. Cracked products are separated into vaporous gasoline and gas, and a higher-boiling hydrocarbon oil. The gasoline and gas are condensed, cooled, and separated, and the higher-boiling hydrocarbon oil is passed into the vaporous oil and gas from thermal cracking, and fractionated.

J. Delattre (Universal Oil Products Co.). U.S.P. 2,348,576, 9.5.44. Appl. 13.5.40. To produce high anti-knock gasoline of relatively low olefin content, hydrocarbon oil heavier than gasoline and a powdered cracking and hydrogenating catalyst are introduced into a reaction zone and passed from one end to the other. A substantial part of the oil is cracked to olefinic gasoline in the portion of the zone adjacent to the inlet. Hydrogen is introduced at an intermediate point to mix with olefinic reaction products. Thus substantial olefin saturation is effected during the passage of the hydrocarbons and hydrogens through the remaining part of the reaction zone.

F. E. Frey (Phillips Petroleum Co.). U.S.P. 2,348,802, 16.5.44. Appl. 7.10.40. To produce hydrocarbons suitable for use as motor fuel, a mixture of hydrocarbons having at least 2 carbon atoms per molecule, and boiling not higher than the end-point of motor fuel, is introduced to a non-catalytic conversion zone under conditions designed to produce an optimum yield of normally liquid, substantially aliphatic hydrocarbons. These hydrocarbons boil within the motor fuel range, and include low-boiling *iso*paraffins. With at least a portion of the effluent from the conversion zone, consisting of normally gaseous and normally liquid hydrocarbons, and including olefins and low-boiling *iso*paraffins, there is mixed concentrated sulphuric acid, at an alkylation temperature and pressure, to unite olefin and *iso*paraffin hydrocarbons and form hydrocarbons in the motor-fuel range. Subsequently a fraction comprising hydrocarbons suitable for motor fuel is removed. A normally gaseous hydrocarbon fraction comprising hydrocarbons with at least two carbon atoms per molecule is also withdrawn, and at least part of it is returned to the non-catalytic conversion zone.

H. B. M.

J. R. Bates (Houdry Process Corp.). U.S.P. 2,349,243, 23.5.43. Appl. 4.3.42. A hydrocarbon material is contacted under cracking conditions with a catalyst consisting of zirconium phosphate. The catalyst is prepared by mixing a solution of a soluble zirconium salt and a solution of a soluble metaphosphate and afterwards drying the mixture.

C. E. Hemminger (Standard Oil Development Co., Delaware). U.S.P. 2,349,428, 23.5.44. Appl. 30.12.39. Crude residual oils are treated in the following way to obtain vaporizable constituents suitable for further cracking treatment. The oils are heated to a sufficient temperature to vaporize a portion of them, and the vapours so formed are separated from unvaporized residue. The residue is maintained at reduced pressure for 1–2 minutes at a temperature between 775° and 800° F. Vapours formed during this viscosity-breaking treatment are separated, and part of them are condensed and combined with the initial material prior to heating. H. B. M.

## Hydrogenation.

**334. Patents on Hydrogenation.** W. J. Mattox (Universal Oil Products Co.). U.S.P. 2,348,557, 9.5.44. Appl. 17.10.40. A method is described for improving the anti-knock characteristics of hydrocarbon distillates consisting of gasoline fractions containing naphthenes with 5 carbon atoms in the ring. The distillate is subjected to the action of hydrogen in the presence of a catalyst to convert the naphthenes into open-chain, aliphatic hydrocarbons. The resultant conversion products are reformed in the presence of a dehydrogenating catalyst. H. B. M.

## Polymerization.

**335. Patent on Polymerization.** R. E. Nagle (The Texas Co.). U.S.P. 2,348,836, 16.5.44. Appl. 13.7.39. In a process for converting normally gaseous olefin-containing hydrocarbons into a normally liquid hydrocarbon product boiling in the gasoline range, a stream of $C_4$ and lighter hydrocarbons containing 20–40% olefines are heated to a temperature between 375° and 400° F. The stream is then passed through a catalytic reaction zone containing a phosphoric acid catalyst of about 100–110% $H_3PO_4$ by weight to effect polymerization. Hydrocarbon reaction products are removed from the outlet end of the reaction zone. Relatively cool normally gaseous hydrocarbons are introduced into the zone at a number of points between the inlet and outlet ends in an amount and at such a temperature that the overall temperature difference from inlet to outlet is 50–60° F. The temperature increases in the direction of flow of the stream, and the water content of the hydrocarbon material is progressively increased during flow through the reaction zone. H. B. M.

## Alkylation.

**336. Patents on Alkylation.** A. A. O'Kelly and D. P. J. Goldsmith (Socony-Vacuum Oil Co.). U.S.P. 2,347,790, 2.5.44. Appl. 15.3.40. Paraffinic hydrocarbons are alkylated with olefinic hydrocarbons by contacting them under alkylating conditions in the presence of a catalyst consisting essentially of solid material selected from the group consisting of compounds of the general type MX and associations between such compounds. M is a metal and X is chlorine or fluorine; MX is a metal halide which is a solid stable compound at 800° F. The concentration of olefins is so controlled that alkylation is the principal reaction.

L. P. Elliott and L. F. Brooke (Standard Oil Co. of California). U.S.P. 2,347,999, 2.5.44. Appl. 2.12.40. In a process for alkylating an *iso*paraffin to produce *iso*paraffins of higher molecular weight, an acid alkylation catalyst is reacted in a first zone with an olefin to form an alkyl acid ester. The alkylated acid catalyst is then withdrawn and an *iso*paraffin is alkylated with it in a second zone. In this way an *iso*paraffin of higher molecular weight is produced and acid alkylation catalyst is liberated. After separation from the hydrocarbon the catalyst is treated and returned to the first zone for realkylation.

O. N. Miller (Standard Oil Co. of California). U.S.P. 2,348,017, 2.5.44. Appl. 13.10.39. High anti-knock motor-fuel hydrocarbons are obtained from a mixture of relatively light hydrocarbons containing normal butane, *iso*butane, *iso*butene, 1-butene, and 2-butene in the following way. Normal butene and 2-butene are separated from the mixture by fractional distillation, and the residue of the mixture is subjected to polymerization. Polymers are separated from the unpolymerized portion. 2-Butene is absorbed from normal butane in an excess of alkylation catalyst, and the unpolymerized portion of the mixture and the alkylation catalyst solution containing excess catalyst is passed to an alkylation zone in which *iso*butane is alkylated.

A. R. Golsby, E. F. Pevere, and G. B. Hatch (The Texas Co., New York). U.S.P. 2,348,467, 9.5.44. Appl. 10.5.41. In the alkylation of hydrocarbons, a solution of olefin in sulphuric acid is prepared and contacted with substantially olefin-free, low-boiling *iso*paraffin to strip absorbed olefin product from the acid. The resulting mixture is passed to a reaction zone containing an alkylation catalyst, and conditions are so controlled that the *iso*paraffin is alkylated by the olefin product with the formation of saturated hydrocarbons boiling in the gasoline range.

F. Horton, L. C. Kemp, R. E. Nagle, and L. P. Scoville (The Texas Co., New York). U.S.P. 2,348,815, 16.5.44. Appl. 20.6.39. In the manufacture of anti-knock gasoline cracked naphtha is stabilized, and an overhead stream is separated from the stabilizer. This contains mainly $C_3$ and lighter hydrocarbons. A side stream containing $C_4$ olefins and paraffins and some $C_3$ hydrocarbons is also separated and fractionated to remove additional $C_3$ hydrocarbons and a portion of normal butane. In this way a fraction concentrated in *iso*butane and $C_4$ olefins is obtained. This is subjected to alkylation, and the *iso*butane is alkylated by the olefins. An unstabilized alkylate is separated from the reaction products and then stabilized to separate normally liquid alkylate from an overhead fraction consisting essentially of *iso*butane and normal butane, together with any $C_3$ carbons remaining. A portion of the overhead fraction is recycled to the side-stream fractionating process to prevent build-up of $C_3$ hydrocarbons in the system. A further fraction of the overhead is fractionated to separate *iso*butane from normal butane, and the *iso*butane fraction is recycled directly to the alkylation zone. H. B. M.

## Isomerization.

**337.* The Commercial Isomerization of Lighter Paraffins.** B. L. Evering, N. Fagen, and C. S. Weems. *Oil Gas J.*, 28.10.44, **43** (25), 77.—Isomerization methods developed by the Standard Oil Co. of Indiana consist of three processes for the isomerization of light naphtha, butanes, and pentanes which are operated in five of their plants, the whole forming a complete system of isomerization of C4, C5, and C6 paraffins, as follows :—

(1) Naphtha isomerization (pentanes and hexanes) :
  (*a*) isomate (once through),
  (*b*) neohexane (recycle).
(2) Pentane isomerization.
(3) Butane isomerization.

The paraffinic feed is contacted with a liquid aluminium chloride–hydrocarbon complex catalyst in the presence of hydrogen chloride to produce branched-chain isomers. Although aluminium chloride is appreciably soluble in hydrocarbons, this complex catalyst is substantially insoluble, and is easily separated from the hydrocarbons by settling. The catalyst also has a capacity for holding aluminium chloride, added as make-up, due to the high distribution coefficient between the complex catalyst and hydrocarbon under reactor conditions. Side reactions are reduced by the use of a suitable inhibitor. The process is particularly useful for the conversion of hexanes, but it is often convenient to use a naphtha containing both pentanes and hexanes. With a once-through operation a high-quality aviation base-stock is obtained almost in equilibrium proportions. With a cycling operation, the higher-boiling, low-octane-number isomers may be selectively removed from the product and recycled.

The isomate plant operates on light naphthas, and isomerizes hexanes and pentanes simultaneously, once-through on hexanes and recycling the pentanes.

