ABSTRACTS.

	PAGE
OILFIELD EXPLORATION AND EXPLOITATION.	
Geology	368 A
Geophysics and Geochemical Prospecting	372 A
Drilling	373 A
Production	377 A
Oilfield Development	384 A
TRANSPORT AND STORAGE. ...	386 A
REFINERY OPERATIONS.	
Refineries and Auxiliary Refinery Plant	388 A
Distillation	389 A
Absorption and Adsorption ...	389 A
Cracking	390 A
Special Processes	391 A
Safety Precautions	391 A
PRODUCTS.	
Chemistry and Physics ...	392 A
Analysis and Testing ...	396 A
Engine Fuels	398 A
Gas Oil and Fuel Oil	398 A
Bitumen, Asphalt and Tar ...	399 A
Derived Chemical Products ...	400 A
Miscellaneous Products ...	400 A
ENGINES AND AUTOMOTIVE EQUIPMENT	401 A
MISCELLANEOUS	405 A
REVIEWS AND BOOKS RECEIVED	405 A

AUTHOR INDEX.

The numbers refer to the Abstract Number.

Abernathy, J. H., 1221
Adams, R. S., 1217
Allen, W. F., 1255
Archer, M. T., 1209
Armistead, G., 1256, 1263
Arps, J. J., 1215
Arsdell, P. M. van, 1265

Bain, H. T., 1194
Banta, H. M., 1208
Basford,, P. R., 1275
Beal, A. H., 1209
Bennison, E. W., 1212
Benson, R. G., 1265
Blakeslee, —, 1302
Bossler, R. B., 1229
Bradsher, C. V., 1274
Brown, L. E., 1235
Bruce, —, 1302
Buckley, S. E., 1210
Buttner, W. C., 1255
Buu-Hoi, M. M., 1273

Cardwell, W. T., 1209
Cauley, S. R., 1294
Church, W. L., 1235
Cody, M. O., 1186
Colonge, J., 1264
Craze, R. C., 1210

Davies, H. M., 1291
Dews, S. C., 1301
Dight, S. R., 1322
Doan, R. L., 1209
Douthit, L. E., 1223
Dunlap, W. E., 1200

Earlougher, R. C., 1222
Ellis, A. L., 1255
Esseling, C. J., 1205

Flanders, J. E., 1254
Folsour, M. W., 1226
Foote, L. P., 1261
Foran, W. T., 1179
Friend, J. N., 1281

Gagnaiaut, P., 1273
Ghent, J. R., 1227
Granger, P. H., 1209
Grant, B. T., 1229

Halford, R. S., 1271
Hamlin, B., 1309
Hargreaves, W. D., 1281, 1289
Harkins, W. D., 1275
Hayward, J. T., 1209
Hepburn, J. W., 1224
Houston, H. G., 1235
Hughes, R. V., 1211
Humphrey, J. B., 1235
Hunter, A. L., 1200

Jackson, L. R., 1208
Johnson, W. H., 1266
Jones, L. L., 1201
Jura, G., 1275

Kantrowitz, A., 1277
Kartinan, L., 1299
Kastrop, J. E., 1204
Kaveler, H. H., 1214
Keirn, D. J., 1305
Kilpatrick, J. E., 1267
Kirkwood, J. G., 1279
Kipp, H., 1228
Knipling, E. F., 1300
Kniseley, H. B., 1176
Kreulein, D. J. W., 1269, 1270

Lahee, T. H., 1177
Laitinen, H. A., 1286
Lassiat, R. C., 1262
Leiserson, L., 1235
Lewis, J. O., 1235
Leyer, A., 1235
Linden, H. R., 1294
Linz, B. F., 1247
Loeser, E. H., 1275
Logan, L. J., 1236
Loomis, G. L., 1209
Louis, M., 1296

McElhatton, F. L., 1253
McGivern, P. V., 1216
McMaster, R. C., 1208
Maier, Q. R., 1225
Mardles, E. W. J., 1287
Maurer, J. A., 1209
Melton, F. A., 1175
Mercier, V. J., 1198
Monson, R. T., 1250
Montroll, E. W., 1280
Morrill, A. W., 1301
Morris, W. S., 1230, 1231, 1232