The neohexane plant recycles hexanes to produce a neohexane concentrate, and operates once-through on pentane. The quality of the concentrate is affected by the degree of fractionation and extent to which the hexanes are recycled. The yields and product quality for once-through and recycle hexane isomerization are :—

| Yields. | Hexane feed. | Once-through. | Recycle ratio. 1 : 1. | 2 : 1. |
|---|---|---|---|---|
| Dry gas, vol.-% | — | 1·8 | 3·6 | 5·3 |
| Butanes, vol.-% | — | 3·8 | 6·3 | 8·7 |
| Product, vol.-% | — | 96·8 | 87·2 | 85·2 |
| Bottoms, vol.-% | — | — | 7·0 | 6·2 |
| Product Octane No. : | | | | |
| A.S.T.M. (clear) | 65·0 | 80·0 | 88·0 | 91·4 |
| A.F.D.1–C. + 4 c.c. T.E.L. | 87·0 | 100·0 | 100 + 1·5 | 100 + 3·5 |

Doubling the recycle ratio decreases the yield of neohexane concentrate only 2%, while effecting a considerable improvement on the product. The bottoms are also valuable for aviation purposes. The liquid yield (neohexane and bottoms) is 94·2% and 91·4% for the 1 : 1 and 2 : 1 ratios, respectively. The butanes consist of 75% *iso*butane.

The working of the *iso*butane and *iso*pentane plants are briefly described and the yields are given. Both plants employ a small amount of inhibitor. W. H. C.

**338. Patents on Isomerization.** V. N. Ipatieff and L. Schmerling (Universal Oil Products Co.). U.S.P. 2,347,266, 25.4.44. Appl. 20.1.39. Normal paraffins having at least 4 carbon atoms to the molecule are converted into branched-chain paraffins by contacting them, under isomerizing conditions and in the presence of hydrogen and hydrogen chloride, with a sludge produced in an independent hydrocarbon condensation reaction in the presence of aluminium chloride.

J. D. Gibson (Phillips Petroleum Co.). U.S.P. 2,347,317, 25.4.44. Appl. 6.4.42. A combination isomerization-alkylation process is described in which there is produced a mixture comprising *iso*butane, normal butane, hydrocarbons boiling higher than normal butane, and hydrofluoric acid in excess of the amount required to form azeotropic mixtures with all the *iso*butane and all the normal butane. H. B. M.

## Chemical and Physical Refining.

**339. Patents on Chemical and Physical Refining.** A. J. Schmidl (Standard Oil Development Co.). U.S.P. 2,347,515, 25.4.44. Appl. 11.4.40. A process is described for the manufacture of refined petroleum-oil products of improved burning qualities. The feed oil is contacted in a two-stage alkali metal hydroxide treating system in such a way that the oil in the initial stage is contacted with the whole of the spent metal hydroxide solution removed from the secondary stage, and the oil withdrawn from the initial stage is contacted solely with fresh alkali metal hydroxide solution in the secondary stage. After removal, the oil is treated with a doctor solution to remove objectionable sulphur compounds.

D. B. Bell (Kenyon F. Lee). U.S.P. 2,347,805, 2.5.44. Appl. 26.12.39. In an oil-conversion process, the initial material after preheating to 600–650° F. is reacted with an oxygen-containing gas to raise the temperature to 800° F. or higher. Unvaporized oil is separated and cooled to 600–650° F. Afterwards it is again reacted with an oxygen-containing gas to raise the temperature to 900–950° F. In this way coking is effected, and the oil can then be introduced into a coking zone, where coke and vaporous fractions are separated.

F. E. Frey (Phillips Petroleum Co.). U.S.P. 2,347,945, 2.5.44. Appl. 16.6.41. To remove organically combined fluorine from hydrocarbon materials, they are sub-subjected to the action of a solid, porous metal oxide catalytically active for hydrogenation and dehydrogenation reactions. Time of the reaction is so controlled that extensive chemical changes in the hydrocarbon material itself are not effected, and the total effluent is essentially fluorine-free.

K. Korpi (Union Oil Company of California). U.S.P. 2,347,955, 2.5.44. Appl. 28.5.40. A catalyst is prepared by adsorbing phosphoric acid on a carrier and then neutralizing the acid with caustic alkali.

E. R. Kanhofer (Universal Oil Products Co.). U.S.P. 2,348,072, 2.5.44. Appl. 31.3.43. In the manufacture of finely divided hydrated silica for use as a catalyst, an acid is added to a solution of an alkali metal silicate containing an alkylene polyamine.

J. A. Camelford (Alox Corp.). U.S.P. 2,348,191, 9.5.44. Appl. 7.2.42. A method is described for removing unoxidized hydrocarbons from a saponifiables-free mixture of unoxidized hydrocarbons, and unsaponifiable oxidation products resulting from the liquid-phase controlled partial oxidation of a mixture of essentially saturated aliphatic hydrocarbons of mineral origin.

J. M. Page (Standard Oil Co., Chicago). U.S.P. 2,348,408, 9.5.44. Appl. 30.11.40. A method is given for the recovery of a catalytically active aluminium halide–hydrocarbon complex from a comparatively inactive aluminium halide–hydrocarbon sludge formed during the conversion of hydrocarbons. The sludge is treated with hydrogen in the presence of an active hydrogenation catalyst selected from the group comprising oxides and sulphides of the heavy metals of the six group of the Periodic System. Conditions of temperature are so controlled that there is no substantial vaporization of aluminium chloride, but that there is restoration of the aluminium halide–hydrocarbon complex to a catalytically active fluid state.

H. R. Johnson. U.S.P. 2,348,543, 9.5.44. Appl. 17.10.41. To desulphurize a hydrocarbon oil it is treated with a contact agent consisting essentially of chalk. The treatment is carried out at a temperature of approximately 500° F., but under conditions designed to prevent substantial cracking.

F. C. Moriarty (Universal Oil Products Co.). U.S.P. 2,348,745, 16.5.44. Appl. 8.12.41. Hydrocarbon distillate is refined by treating with marl at a temperature above 500° F., but under conditions which inhibit substantial cracking.

I. H. Welinsky and M. H. Gorin (Socony-Vacuum Oil Co.). U.S.P. 2,348,770, 16.5.44. Appl. 24.9.42. A process is described for recovering aluminium bromide after use as a catalytic agent in low-temperature conversion processes of hydrocarbons. A small amount of metallic aluminium is added to the tarry complex of aluminium bromide and hydrocarbons. Destructive distillation is then carried out by heating to a temperature between 300° and 900° C. for a prolonged period of time in a heating zone. Evolved vapours are passed through a fractionating column to a condenser and condensed at a temperature above 100° C. Uncondensed vapours are withdrawn, and the condensate is returned to the column as reflux. Distillation is continued until the vapours attain a relatively constant temperature at approximately the boiling point of the catalyst. Finally aluminium bromide is withdrawn and recovered.

H. B. M.

## Special Processes.

**340. Patents on Special Processes.** F. E. Frey (Phillips Petroleum Co.). U.S.P. 2,347,256, 25.4.44. Appl. 12.11.40. In the dehydrogenation of a paraffin hydrocarbon having at least two carbon atoms per molecule to form unsaturated hydrocarbons and free hydrogen, the effluent is subjected to the action of a reducible metal hydroxide at a temperature not greater than 650° F. In this way free hydrogen is reacted with the metal oxide and water is formed. The reaction is carried out in the presence of a material adapted to inhibit any substantial action of the metal as a hydrogenation catalyst.

E. F. Pevere (The Texas Co., New York). U.S.P. 2,349,053, 16.5.44. Appl. 21.3.41. To obtain butane and heavier hydrocarbons from propane and ethylene, the feed hydrocarbons are passed to an alkylation zone in the proportion of 5–30 parts propane to 1 part ethylene, and contacted with aluminium halide in the presence of a small quantity of hydrogen halide. Contact is effected at a temperature between 250° and 325° F. and under a pressure of 2000–3000 lb. Thus propane and ethylene react without substantial polymerization of the olefin. A hydrocarbon mixture containing butane and heavier hydrocarbons in substantial amount is withdrawn from the reaction zone, and afterwards butane is separated from the heavier hydrocarbons.

F. E. Frey, R. D. Snow, and W. F. Huppke (Phillips Petroleum Co.). U.S.P. 2,349,160, 16.5.44. Appl. 29.4.40. Paraffinic hydrocarbons boiling above the lower part of the gasoline boiling range can be converted into hydrocarbons of a smaller number of carbon atoms per molecule and in the gasoline range in the following manner. The original paraffinic material is dehydrogenated in the presence of a solid catalyst to produce olefines and free hydrogen without substantial cracking. A fraction comprising olefines is then cracked to produce a substantial amount of hydrocarbons of a smaller number of carbon atoms per molecule and in the gasoline range, together with lighter olefines having at least three carbon atoms per molecule. The effluent is passed to a separating zone, and a fraction comprising lighter olefines is removed. These are then catalytically polymerized to form hydrocarbons in and above the gasoline boiling range. Effluents from polymerization are passed to the separating zone, and an olefinic fraction above the gasoline range is removed and, in admixture with the olefin fraction obtained by dehydrogenation, is subjected to depolymerization. An olefinic fraction comprising hydrocarbons in the gasoline range and obtained from the cracking and polymerizing operations is also removed from the separating zone. H. B. M.

## Safety Precautions.

**341.* Evaluation of Plant "Fire-Control Index."** R. L. Davis. *Oil Gas J.*, 2.12.44, **43** (30), 67.—In the absence of concrete information on fire hazards during the rapid growth of catalytic alkylation and isomerization processes, only small efforts patterned on conventional methods have been made to provide safety facilities on new plants. As volatile hydrocarbons and poisonous and corrosive catalysts are involved, the difficulties are increased. The author has devised five formulæ based on factors which affect the hazard of a unit in case of fire, *viz.* hydrocarbon concentration, volatility, plant value, chemical hazard and corrosion factor, and proximity to other equipment. Solution of the formulæ gives the "Fire Control Index" of any plant, and this latter assists in designing the safety equipment for the plant in question. Two examples to determine the cost of emergency safety facilities are worked out by means of the formula.

On units containing hydrocarbons heavier than pentane, the usual cracking unit drop-out system is adequate and time-saving, but for propane or butane units a pressure vessel is required; and for alkylation units containing 4000 brl. of hydrocarbon and acid a 5000-brl. pressure sphere would be recommended. G. A. C.

# Products.

## Chemistry and Physics.

**342.* An Elementary Description of Some Molecular Concepts of the Structure of Dielectrics.** E. B. Moullin. *J. Instn. elec. Engrs*, 1944, **91**, Pt. I, 448–455.—Intended as a popular introduction to the "Theory of Dielectric Constant and Energy Loss in Solids and Liquids" (see next abstract), this paper outlines the Bohr atom and the electronic theory of valency. The mechanism of polar molecules and the manner in which such molecules would produce heat under the influence of an alternating field are described. Results of experiments in which power-factor determinations were carried out on solutions of spermaceti in paraffin wax indicate that polar molecules are a cause of dielectric losses. The significance of this fact as regards the electrical and mechanical properties of dielectrics is briefly discussed. C. F. M.

**343.* Theory of Dielectric Constant and Energy Loss in Solids and Liquids.** H. Fröhlich. *J. Instn Elec. Engrs*, 1944, **91**, Pt. I, 456–463.—The dielectric properties of solids and liquids consisting of long-chain molecules are discussed theoretically from the point of view of modern atomic and molecular structure. It is shown that in such substances dipoles have two equilibrium positions with opposite dipole directions. The static dielectric constant should increase with temperature below a critical temperature and decrease above it. The power loss for crystalline solids should be approximately described by the Debye equations. For amorphous substances, however, a flattening-out of the Debye loss curve is expected. The dependence of the time of relaxation on chain length has been calculated. C. F. M.

**344. Heat Capacity of Carbon Tetrachloride from 15° to 300° K. Heats of Transition and of Fusion. The Entropy from Thermal Measurements Compared with the Entropy from Molecular Data.** J. F. G. Hicks, J. G. Hooley, and C. C. Stephenson. *J. Amer. chem. Soc.*, 1944, **66**, 1064–1067.—Results of the measurement of the heat capacity of carbon tetrachloride over the range 17–300° K. are given. The melting point was 250·3° $\pm$ 0·1° K. and heat of fusion 601$\pm$2 calories per mole., transition temperature

$225 \cdot 35 \pm 0 \cdot 03°$ K., and heat of transition at this temperature $1095 \pm 3$ calories per mole. The entropy of $CCl_4$ (liquid) and $CCl_4$ (gas) are also reported, the latter value being compared with the third-law entropy calculated from Raman spectra and electron diffraction data. E. H. W.

**345. Sulphonation of the Phenylpropylenes.** C. M. Suter and W. E. Truce. *J. Amer. chem. Soc.*, 1944, **66**, 1105–1109.—The three phenylpropylenes were sulphonated with a suspension or solution of the co-ordination compound of dioxane and sulphur trioxide in an inert solvent. α-Methylstyrene gave 2-phenylpropene-1 : 3-disulphonic acid. The small amount of monosulphonation product could be increased by modifying the conditions.

With propenylbenzene the sole product was 1-phenylpropene-2-sulphonic acid. Alkylbenzene yielded about 50% of 3-phenyl-2-hydroxypropane-1-sulphonic acid; an appreciable amount of 3-phenyl-2-propene-sulphonic acid was also isolated.

E. H. W.

**346. An X-Ray Examination of Crystals of Triphenylmethyl Chloride and Bromide.** Sheng-Nien Wang and Chia-Si Lu. *J. Amer. chem. Soc.*, 1944, **66**, 1113–1114.—The results are given of the determination of the unit cells of triphenylmethyl chloride and bromide from an X-ray examination. The halogen atoms were located approximately, but the configuration of the triphenylmethyl group was not determined.

E. H. W.

**347. Catalytic Aromatization of Branched Chain Aliphatic Hydrocarbons.** V. I. Komarewsky and W. C. Shand. *J. Amer. chem. Soc.*, 1944, **66**, 1118–1119.—Aliphatic hydrocarbons with six (or seven) carbons in a straight chain but containing a quaternary carbon atom (or atoms) cannot form aromatic compounds direct, but dehydrocyclize to form aromatics in the presence of a chromia–alumina catalyst. Isomerization must therefore take place during the dehydrocyclization. Aliphatic hydrocarbons having structures which allow cyclization in two ways dehydrocyclize to aromatics by a mechanism which permits their direct formation. E. H. W.

**348. Direct Aromatic Amination. A New Reaction of Hydroxylamine-O-sulphonic Acid.** R. N. Keller and P. A. S. Smith. *J. Amer. chem. Soc.*, 1944, **66**, 1122–1124.—Benzene, toluene, *o*-, *m*-, and *p*-xylene, chlorobenzene and nitrobenzene formed amine derivatives direct by the action of hydroxylamine-O-sulphonic acid in the presence of anhydrous aluminium chloride. Yields varied from *ca.* 50% with tolueme to *ca.* 1% with nitrobenzene.

Toluene was also aminated in small yield by hydrazoic acid under the influence of ultra-violet light. Possible mechanisms for these reactions are discussed.

E. H. W.

**349. Thiocarbonyls I. Condensation of Thioacetophenone with Activated Nickel.** J. K. Clive, E. Campaigne, and J. W. Spies. *J. Amer. chem. Soc.*, 1944, **66**, 1136–1137.—Simpler methods for the preparation of stilbene derivatives, to be tested for carcinogenicity, are being investigated, and a synthesis of *trans*-α : α′-dimethylstilbene by the reaction of thioacetophenone with Raney nickel is reported. E. H. W.

**350. An Anomalous Reaction of Dipyrrylmethanes Leading to a New Class of Heterocyclic Compounds.** A. H. Corwin and R. C. Ellingson. *J. Amer. chem. Soc.*, 1944, **66**, 1146–1151.—The investigation is reported of the structure of a new class of heterocyclic compounds called dipyrrolopyridones.

These derivatives of dipyrrylmethanes are of interest because their colour and fluorescence in organic solvents resemble those of crude oil. E. H. W.

**351. Preparation and Properties of the *n*-Alkyl Acrylates.** C. E. Rehberg and C. H. Fisher. *J. Amer. chem. Soc.*, 1944, **66**, 1203–1207.—Higher *n*-alkyl acrylates having 2 to 16 carbon atoms in the alkyl groups have been prepared in good yields by the alcoholysis of methyl acrylate. Polymers of these compounds were prepared, and some of their properties are described. E. H. W.

**352. Effect of Bases on the Hydrogenation of Alkylphenols in the Presence of Raney Nickel.** H. F. Ungnade and D. V. Nightingale. *J. Amer. chem. Soc.*, 1944, **66**, 1218–1220.—The hydrogenation by Raney nickel of phenol and alkyl phenols was effected more rapidly in the presence of the corresponding phenoxides. Constants of the *cyclo*hexanols produced are tabulated. E. H. W.

**353. 2 : 3-Dihydroxypropyl *n*-Dodecyl Ether.** Note by O. Grummitt and R. F. Hall. *J. Amer. chem. Soc.*, 1944, **66**, 1229–1230.—The preparation and properties of 2 : 3-dihydroxypropyl *n*-dodecyl ether are described. This synthesis was undertaken to obtain a typical higher aliphatic alpha mono-ether of glycerol. E. H. W.

## Analysis and Testing.

**354. Apparatus for Determining Minimum Energies for Electric-Spark Ignition of Flammable Gases and Vapours.** P. G. Guest. U.S. Bur. Mines. Report of Investigations No. 3753. May 1944. During recent years considerable attention has been given to the problem of static spark ignition. Contrary to general belief that any condition which may give rise to a spark is unsafe, it has been found that for certain gas mixtures an energy of at least 0·002 joule is required in a spark to cause ignition. Since the energy, in joules, of a capacitor-type spark can be expressed at $1/2\ CV^2$, where $C$ is the capacitance in farads and $V$ is the voltage, it follows that the voltage need not be high to cause ignition if the circuit capacitance is large. In order to formulate adequate, and yet not unduly expensive or cumbersome safety measures, complete information is desirable regarding spark energies.

To this end, the Physical Chemistry and Hydrogenation Section of the Central Experiment Station of the Bureau of Mines, Pittsburg, has designed an apparatus by means of which almost any flammable gas or easily volatilized liquid can be tested. It is fully described in this report, and its adaptability is claimed to be such that studies can be made of spark length, shape, size, and material of electrodes, gas density, additions of inhibitive or sensitizing gases, artificial ionization of the gap, changes in circuit constant, etc. With slight modifications and suitable auxiliary equipment, direct comparison can be made of the ignitibility of different types of sparks, *i.e.* sparks following a gradual rise of potential, impulse sparks, prolonged sparks or discharges, rapidly recurring sparks, etc.

Routine ignition tests with single capacitance-type sparks are reported to be in progress, and by way of illustration a few minimum energy values obtained with Pittsburg natural gas and with benzene are quoted. The conclusion is reached that ignition of mixtures near the upper and lower limits for flame propagation (1·41–6·75% for benzene and 4·75–13·8% average for Pittsburg natural gas) requires comparatively high energy when sparks shorter than 0·050 in. occur between electrodes ½ in. or larger in diameter. H. B. M.

**355. Softening-Point of Fats.** C. R. Barnicoat, *Analyst*, 1944, **69**, 176.—The method described is based on the ring-and-ball method for bitumen. Essentially it consists of obtaining the temperature at which an ⅛-in. steel ball falls half-way through a 1-ml. sample of fat in a 5 × 1 cm. (external diameter) test tube. A few interesting figures are reported giving the effect of varying conditions of test, *e.g.*, rate of heating during determination of softening point, rate of pre-cooling sample, degree of oxidation of fat. T. C. G. T.

**356. Mixed Indicator in the Titration of Fatty Acids.** A. Kleinzeller and A. R. Trim. *Analyst*, 1944, **69**, 241.—Phenolphthalein, although widely used in titration of fatty acids, has a wide range of colour change (pH 8·0–9·0), and the authors recommend an indicator consisting 1 part of 0·1% aqueous solution of cresol red neutralized with sodium hydroxide and 3 parts of 0·1% thymol blue solution neutralized with sodium hydroxide. The colour of this indicator changes from pink at pH 8·2 through grey to purple at pH 8·4. It is claimed that accurate microtitration (N/100 NaOH) of fatty acids (2–6 mgrms.) can be obtained using the indicator described. T. C. G. T.