Nash, L. K., 1284
Nelson, J. S., 1286
Nelson, W. L., 1258, 1259, 1260, 1283, 1288
Nicholson, G. B., 1196
Nixon, J. D., 1235
Norton, J. N., 1235

O'Brien, A. S., 1286

Parsons, H. O., 1255
Pitzer, K. S., 1267
Prosen, E. J., 1266, 1267, 1268

Puck, T. T., 1276

Rankin, D. R., 1213
Read, D., 1293
Roberts, A. O., 1209
Rochas, P., 1264
Rogers, D., 1218
Rossini, F. D., 1266, 1267, 1268, 1285

Schaeffer, O. A., 1271
Sheppard, G., 1181
Short, E. H., 1220, 1234
Shoults, D. R., 1305
Shrewsbury, R. D., 1172
Silveira, M. M. Da., 1299
Smith, W. T., 1235
Spenceley, F., 1309
Sterne, W. P., 1199
Stueve, W. H., 1233
Sundstrom, S. L., 1255

Taylor, W. G., 1226
Telang, M. S., 1282
Thayer, C. H., 1262
Thomas, J. E., 1241
Tucker, A. J., 1202
Tuttle, R. B., 1257

Wade, F. A., 1195
Ward, R. A., 1209, 1235
Waterman, R. R., 1209
Weber, G., 1206
Wharam, J. J., 1209
Willingham, C. B., 1285
Wilhelm, O., 1173, 1174
Wise, H., 1276
Wollman, S. H., 1272

Zimm, B. H., 1278
Zublin, J. A., 1235

Oilfield Exploration and Exploitation.

Geology.

1172. A Theory on Occurrence of Salt Domes. R. D. Shrewsbury. *Oil Wkly*, 3.6.46, **122** (1), 36.—The parent salt bed of the domes lies many thousands of feet deep. The overburden and the salt have many of the characteristics of fluids when under sufficient pressure, and salt domes appear to rise by virtue of density differences.

The salt domes of the Gulf Coast are probably but a small segment of a very large system of similar structures, most of which are now submerged and distributed throughout the area of subsidence. If domes are still rising beneath the sea in areas where there is no erosion they may be marked by humps. The most deeply buried salt will become potentially fluid first, but will be unable to flow until adjacent salt also is fluid. Only when pressure has been transmitted to the edge of the area of salt deposition will the salt break through the overlying formations. G. D. H.

1173. Pinch-out Trap Reservoirs. O. Wilhelm. *Oil Gas J.*, 6.4.46, **44** (48), 139.—The term pinch-out trap is reserved for those in stratigraphic intervals having zones which actually disappear. Depositional pinch-outs may have members dropping out irregularly, in contrast with truncated pinch-out traps associated with angular unconformities. Both types occur on the flanks of uplifts and in association with salt domes. Overlap pinch-out reservoirs are found in the porous conglomeratic material on regional unconformities or at the base of marine overlaps over a basement complex. G. D. H.

1174. Fault-trap Reservoirs. O. Wilhelm. *Oil Gas J.*, 13.4.46, **44** (49), 119.—Faults which bring an impervious bed into contact with a porous bed may give rise to oil-traps. Sometimes even fault-gouge may be sufficient to give a seal, and at times fine sand may be effective. Much depends on the pressure and on the nature of the oil.

Thrust as well as normal faults give traps if other conditions are favourable. Fault-block reservoirs lie between more or less parallel faults. G. D. H.

1175. Aerial Photography Aids Geologist. F. A. Melton. *Oil Wkly*, 25.3.46, **121** (4), 48.—Stereoscopic study, in spite of its limitations, is of great value in interpreting aerial photographs. It is impossible to recognize a level surface by its aid within ½–1% without the use of bench-marks. These limits depend on the quality of the lens, the nature of the ground, and the tilt of the camera axis.

The best geological interpretation requires that only the central parts of the photographs be used, and that the focal length of the lens be 10–12 in or more.

The stereoscopic model is distorted by the prints being bent, by the line of sight not being perpendicular to the prints, by imperfect lenses, and by the camera axis being grossly tilted for one photograph of the stereoscopic pair.