**357. A Micro-Pyknometer.** A. A. Houghton. *Analyst*, 1944, **69**, 345–346.—A micro-pyknometer for 0·01 ml., or less, of liquid, its construction and calibration are described. T. C. G. T.

**358.* Some Simple Automatic Controls for Gas Burners and Electric Circuits.** J. E. Still. *Chem. and Ind.*, 1944, 309–310.—A few neat but simple automatic controls for laboratory use are described. No particular originality is claimed, although the author believes each device has so far unpublished features. The devices are: (1) a method for shutting off a gas supply or breaking an electric circuit at a given time, utilizing the rotation of the alarm winding key of an ordinary alarm clock; (2) a thermo-regulator for gas-heating in which the gas-flow is regulated by a mercury seal operated by the vapour pressure of acetone or benzene—a varying head of mercury permits a setting for any temperature between 30° and 130° C.; (3) a vacuum pump control in which a vacuum reservoir can be maintained at a predetermined pressure by a very simple mercury electric circuit-breaker. T. C. G. T.

**359.* Moisture-Vapour Barriers.** C. R. Oswin. *Chem. and Ind.*, 1944, 429.—It is suggested that the term "Resistance to Aqueous Penetration" ("R.A.P.") should be adopted as the unit of moisture permeability of wrapping material. The "R.A.P." unit will be based on the millibars required to drive 1 gm. of water through 1 sq. m. of the membrane in 25 hours. R.A.P. units for cellulose, waxed cellulose, nitrocellulose, polyethylene, polyvinyl chloride, and rubber hydrochloride are reported.
T. C. G. T.

**360.* Density Pipette for Very Viscous Liquids.** A. J. C. Nicholson and A. G. Ward. *Chem. and Ind.*, 1944, 429–430.—It is considered that most density bottles described in the literature are unsuitable for measuring densities or thermal expansions of viscous liquids in the range 100–10,000 poise. The pipette described consists of a 50-ml. bulb having a length of tubing calibrated in 1/10 ml. up to 2 ml. extending from the top of the bulb. From the bottom is a short tapped tube through which the bulb is filled by suction on the top of the graduated tube. T. C. G. T.

**361.* Determination of Small Amounts of Anthracene in Tar and Tar Oil Fractions.** F. R. Cropper and N. Strafford. *J. Soc. Chem. Ind.*, 1944, **63**, 268–272.—Anthracene is estimated by ultra-violet absorption measurement after substances which might interfere have been separated chromatographically (activated alumina).
T. C. G. T.

## Crude Oils.

**362.* Precipitation of Asphalt from Crude Oil by Flow Through Silica.** H. Dykes, K. Bleu, and Dl. Katz. *Oil Gas J.*, 30.9.44, **43** (21), 79.—Paraffin deposits common to many oil-wells are usually attributed to separation of a solid wax phase as a result of gas evolution from the oil accompanied by a temperature decrease. The Greeley crude oil of California forms a granular bituminous deposit which accumulates in the well casing at depths in which the well fluid is still in a single phase, accumulation also occurring at points near the surface and in the separators.

Lowering the temperature and pressure of a subsurface sample of the crude oil saturated with bitumen, and also vaporization of the natural gas, did not produce asphaltic particles, but on passing the oil through sand, electrical effects occurred, and asphaltic particles were observed in the oil by means of the electron microscope. The appearance of asphaltic particles under these conditions suggested that the bitumen might be precipitated by the electric potential set up by the flow of the oil through the sand.

An apparatus was devised, and is described, consisting of a means for passing oil through a column of fine silica containing electrodes at the top and bottom, to which is attached a vacuum-tube potentiometer for measuring the potential created by the flow through the column. Preliminary experiments were made to measure the flow potential of a ferric hydroxide suspension. Afterwards, filtered Greeley crude oil was passed through the column and the flow potentials were measured at different pressure drops across the silica, the outlet electrode being positive. The results are given in a table, and show the pressure drop across the silica, the flow potential in millivolts, and flow rate in c.c. per minute. Electromicrographs of thin films of the oil, before and after passage, show asphaltic particles after, but none in the oil before passage through the silica. These measurements of flow potential with crude oils are believed to be the first to be recorded.

Having ascertained that precipitation of asphalt is caused by the potential set up by the flow, it was considered that if a counter potential was applied across the silica, precipitation might be avoided. Experiments were made with this objective, the electrodes being maintained at a potential of 1·4 volts in reverse to the observed flow potential, *i.e.*, the outlet electrode was made negative. Under these conditions the oil after flowing through the silica did not contain asphaltic particles, as shown by the electromicrographs. It is possible that the precipitated particles were attracted by the negative electrode, but it is doubtful whether all the particles would have been removed by this relatively low potential.

The significance of precipitation is discussed. Electromicrographs are also shown demonstrating sedimentation of asphaltic particles in 2% solutions of asphaltic crude oils in benzene and petroleum ether; and also of asphaltic particles in a Texas Panhandle wax deposit.

*Conclusions.*—(1) The potential measured is proportional to the flow rate, and was of the order of 3–4 millivolt per square inch pressure drop for a silica plug 2·1 in. long; (2) the application of an opposite potential to that caused by the flow of oil, through the sand, prevents precipitation of the asphalt; (3) the presence of asphaltic particles could be associated with or responsible for paraffin deposits in tubing, tank bottoms, and oil–water emulsions; (4) the control of bitumen formation in crude oil by impressing potentials across the porous solid strata through which oil flows; (5) asphalt particles were found in the paraffin deposit. The application of bitumen control to wells producing paraffin may assist in preventing crystalline wax accumulation in flow-lines. W. H. C.

**363.* The Refiners Notebook. No. 11. Paraffin Base Crude Oils.** W. L. Nelson. *Oil Gas J.*, 30.9.44, **43** (21), 111.—Paraffin-base crude oils are produced in the Pennsylvanian and certain fields in Texas, Louisiana, and Oklahomo. They constitute about 16% of the U.S. crude oil production, and generally command high prices for the manufacture of high-viscosity-index lubricating oils; they also give excellent kerosines and good diesel-index fuels. The average properties of these crude oils are given, and the properties of the products are briefly described and discussed. The lubricating oils characteristics are discussed in relation to their performance in both spark-ignited and diesel engines. W. H. C.

**364.* The Refiners Notebook. No. 15. Aromatic-Base Crude Oils.** W. L. Nelson. *Oil Gas J.*, 29.10.44., **43** (25), 101.—A chart is given which shows the composition of the Grosny aromatic crude oil throughout its entire boiling range. Some aromatic crude oils contain more aromatic hydrocarbons in the gasoline, but few crude oils contain more high-boiling aromatics than the Grosny. The percentage of aromatics in gasolines from the aromatic crude oils of various countries are tabulated, it being pointed out that highly aromatic crudes are scarce in the United States.

*Gasoline.* Most aromatic hydrocarbons have octane numbers greater than 100, and when blended with other materials and used in engines behave as if they had even higher octane numbers. Nevertheless, some of the straight-run gasolines from aromatic crude oils are also rich in normal paraffin hydrocarbons, and hence do not exhibit high octane numbers. The extra power contained in aromatic gasolines is indicated by the following comparison:

| Octane No. | Type. | Power. |
|---|---|---|
| 92 | Paraffinic | 100 |
| 92 | Aromatic | 161 |
| 97 | Aromatic | 194 |
| 99 | Aromatic | 243 |
| 100 | Paraffinic | 124 |

The determination of aromatics, the significance of their presence in solvents, kerosine, and diesel fuel is briefly discussed. W. H. C.

## Gas.

**365. Retention of Vitamin-C in foods by the use of Natural Gas Atmosphere in Dehydration.** H. L. Titus, O. J. Brown, J. Wertheim, L. M. Skofield, R. E. Morse, and F. P.

Griffiths. *Chem. Prod.*, November–December 1944, **8** (1–2), 3.—It has previously been shown that foods dried or dehydrated in air lose from 30 to 90% of their original vitamin C content, while dehydration under a high vacuum or in the presence of $CO_2$ or nitrogen is uneconomic. It is now shown that dehydration in an atmosphere of natural gas results in retention of vitamin C and little or no loss of carotene and thiamin, with improved appearance over the air-dried product, but with no effect on the taste. In pilot-plant tests at Wickett, Texas, natural gas from Herthold Well, Panhandle, was heated to 93° C. and pumped into the drying chamber. In some cases, mainly with potatoes, an increase in vitamin C content was recorded, it being suggested that under the drying conditions vitamin C is formed from precursors existing in the plants. Dehydrated products stored at normal room temperature in natural gas show less vitamin loss than those stored in air, though at higher temperature there was not much difference. C. L. G.

**366. Patent on Gas.** H. Koppers (Koppers Co.). U.S.P. 2,349,438, 23.5.44. Appl. 25.11.39. To produce a gas suitable for the synthesis of hydrocarbons and containing CO and $H_2$ in the ratio of 1 : 1 to 1 : 2, producer gas is mixed with at least one of the hydrocarbon gases of the group consisting of coke-oven gas, natural gas, and residual gas from the synthesis of hydrocarbons, and with steam. The mixture is heated to a temperature between 1100° and 1200° C. to react the hydrocarbon gas with the steam and with $CO_2$ of the producer gas. H. B. M.

## Engine Fuels.

**367.* National Motor Gasoline Survey, Winter 1943–44.** O. C. Blade. U.S. Bur. Mines. Report of Investigations No. 3758. May 1944. This is a continuation of a series of reports on properties of motor fuels sold through service stations in the United States. It summarizes analytical data of 1356 samples, representing the products of approximately 103 companies. Statistics are given on gravity, sulphur content, Reid vapour pressure, octane number, and distillation characteristics of each sample, and averages for each grade of gasoline are recorded. In addition, graphs of octane number and vapour pressure data are included for the winters of 1935–1936 to 1943–1944, with the exception of 1941–1942, when no survey was made. H. B. M.

**368.* Creosote–Petroleum Mixtures as Vehicle Fuel. Used by Glasgow Corporation Transport.** Anon. *Petrol. Times*, 11.11.44, **48**, 752.—Glasgow Corporation Transport has had an extensive experience in the use of creosote–fuel oil mixtures during the past 4½ years. Its 450 diesel buses form one-third of the total vehicles run on these mixtures in the U.K. When creosote alone is used in diesel engines its gummy deposits, unpleasant fumes (unless tar is removed), high boiling point, and high ignition point have all led to the opinion that mixtures are preferable. Where there is less than 20% creosote in the mixture, the sludge formed by acids in the creosote is appreciable, a maximum of 15% being shown. When between 30% and 50% creosote is used, sludge acids are considerably less. Actually resinous and asphaltic bodies are readily held in solution by creosote, but once fuel oil is added to the creosote there is a tendency towards precipitation, due to the lower solubility of the resins and asphalt in the fuel oil. Washed creosote does not give sludge with fuel oil. Slight amounts of solids in the mixture are removed by the centrifuge.

The performance is shown of two buses run experimentally on mixtures of creosote and fuel oil (shale oil, sp. gr. 0·838), in the proportions 73% fuel oil and 27% creosote, and 85%/15% creosote, and later, owing to restrictions in the use of creosote, on fuel oil alone.

A Daimler C.O.G. 5 single-deck Gardner 5. L.W. Engine gave the following consumptions: 12·3 mile per gallon with 27% creosote, 11·25 m.p.g. with 15% creosote; and with fuel oil alone, 10·38 m.p.g.

A Daimler C.O.G. 6 double-deck Gardner 6. L.W. Engine gave with 27% creosote mixture, 8·82 m.p.g.; with the 15% creosote mixture, 8·43 m.p.g.; and with the fuel oil alone, 8·28 m.p.g.

With the 27% creosote mixture running was satisfactory, except for filter clogging. The pulling power and general performance were indistinguishable from the performance of similar buses running on fuel oil alone. The lower percentage of creosote gave longer period between cleaning the filters, but the fuel consumed was greater in all cases. The use of creosote gave increased mileage. The specification of the creosote used by the Glasgow Transport is : a coal-tar fraction distilling between 180° and 370° C. washed free of tar acids and basic substances by caustic soda and sulphuric acid. The creosote thus obtained is a mixture of hydrocarbons with a hydrogen content of 8% in creosote high in naphthalene, and 12% in those of low naphthalene content.

The apparatus for mixing, which includes a De Laval centrifuge, is briefly described.

Rate of engine wear—pistons and liners show more than normal wear, and lubricating oil becomes somewhat contaminated with resinous bodies.

The handling of creosote is discussed as regards storage and mixing and cold-weather difficulties.

The self-ignition temperature of creosote is around 600° C. and requires a compression ratio of 30/1 to ensure ignition. A 20% addition of creosote only raises the S.I.T. of a normal diesel oil some 25° C. from, say, 270° C. to 295° C., there are distinct possibilities for the use of ratios up to this figure in existing transport C.I. engines.

W. H. C.

**369. Patent on Engine Fuels.** E. E. Gilbert (Tide Water Associated Oil Co.). U.S.P. 2,348,290, 9.5.44. Appl. 28.3.41. An alkyl amino-diphenylamine is added to motor fuel to inhibit oxidation in storage.

## Lubricants.

**370.* Separability Characteristics of Lubricating Greases.** T. G. Roehner and R. C. Robinson. *Oil Gas J.*, 25.11.44, **43** (29), 76.—The stability of a grease under pressure is discussed. The separation of the mineral oil from greases whilst in use may lead to concentration of the soap content to a point where the devices become clogged and the feed of new lubricant to the bearings is hindered. Separation of oil in the automatic cups is considered largely due to a filtering action, and a laboratory method has been devised to estimate this, using fritted glass plates in place of the automatic cups which are unsuitable for use in laboratory tests. A tube and burette are filled with oil the same as that employed in the manufacture of the grease under test. The tube is connected to a funnel containing the filter-plate ; and the grease is placed on top of the glass filter-plate in the funnel. Pressure is exerted on the system under controlled conditions, and the volume of oil separating from the sample through the filter-plate is read directly from the burette. Data are given in tables showing reproducibility of the runs made in the tester, and comparisons made with set-ups employing a series of automatic grease-cups. The data also reliably indicate the relative tendencies of the grease to separate oil when subjected to pressures in centralized greasing systems and high-pressure guns. The factors which determine the rate at which the oil may be filtered from the grease have been investigated by means of this test. The structure of greases influences the stability, and, with other factors being equal, lithium-base products tend to be the least stable, and aluminium-base greases the most stable in respect to separation under the test conditions. The higher the soap content, the more difficult will it become to filter oil from the grease ; and the test also proves that for a given soap base, the lighter the viscosity of the mineral-oil component, the greater will be the rate of separation of oil. By means of the test the effect of temperature on the grease may be examined ; it being shown that the separation of the oil changes the concentration of the soap in the top and bottom portions of the samples as they were removed from the tester after runs at 130° F. Time and pressure are obvious factors which influence the amount of oil that will be separated from the grease ; and the design of the retaining agency—for example, the effective clearance of the piston in the cup—is another evidently important variable.

G. A. C.

**371.* Aviation Engine Lubricants.** F. L. Miller. *Petrol. Times*, 6.1.45, **49** (1238), 20.—The demand for high-quality aviation lubricants has led to the production of these oils by new propane solvent refining methods from many crudes previously considered unsatisfactory for this purpose. The performance of these aviation oils in a Pratt and Whitney Hornet Engine test and in full-scale engine tests demonstrates the superiority of the new products. Improvement in overcoming ring-sticking and sludge deposition is still needed, since the severe conditions of operation aggravate these difficulties. Research has indicated that the upper limit of quality has been reached with regard to selection of crude source and method of refining, and superior performance will be obtained by the addition of small quantities of synthetic additives. For instance, Paranox 56 has been shown in extensive engine and flight tests to give excellent performance with regard to ring-sticking and ring-zone condition. Future possibilities may lie in the development of oils wholly or partly synthetic, from polymerized olefins and voltolization of fatty oils. A summary of comparative engine data and photographs of pistons shows probable performance characteristics of the synthetic and voltolized oils to be good. Continued improvement in engines and lubricants has raised the overhaul periods on commercial air lines to as high as 500 or 600 or more hours; and prior to the War the K.L.M. lines in Europe ran above 750 hours on a Voltol blend before overhaul. A table shows the effect of increased overhaul periods on incremental value of the lubricating oil. G. A. C.

**372. Patents on Lubricants.** C. F. Prutton and A. K. Smith (Lubin-Zol Development Corp.). U.S.P. 2,347,217, 25.4.44. Appl. 19.12.40. A mineral lubricating oil has incorporated in it small proportions of both a sulphur-treated oil and a stable oil-soluble halogen bearing organic ring compound containing a carbonyl radical.

W. L. Finley (Sinclair Refining Co.). U.S.P. 2,347,546, 25.4.44. Appl. 7.12.40. A petroleum lubricating oil has incorporated with it the calcium salt of an alkyl ester of salicylic acid.

W. L. Finley (Sinclair Refining Co.). U.S.P. 2,347,547, 25.4.44. Appl. 15.8.41. A lubricating composition is prepared from a petroleum lubricating oil and a small proportion of a calcium salt of an *iso*-alkyl ester of salicyclic acid.

E. W. Cook and W. D. Thomas (American Cyanamid Co.). U.S.P. 2,347,592, 25.4.44. Appl. 28.1.43. 0·1–5% of a di-(dihydroabietyl) dithiophosphate is added to a lubricating oil.

T. E. De Villiers (Cities Service Oil Co.). U.S.P. 2,347,814, 2.5.44. Appl. 7.11.42. A crankcase lubricant consists of a relatively large proportion of a solvent-refined mineral oil and a smaller proportion of an oil-soluble stabilizing agent. The stabilizing agent comprises a tri-trialkyanolamine phosphite and has a high stability towards deterioration by oxidation under normal conditions in the presence of the metals of the crankcase.

W. A. Whittier and J. B. Stucker (The Pure Oil Co.). U.S.P. 2,348,044, 2.5.44. Appl. 22.11.40. A mineral-oil addition agent consists of an acid which has been sulphurized at a sufficiently high temperature to give a good copper-strip corrosion, but not above 280° F., and afterwards phosphorized at 220–230° F. for a sufficient length of time to avoid fuming. The composition is then heated to 350° F.

W. L. Finley and J. H. Kirk (Sinclair Refining Co.). U.S.P. 2,348,461, 9.5.44. Appl. 19.8.41. A petroleum lubricating oil has added to it a small amount of a mixed calcium salt of an alkyl phenol sulphide, of which the alkyl groups contain from 4 to 6 carbon atoms, and an alkyl ester of salicylic acid of which the alkyl groups contain 6–18 carbon atoms.

R. A. Swenson (Standard Oil Co., Chicago). U.S.P. 2,349,058, 16.5.44. Appl. 31.7.41. A lubricant contains the following ingredients. A complex soap of lead and a metal selected from the group consisting of alkali metals and alkaline-earth metals, a glyceroxide of a metal selected from the group consisting of alkali metals and alkaline-earth metals, a solubilizer selected from the group consisting of a metal soap of preferentially oil-soluble sulphonic acid, and a metal soap of preferentially oil-soluble naphthenic acid and mineral oil.

E. A. Nill (The H. A. Montgomery Co.). U.S.P. 2,349,224, 16.9.44. Appl. 22.11.40. A lubricating composition for internal-combustion engines contains mineral oil, 0·1–0·5% of sulphur dissolved in mineral oil, 0·1–0·5% of a heavy metal soap, and 0·5–0·3% of an alcohol having at least 12 carbon atoms in a chain. H. B. M.

## Bitumen, Asphalt and Tar.

**373. Patents on Bitumen, Asphalt, and Tar.** G. S. Merrill and G. P. Hollingsworth (Minnesota Mining and Manufacturing Co.). U.S.P. 2,347,211, 25.4.44. Appl. 16.3.39. A sealing compound has the following ingredients: reclaimed rubber, asphalt, a mixture of rosin and a rosin soap of lower acid value than untreated rosin, finely divided clay, and a material similar to short-fibre asbestos. The constituents are disseminated in a volatile solvent to provide a viscous, spreadable mass at room temperature.