Where relief is low, photo-index sheets are good picture maps. They show a wealth of detail. Large structures in thick formations are clearly visible, but stereoscopic examination is not possible, and some detail is lost in printing these sheets. In country of high relief usable index sheets cannot be made because of matching difficulties. Geological interpretation is largely dependent on the ability to interpret drainage and topographic form.

In mountainous country with thick lithological units the main structural irregularities stand out clearly ; scale is relatively unimportant, and drainage patterns generally show the location if not the exact nature of the structures. Structures which are small compared with the thickness of the lithological units are difficult to discover. In strata-bench lands and in the true depositional coastal plains the drainage patterns cannot be relied upon for discovering structures. Confusion may be introduced into topographic interpretation by the effects of weathering and erosion under the rigorous late Pleistocene climate of certain regions which are warmer and dryer now.

At scales of 1 : 20,000 the bedding in soft rocks may not be visible. This scale, while popular for engineering purposes, is too small for geological studies in many regions. A scale of 1 : 8000, with the finest-grained films, would probably be of much greater value. G. D. H.

1176. Mattoon. H. B. Kniseley. *Oil Wkly*, 15.4.46, **121** (7), 33.—The Mattoon pool of Coles County, East Central Illinois, is about 8 ml long and 1½ ml wide. Its reserve may be 20–30 million barrels. Numerous wells have been completed for 400 brl/day or more. The producing area is defined except possibly in the north. Mattoon has five producing horizons, although only two have been proved over a wide area. The field is on an anticline, like Loudon and Salem to the south. 27 wells have been completed in the Cypress, 107 in the Rosiclare, and 39 in both. The Cypress occurs at 1775 ft, the Rosiclare at about 1925 ft, and the Devonian at 3100 ft.

The Mattoon field was discovered in 1940, but no substantial producer was completed until 1945. The first test found oil shows; two others failed, and the fourth found McClosky production. The structure was first outlined by seismic work and core drilling.

The gas cap may cover 300 acres. In the Cypress the gas/oil ratio is 350–400 cu. ft/brl, and in the Rosiclare 500–600 cu. ft/brl. G. D. H.

1177. Wildcat Drilling in 1945. F. H. Lahee. *Oil Gas J.*, 13.4.46, **44** (49), 64.—5613 wildcats were drilled in U.S.A. in 1945, 4399 being dry. The total footage was 23,030,266 ft. In the southern states there were 2706 wells, 2093 being dry. Their total footage was 13,452,603 ft. Of the wells drilled on technical advice 1115 were successful and 3697 were dry. 47 wells located for non-technical reasons were successful and 404 were dry. Technical recommendations were 2·2 times as successful as those drilled without such advice.

17% more exploratory wells were drilled in 1945 than in 1944.

Roughly 60% of the wildcatting was for new fields, 20% for new pools on known producing structures, and 20% was outpost drilling or long-distance extension of partly developed pools.

894 new field wildcats were drilled by major companies (158 producers); 1854 new field wildcats were drilled by minor companies and independents (165 producers); and 288 new field wildcats (28 producers) were drilled by minor companies or independents with the drilling financed by major companies.

A series of tables summarize data on wildcat drilling, giving the footage, results, and the basis for the locations. G. D. H.

1178. 1946 Exploration May Set New High. Anon. *Oil Wkly*, 27.5.46, **121** (13), 47.—During April 1946, 359 exploratory completions were made in U.S.A., bringing the total for the first four months to 1372, compared with 1337 for the same period of 1945. The April exploratory completions yielded 43 oil discoveries, 11 distillate discoveries, and 12 gas discoveries. There were 85 extensions. The total discoveries in the first four months of 1946 number 523.

Tables summarize the exploratory drilling results for April and for the first four months of 1946. The April discoveries are listed with brief particulars. G. D. H.