C. G. Abernathy. U.S.P. 2,347,233, 25.4.44. Appl. 12.2.41. A composite surfacing material is prepared in the following way. First a base is formed of plastic bituminous material and a coating of finely divided rubber particles is worked into its surface. Next a layer of surfacing material is formed. This includes an inert aggregate and a binder of an alkyd resin, also a modifier which renders the alkyd resin non-drying on the coating of rubber particles.

T. F. Bradley (American Cyanamid Co.). U.S.P. 2,347,626, 25.4.44. Appl. 6.5.41. To harden asphaltic residues, maleic anhydride is reacted with a partly oxidized asphaltic petroleum residue containing unsaturated ingredients by heating the mixture to a temperature between 150° and 250° C., and maintaining this temperature until the softening point of the reaction product is substantially higher than that of the original residue.

C. D. Levey. U.S.P. 2,347,697, 2.5.44. Appl. 2.12.39. A moulded composition is prepared from a compacted mixture of powdered bagasse, having a moisture content of less than 10%, and powdered gilsonite. At least one outer surface of the material consists of pre-formed thermoplastic sheeting bonded to the bagasse.

G. H. Sandenburgh (W. M. Pindell). U.S.P. 2,348,365, 9.5.44. Appl. 13.3.40. A thin protective coating for concrete pavements comprises a layer of tar which penetrates at least partly into the pores of the concrete, and a wear-resisting surface containing asphalt. At least one of the layers has incorporated in it small particles of stone. H. B. M.

## Special Hydrocarbon Products.

**374. Patents on Special Hydrocarbon Products.** J. H. Fritz and E. A. Robinson (National Oil Products Co.). U.S.P. 2,347,178, 25.4.44. Appl. 7.1.42. A reversible emulsion of water in oil has for its chief emulsifying ingredient a cationic surface active fatty amino-compound, the fatty residue of which contains at least 10 carbon atoms and no hydrophilic groups. The emulsifier is adjusted with acid to have a pH value of 6·0 or less in 2% aqueous solution.

J. Hyman (Velsicol Corp.). U.S.P. 2,347,265, 25.4.44. Appl. 25.5.42. An insecticide is made from refined, inactive carrier oils and a methyl-substituted naphthalene as an active ingredient.

K. M. Gaver (The Komel Corp.). U.S.P. 2,347,678, 2.5.44. Appl. 15.2.41. A new product is prepared from a water-insoluble substance, selected from the group consisting of oils, bituminous substances, and waxes, emulsified with a product comprising an aqueous colloidal suspension of sodium starchate.

K. M. Gaver (The Komel Corp.). U.S.P. 2,347,679, 2.5.44. Appl. 15.2.41. A liquid cleaning and polishing composition consists of an emulsion of wax in water and an alkaline metal starchate as emulsifier.

K. M. Gaver (The Komel Corp.). U.S.P. 2,347,680, 2.5.44. Appl. 15.2.41. A new product has for ingredients petroleum oil and dispersed pigment emulsified with an alkali metal starchate.

E. W. Adams (Standard Oil Co., Chicago). U.S.P. 2,348,715, 16.5.44. Appl. 25.6.41. A slushing composition containing a metal soap of preferentially oil-soluble sulphonic acids is obtained by treating a petroleum distillate with approximately 6–9 lb./gall. of concentrated sulphuric acid. The distillate has a Saybolt viscosity at 100° F. above 70 seconds.

E. J. Jahn (Shell Development Co., San Francisco). U.S.P. 2,349,044, 16.5.44. Appl. 21.7.41. A corrosion-inhibitor is prepared from non-gaseous hydrocarbons containing polycarboxylic acid and an oil-soluble water-insoluble compound selected from the group consisting of hydrocarbon monocarboxylic acids free from ether-forming hydroxyl radicals and esters thereof with monohydric alcohols.

O. M. Reiff and A. P. Kozacik (Socony-Vacuum Oil Co.). U.S.P. 2,349,198, 16.5.44. Appl. 17.3.42. To prepare a plastic composition, styrene is polymerized in the presence of at least 10% by weight of a substance obtained by alkylating phenol with chlorinated petroleum wax, in the presence of a Friedel–Crafts catalyst and in a mol. ratio of combined chlorine to phenol of not less than 2 : 1. H. B. M.

## Coal, Shale and Peat.

**375. The Oil-Shales of the Lothians : Structure. Area I—West Calder; Area II—Pumpherston; Area IV—Philpstoun.** J. E. Richey, J. G. C. Anderson, and W. Q. Kennedy. *Wartime Pamphlet* No. 38, June 1942 to November 1943. H.M. Geological Survey : Scotland.—New structural contour maps incorporating recent advances in the study of the Lothians shalefields are provided. Dr. Anderson, writing on the Pumpherston district, suggests the need for new exploratory borings (1) at Almondell to determine the local quality of the Pumpherston shales, (2) on the east side of the Mid Calder basin, to prove the occurrence of the Camps shale and the Pumpherston shales, and (3) at about ½ ml. west-north-west of Letham, to obtain further information about these shales at depth. He notes that an "immense area" of Pumpherston shales must underlie the Newfarm syncline, south-west of Mid Calder, and makes the general statement : "While it is true that the higher shales (Fells and Broxburn), which are confined to relatively small fields, have been exhausted, there remain large unworked areas of the Camps and Pumpherston seams."

Farther to the south-west, in the West Calder area, Dr. Richey says that in the Upper Oil-Shale Group, including the Raeburn, Fells, Broxburn, and Dunnett strata, "large seams of shale still remain to be extracted, as the records of workings show." . . . "To the west the recognition in 1913 of the Fraser shale in a bore at No. 42 Mine, Baads, has led to the proving of a thick development of this shale by further boring and to the opening up of a new and promising field."

Drs. Richey and Anderson reported in 1942; Dr. Kennedy made a similar report on Philpstoun in 1943; and we await a report on the Broxburn area.

So far as the new information goes, it does not appear to confirm fully the view expressed by Dr. Murray Macgregor in *Synopsis of the Mineral Resources of Scotland*, 1940, pp. 16–17, that the 1918 estimate of reserves amounting to about 500,000,000 tons of workable oil-shale is, under present conditions, an overstatement of the facts, though shale rich in nitrogen (*i.e.*, yielding 40 lb. and upwards of ammonium sulphate to the ton), but with a low oil yield (say, under 20 gal. per ton) could not be worked at an economic figure in the between-wars years after 1926. A. L.

## Miscellaneous Products.

**376. Resinous Materials in the Processing of Paper.** J. Y. Kao, L. Gold, A. Stull, R. Worden, and W. Abramowitz. *Paper Tr. J.*, 20.7.44, **119** (3), 43–47.—There has been a very considerable increase in the use of synthetic resins, etc., in paper to improve

(a) protective, (b) decorative, and (c) dielectric properties. The resins are used in three ways: (1) in paper processing by incorporation in the beater, (2) as adhesives, and (3) as impregnants, coatings, and laminations. Such papers are used largely for military packaging, frequently in combination with asphalt—*viz.*, waterproof liners from asphalt laminated urea—or melamine—formaldehyde wet-strength papers; foodstuff packages from kraft asphalt—lead foil—cellophane, etc. Asphalt impregnated kraft paper is water- but not moisture- or vapour-proof, and has poor temperature resistance. Suitable moisture resistance can be obtained by resin-coating papers in which wax and asphalt are incorporated in the beater in emulsion form. Grease resistance is obtained by coating, laminating or impregnating with water-soluble materials, casein, starch, polyvinyl alcohol, etc., while additional water resistance is given by incorporation of resins (*e.g.*, vinyl co-polymers). Resistance to acids and alkalis is given by most of the resins and to solvents and chemicals by the polyvinyls and the thermo-setting resins. These also improve scuffing and abrasion resistance. Cellophane laminated to kraft paper has good resistance to war gases. Tear strength and wet strength and flexibility are improved by lamination or impregnation with emulsions of resins or rubbers, or by incorporation in the beater. For heat sealing, thermoplastic resins are used. Rubber, vinyl, and acrylic resins are used in pressure sensitive tapes, etc. Synthetic coatings provide protection for labels. For the manufacture of rigid boxes, dishes, etc., high-melting-point thermoplastics or thermosetting resins are incorporated into the beater or impregnated into the sheet, followed by the application of heat and pressure to the moulded product. Paper impregnated with chlorinated oils or coated with styrene, acrylics, or ethyl cellulose produce useful insulators.

For decorative purposes any film-forming material may be used. A new development is the coating or impregnation of fibrous materials with monometric resins followed by polymerization *in situ*.

Adhesives from a wide variety of synthetic rubbers and resins are expensive if used in solvent form, but cheaper in emulsion form. For laminating to metal a trace of alkali or acid gives improved results. Dry films of thermoplastic resins are also used, sealing being accomplished by heating.

For impregnation, coating, etc., synthetic resins and rubbers may be used in solutions, emulsions, or hot melts (by calendering). For solutions a low viscosity and high solids content are required. Emulsions give better adhesion, control of penetration, and concentration of solids, while hot melts eliminate solvents and drying problems and increase production rate. Artificial leather and packaging material are produced by impregnating paper in an emulsion bath containing 10–15% reclaim rubber, acrylic, vinyl, or alkyd resins, to deposit 15–30% solids within the paper. To prevent resin precipitation on the surface the dispersions are sensitized with water-soluble complexes of polyvalent metal ions and ammonia, plus protective colloids and wetting agents, the saturated paper requiring slight heating to set the particles uniformly on the fibres.

The article contains tables showing the applications of processed papers, desirable properties, type of products used, resistance of films to solvents, etc., the particular applications for different resins, and diagrams showing the strength, etc., of paper containing resins and rubbers. C. L. G.

**377. Paints for Tankers.** Anon. *Paint Technol.*, November 1944, **9** (107), 248.—U.S. Patent 2,216,514, assigned to Surface Proofing Products, Inc., of New York describes an anti-corrosive composition on a synthetic resin basis, for use as linings of gasoline tanks on tankers. The application of two coats is claimed to produce a heavy coating impervious to gasoline, salt water, or steam, which is not noticeably affected after 10 months' service. C. L. G.

**378. Vinyl Resins for Footwear.** Anon. *Brit. Plastics*, December 1944, **16** (187), 541.—Increasing use is being made in the U.S. of vinyl resins for the soling of boots and shoes, either in the form of canvas laminates or impregnated leather. Polyvinylchloride, or copolymers with vinylacetate or vinylidene chloride, particularly the last mentioned, give satisfactory products in respect of flexibility, fatigue life, elasticity, temperature, abrasion, and moisture resistance. The life of a chrome-tanned leather sole is increased by 50% by impregnation with vinyl resins, while poor-quality leathers so treated will outwear normal leather. Polythene and poly*iso*butylene are also valuable in leather impregnation. It is considered likely that thermo-plastics will be permanently adopted as replacements, or additives to leather, and as replacements for the tallow/paraffin wax mixtures used for waterproofing. A combination of cellulose and leather fibres bound with a synthetic rubber binder is also being used for the manufacture of insole materials. C. L. G.

**379. D.D.T. The New Insecticide. A General Survey and Some Possible Paint Applications.** G. A. Campbell and T. F. West. *J. Oil Colour Chem. Assoc.*, December 1944, **27** (294), 241.—A review is given of (*a*) the research on moth-proofing agents carried out by Lauger, Martin, and Muller in Switzerland (*Helv. Chem. Acta*, 1944, **27**, 71 and 1944, **27**, 892) which led to the discovery of D.D.T. as a powerful general insecticide, and (*b*) work carried out in this country on the toxicity to flies of D.D.T. in oil-bound water paints. (*a*) The original research was aimed at finding a colourless dye of good affinity for wool fibre with toxic properties to moth larvæ, and was based on modifications of triphenylmethane dyes. The addition of solubilizing groups and toxic chlor-phenol groups led to useful products, of which, however, too high quantities were required, and which were not easily exhausted from the bath. Such products were similar to the Eulan moth-proofing agents of the I.G. At this stage the field was widened to cover toxicity to other insects, based on a wide range of insoluble toxic compounds, such as phenolic ethers and their chlorinated derivatives solubilized by combining with a direct dye structure. Modifications of *pp'*-dichlor-diphenylsulphone, which was known to be a stomach poison against the moth larvæ, led to the conclusion that *pp'*-dihalogenated diphenyl derivatives were essential to give maximum effect, and a consideration of the biological effects of various groups led to the attachment of a chloroform grouping to give maximum lipoid solubility, thus giving D.D.T. The possibility of producing other synthetic insecticides by the condensation of other inhalation narcotics with condensed chlorbenzene, etc., is thus suggested.

In addition to the previously described uses of D.D.T. in a dusting powder for lice control, as an impregnant for service clothing and against fly and mosquito adults and mosquito larvæ, etc., a new development is its use in oil-bound water paints. Tests are described in which cages, partly boarded, were painted with an oil-bound water paint containing 5% D.D.T. on the oil, and flies introduced. All died within a few days, the paint still retaining its toxic properties after six months. A room painted with a similar paint, but containing 0·5% D.D.T., was similarly lethal, giving a 90% kill in 48 hours, while in another room in which the windows were covered with painted paper, 95% kill was obtained in 28 hours. It was found that increase of humidity had no effect; reduction of temperature gave a slight fall; that 6-day-old flies were more quickly affected than 2-day-old flies; there was no evidence of a repellent action. Practical tests of paint containing 1% of D.D.T. applied to a factory dining-room and kitchen gave excellent results. C. L. G.

**380.* Plastic coating used to Prevent Corrosion of Oil-Field Equipment.** E. H. Short. *Oil Gas J.*, 2.12.44, **43** (30), 59.—The application of a thin coating of a plastic material of the phenolic thermo-setting type resin to oil-well equipment prevents corrosion. In an East Texas salt-water disposal well, 4535 ft. of 4½-in. tubing and surface connections were plastic-coated by a dipping process after sand-blasting. Four coats in all were applied, giving a thickness of 0·005 in. on the equipment. In running the string of tubing, the required time approximated that of ordinary tubing.

Besides affording protection against corrosion, the extremely smooth surface of the plastic gives appreciable reduction in pump pressures; and the outside coating gives protection against soil-stress. G. A. C.

**381. Polvinyl Chloride for Prostheses.** Anon. *Brit. Plastics*, January 1945, **17** (188), 21.—Plasticized polyvinyl chloride is being used for the construction of false features, fingers, etc., in cases where the injury does not allow of surgical restoration. In view of possible effects on the skin, phthalate esters instead of tricresyl phosphate are used as plasticizers, and calcium stearate instead of lead salts as heat stabilizer. The prostheses are attached by gum trajacanth or spirit gum or by conventional methods, such as attachment to spectacles. C. L. G.

**382. Polyallyl Alcohols.** Anon. *Chem. Tr. J.*, 5.1.45, **116**, 18.—E.P. 565,719 of 1943, assigned by D. E. Adelson and T. W. Evans to Shell Development Co., describes the production of stable, non-discolouring, polymerized allyl alcohol and esters. Polymerization of the unsaturated alcohols normally does not yield true polymers, and gives rise to oxidation by-products, but on esterification with a carboxylic acid, polymerization, preferably in the presence of an alkali or alkali-earth alcoholate, gives true polymers of the alcohol, the ester group being removed. The polymers are soluble in water and alcohol, but insoluble in acetone, benzene, and aliphatic hydrocarbons. They are useful as glues, sizing materials for textiles and fabrics, greaseproof impregnating agents, and oil-resisting lubricants. Further resinous materials can also be prepared by reacting the allyl products with polycarboxylic acids or anhydrides and drying oils by reacting with unsaturated acids of the drying-oil type. With aldehydes, resinous acetals are formed, and with nitric acid explosives can be produced.

C. L. G.

## Engines and Automotive Equipment.

**383. The Combustion Gas Turbine. Part II.** F. K. Fischer and C. A. Meyer. *Petrol. Engr*, June 1944, **15** (9), 124–134.—The third method of improving efficiency is reheating, and consists of adding heat to the gas as it passes through the turbine by burning fuel directly in the gas. Reheating and intercooling increase the amount of useful energy per lb. of working gas passing through the system, thus reducing size of equipment required. Efficiency at partial load is much increased. Individual and combined effects of regenerating, reheating, and intercooling on thermal efficiency over the range of 1000–1500° F. temperature of gas turbine inlet are illustrated by tables and diagrams for open-cycle systems. Expected efficiencies of steam and gas cycles are also compared at inlet temperatures up to 2000° F., showing the improved efficiency at the higher temperature which may be expected of gas cycles when such operation becomes a practical possibility. Effects of air temperature on the thermal efficiency of the open-cycle gas turbine are also illustrated.

The relatively low operating pressure and consequent large volume of gas which has to be handled by the open-cycle gas turbine means that, for a given output, the piping and blading of the turbine inlet are large in comparison with the steam turbine. The ratio of exhaust to inlet volume is, however, much smaller in the cases of the gas turbine, making for a balanced blade path. The large blade dimensions limit the maximum output of the open-cycle, single-flow combustion gas turbine to approximately 7500 kw., but there is a possibility that the injection of liquids may extend this considerably.

The closed cycle offers a method of increasing the maximum capacity of the open cycle by enabling higher working pressures to be utilized. The system, which is utilized by Echer Wyss, a Swiss firm, is described and illustrated. The possibility of using a gas with more suitable properties (density, specific heat, and thermal conductivity) than air is mentioned. Hydrogen is a possibility. A closed-cycle system devised by Westinghouse is also described and illustrated.

Combustion-gas turbine control can be simple and reliable, consisting only of control of gas temperature by regulating the rate of fuel supply. Efficient partial load performance can be obtained by combining a variable-speed turbine driving a compressor with a constant-speed turbine driving a generator. High efficiency in closed cycle can be maintained by reducing gas pressures as the load is reduced. Possible applications of gas turbines, with notes on advantages and disadvantages, to locomotives, airplanes, ships' drives, power production, and general industrial work are tabulated and discussed, with notes on the type of fuel required from operational and economic aspects.

It is pointed out that up-to-date experience with gas turbines has been limited to special applications, and much development work remains to be carried out to improve the systems and to develop the best system for each application.

Developments, especially in the high-temperature range, must obviously await the post-war era, but there is no doubt that gas turbines are destined to play an important rôle in power plants of the future. R. A. E.

# INSTITUTE NOTES.

MARCH, 1945.

## FORTHCOMING MEETINGS.

Wednesday, 18th April, 1945. **Joint Meeting with the British Rheologists' Club.** (Further particulars to be announced.)

Wednesday, 9th May, 1945, at 5.30 p.m. **"Code of Electrical Practice for the Petroleum Industry,"** by Alan D. Maclean, A.I.E.E. (Fellow).

Wednesday, 13th June, 1945, at 5.30 p.m. **"H.D. Lubricating Oils,"** by Special Sub-Committee of the Standardization Committee.

All the above meetings will be held at 26, Portland Place, W.1.

STANLOW BRANCH.

Wednesday, 18th April, 1945. **Annual General Meeting,** followed by **"Education for the Industry,"** by F. H. Garner, O.B.E., Ph.D.

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## 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.*

ADLINGTON, Dennis George, Research Chemist, Anglo-Iranian Oil Co., Ltd. (*W. H. Thomas ; A. R. Javes.*)

AINSWORTH, John Alfred, Senior Assistant, Public Control Dept. (Petroleum Division), L.C.C. (*S. G. Burgess ; R. A. Thomas.*)

ARCHER, Frederick Stanley, Research Chemist, Lobitos Oilfields Ltd. (*V. Biske ; J. C. Wood-Mallock.*)

BARR, Kenneth William, Geologist, Trinidad Leaseholds Ltd. (*H. C. H. Thomas ; H. H. Suter.*)

BROWN, Dorothy, Research Chemist, Ministry of Supply. (*D. Clayton ; H. F. Jones.*)

BRUNNER, Christopher Tatham, Manager, Petroleum Board Secretariat. (*F. H. Garner ; E. B. Evans.*)

BURGESS, Bruce Henry, Research Physicist, Esso European Laboratories. (*H. C. Tett ; W. E. J. Broom*).