1179. Geology of Alaska Naval Reserve. W. T. Foran. *Oil Wkly*, 6.5.46, **121** (10), 35 (International Section).—The earliest geological work in or near the Alaska naval reserve was in 1904. A second study began in 1923. A further investigation was initiated in 1944. This investigation showed that a petroliferous area apparently of major importance exists in Naval Petroleum Reserve No. 4. The structure and stratigraphy are favourable and active seeps exist. The area is capable of development if sufficient oil is found. Later a structure with 650-ft closure was defined, and a location for Umiat 1 was selected. Aerial photography, seismic, and gravity work were carried out.

The Umiat dome is outlined by the massive Umiat (Upper Cretaceous) sandstone. Seemingly about 35,000 ft of marine Cretaceous sediments were deposited in the Barrow basin. The uppermost 12,000 ft has excellent reservoir rocks. The Cretaceous structure may overlie fault-zones in the Palæozoic basement of Devonian, Mississippian, and Triassic. The Devonian and Mississippian are petroliferous in adjacent areas to the north. The seeps of the Barrow basin are on the rim and are almost certainly derived from the Upper Cretaceous, with which formation there are angular discordances. The seeps are related to faults. G. D. H.

1180. Wildcat Completions Total 15 Last Year in Eastern Canada. Anon. *Oil Wkly*, 6.5.46, **121** (10), 39 (International Section).—During 1945 15 dry wildcats were drilled in Eastern Canada. 9 were in Kent County, Ontario. The deepest was 3685 ft, and this reached granite. G. D. H.

1181. Geology of the Guayaquil Estuary, Ecuador. G. Sheppard. *J. Inst. Petrol.*, 1946, **32**, 492–514.—The area studied is some 70 miles from the Pacific Ocean, and consists of the relic of an ancient estuary. The formations of the region consist of (1) Recent Deposits and (2) Tertiary Formations. The Recent Deposits comprise (*a*) fluvial, etc., including shoals and manglares (mangrove swamps), and (*b*) scree accumulations. The Tertiary Formations consist of (*a*) Chongon Sandstones and Shales; (*b*) Guayaquil Group: (1) San Eduardo Limestone; (2) Guayaquil Argillites and Cherts; (3) Moreno Sandstone; (4) Tres Cerritos Breccias. Characteristics of these formations are detailed, followed by studies of the structure and associated features of the region. A. H. N.

1182. Spring Hill 2 in Chile is Reported as Abandoned. Anon. *Oil Wkly*, 10.6.46, **122** (2), 23.—Spring Hill 2 is reported to be structurally lower than the discovery well, and has found water in the pay. A non-commercial amount of oil was found in a shallower sand wedge. The well is reported to have been abandoned. G. D. H.

1183. Deeper Sand is Sought in Chile's Spring Hill 2. Anon. *Oil Wkly*, 17.6.46, **122** (3), 31.—Spring Hill 2 has found the discovery sand of the first test dry at 7419–7438 ft. It is now drilling near 8475 ft in search of a deeper sand. G. D. H.

1184. Concession Time Limits Spur Companies Operating in Colombia to Great Activity. Anon. *Oil Wkly*, 6.5.46, **121** (10), 47 (International Section).—Sardinata 1 and Zahino 1 are being drilled in the Middle Magdalena Valley, southwest of the production at El Centro. La Salina 1 and Pedral 1 are being drilled in the same general area.

Tests are to be drilled in the Llanos area east of the Andes. San Martin 2 is testing a 200-ft section at 6200 ft and some 14-gravity oil is being recovered. G. D. H.

1185. New Colombia Field Likely. Anon. *Oil Wkly*, 17.6.46, **122** (3), 30.—Valasquez 1 in the Upper Magdalena valley of Colombia has found 20 ft of saturated sand at 7254–7274 ft, and recovered 15 stands of 35-gravity oil in a drillstem test. The sand is similar to the Guadas Tertiary sand, but it may be in the Upper Cretaceous or in the transition beds at the top of the Cretaceous. G. D. H.

1186. Venezuela's Most Ambitious Exploratory Campaign in History Well Under Way. M. C. Cody. *Oil Gas J.*, 13.4.46, **44** (49), 74.—37 wildcat operations have been reported in Venezuela's 1946 exploratory campaign. Three are possible new field openers, and two others have found new production. 1 well has found gas, 4 are reported dry and abandoned, and 28 are being drilled at present.