CROMWELL, O., Engineer, Shell Co. of West Africa Ltd. (*H. A. Blackmore ; W. T. Jarrett.*)

DAVIES, W. R. Chief Engineer, Shell Co. of West Africa Ltd. (*H. A. Blackmore ; W. T. Jarrett.*)

GRIFFITHS, John Cedric, Petrographer, Trinidad Leaseholds Ltd. (*H. H. Suter ; F. Morton.*)

HEILI, Ernest Albert, Engineer, Schlumberger-Surenco, Trinidad. (*H. C. H. Thomas ; J. E. Smith.*)

HOLMES, Arthur Norman, Chemist, Shell Refining & Marketing Co., Ltd. (*H. E. F. Pracy ; L. J. Black.*)

LANCASHIRE, Eric Peak, Mechanical Engineer, Petroleum Board. (*E. Thornton ; R. B. Southall.*)

MACKAY, William Mackenzie, Senior Operator, Trinidad Leaseholds Ltd. (*J. B. Christian ; B. G. Banks.*)

MACMILLAN, Richard Butler, Chemist, Trinidad Leaseholds Ltd. (*W. K. Dykes ; L. R. Pocock.*)

NETHERSOLE, Harrison John Hastings, Engineer, Trinidad Leaseholds Ltd. (*H. C. H. Thomas ; F. Morton*).

PARK, William Hutcheson, Mechanical Engineer, Shell Refining & Marketing Co., Ltd. (*J. A. Oriel ; J. W. Vincent.*)

POTT, Anthony Fred Doran, Research Physicist, Esso European Laboratories. (*H. C. Tett ; W. E. J. Broom.*)

SMITH, Edward Archibald, Major, R.A.S.C. (*H. F. Jones ; H. C. Tett.*)

SMITH, John, Engineer, National Gas & Oil Engine Co., Ltd. (*E. J. Dunstan ; N. A. Clegg.*)

TAYLOR, Henry Browne, Works Director, Alexander Duckham & Co., Ltd. (*J. S. S. Brame ; J. E. Duckham.*)

WILKINSON, Horace Elliot, Mechanical Engineer, Shell Group. (*H. de Wilde ; J. B. Kay.*)

WILLIAMS, John, Mechanical Engineer, United British Oilfields of Trinidad Ltd. (*C. R. Middleton ; G. F. Hazzard.*)

WORSLEY, Frank Keyte, Chief Engineer, Kern Trinidad Oilfields Ltd. (*A. J. Ruthven-Murray ; C. R. Middleton.*)

YATES, Harold, Analytical Chemist, Wareing Bros. & Co., Ltd. (*E. J. Dunstan ; G. H. Harries.*)

*Transfers.*

Harkess, John Mackay, Chemist, Lobitos Oilfields Ltd. (*J. C. Wood-Mallock ; J. S. Parker.*)

Hazzard, Geoffrey Francis, Chief Chemist, United British Oilfields of Trinidad Ltd. (*C. R. Middleton ; L. H. Hersch.*)

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## MEETINGS OF COUNCIL.

An Ordinary Meeting of Council was held at 26, Portland Place, W.1. on 3rd November, 1944, with Professor F. H. Garner (President) in the Chair. There were also present : Messrs. Ashley Carter. G. H. Coxon, T. Dewhurst, A. E. Dunstan, E. J. Dunstan (Northern Branch), E. A. Evans, Sir Thos. H. Holland, Messrs. H. Hyams, V. C. Illing, J. S. Jackson, J. A. Oriel, J. S. Parker (Stanlow Branch), C. A. P. Southwell, F. B. Thole, A. Beeby Thompson, R. R. Tweed.

A Report was received from the Publication Committee and a recommendation to purchase new books for the Library approved.

A Ordinary Meeting of Council was held at 26, Portland Place, W.1. on 13th December, 1944, with Professor F. H. Garner (President) in the Chair. There were also present : Messrs. Ashley Carter, T. Dewhurst, A. E. Dunstan, E. A. Evans, H. Hyams, V. C. Illing, J. S. Jackson, J. A. Oriel, E. R. Redgrove, C. A. P. Southwell, F. B. Thole.

Reports were received from the Branches, Election, Finance and Standardization Committees.

Eight Members, four Associate Members and eleven Students were elected, and one transfer from Associate Member to Member approved.

An Ordinary Meeting of Council was held at 26, Portland Place, W.1. on 10th January, 1945, with Professor F. H. Garner (President) in the Chair. There were also present; Messrs. G. H. Coxon, T. Dewhurst, A. E. Dunstan, E. A. Evans, E. B. Evans, H. Hyams, J. S. Jackson, J. A. Oriel, J. S. Parker (Stanlow Branch), R. B. Southall (South Wales Branch), C. A. P. Southwell, H. C. Tett, F. B. Thole, A. Beeby Thompson, G. H. Thornley (Northern Branch), R. R. Tweed, W. J. Wilson.

Reports were received from the Finance, House and Engineering Committees.

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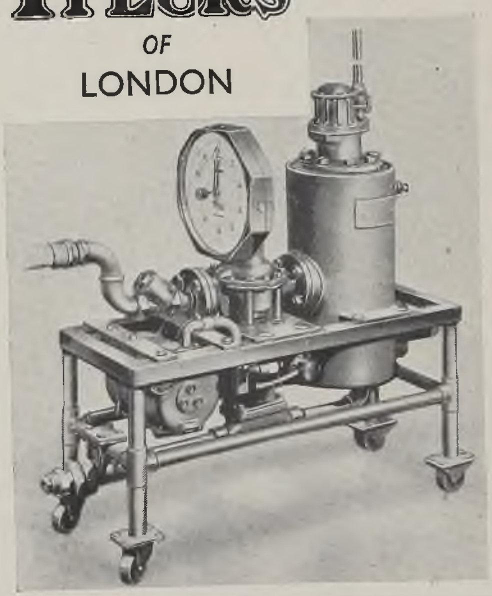
## PERSONAL NOTE.

Professor W. M. Cumming, holder of the "Young" Chair of Technical Chemistry at the Royal Technical College, Glasgow, has been appointed by the Governors of the College as Director of the School of Chemistry.

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





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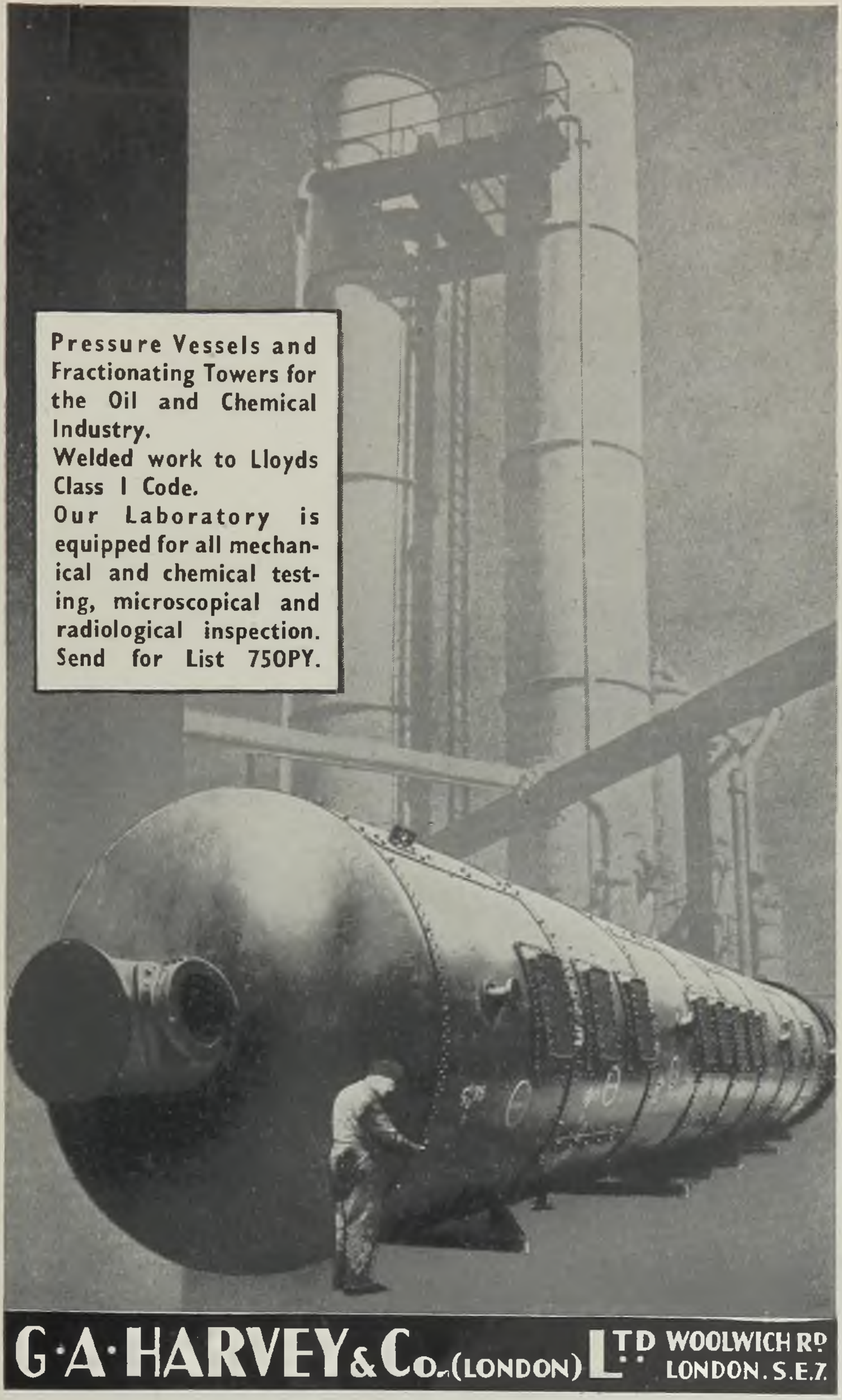
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