1 Caico-Seco obtained 515 brl/day of 49·7-gravity oil from the Oficina formation. Its total depth is 8515 ft, and it lies 30 km north-west of the main Oficina field. It appears to be on a new trend between the Oficina–Guara–Leona trend and the Santa Ana–San Joaquin–Guarico trend. Nipa 1, 20 km north of the Oficina field, obtained 391 brl/day of 37·5-gravity oil from the Oficina formation. A third oil discovery has been made by Mene Grande, 10 km north of the main Oficina field. This was a dual zone producer. Nipa 2 is being drilled 10 km due east of Nipa 1. 10 km east of Caico 1 a small gas producer was drilled by Socony.

1 Manguito is being drilled by Barnsdall 50 km west of the Oficina field. Operations will be renewed on BG 60, which is immediately west of the Santa Barbara field, and temporarily suspended.

Atlantic is drilling 1 San Pedro 25 km southeast of the Jusepin field, 1 El Hueso 15 km west of 1 San Pedro, and 1 Tonoro 40 km farther west. FT-1 has cored oil-sand in the La Pica formation between 4675 and 4702 ft. This well, drilled by Phillips, is 2 km south of BG 60.

Several wildcats are being drilled in Guarico, and there are some in the Barinas area of southwestern Venezuela, which has been largely neglected because of scarcity of geological information. 4 wells are being drilled in the immediate area of Lake Maracaibo.

The wildcats are listed, and maps show their locations. G. D. H.

1187. **Phillips Venezuelan's First Wildcat Unloads Oil and Gas.** Anon. *Oil Wkly*, 13.5.46, **121** (11), 72.—Phillips' wildcat on the Mata Grande concession in Monagas has run wild, flowing several hundred barrels of oil per day and probably 50 million cu. ft. of gas. The gas and oil zone is 600 ft thick and was topped at 4581 ft, the first oil sand being at 4706 ft. The saturated zones total 375 ft in thickness. G. D. H.

1188. **England Wildcat Test is Drilling Below 2200 ft.** Anon. *Oil Wkly*, 3.6.46, **122** (1), 47 (International Section).—Kirkleatham 2, south of Hartlepool, is in the Permian below 2200 ft. Kirkleatham 1 was abandoned in Carboniferous at 3736 ft, after logging traces of oil and gas. Formby 1 is to be taken below its present depth of 6382 ft.

Seismic work is in progress in the Formby area, and gravity work in Wiltshire is continuing with a view to locating buried Carboniferous structures north of the Mendip uplift. G. D. H.

1189. **New Oil Discovery in Italy.** Anon. *Oil Wkly*, 6.5.46, **121** (10), 39 (International Section).—A new oil discovery is reported to have been made in Piacenza Province, the only Italian area which has so far yielded commercial production. G. D. H.

1190. **U.S. Companies Indicate Interest in Renewing Exploration in Italy.** Anon. *Oil Wkly*, 20.5.46, **121** (12), 68.—Societa Petrolifera Italian has begun conversations regarding the continuation of pre-war prospecting for oil. The company controls about half of Italy's 100,000 brl/year output. It is hoped that the size of concession tracts will be increased. A number of oil-bearing structures were found before the war.

The most favourable oil areas are in the Emila region, which now gives 90% of the country's output, the Pescara valley, Tuscany, and Sicily. Oil was first discovered in 1860. The cumulative production is 3½ million barrels. G. D. H.

1191. **Show of Oil is Reported in Wildcat Test South of Suez.** Anon. *Oil Wkly*, 6.5.46, **121** (10), 40 (International Section).—A wildcat at Sudr, 40 ml south of Suez, has found a good oil show at 2700 ft. G. D. H.

1192. **Sinai Peninsula Field Opened by Anglo-Egyptian Company.** Anon. *Oil Wkly*, 20.5.46, **121** (12), 68.—SUDR 1, 40 ml south of Suez, has pumped 22-gravity oil at the rate of 275 brl/day in a short pumping test of a formation between 2680 and 2925 ft. Production is believed to be from the Cretaceous.

9 ml southeast of Suez 2 dry holes have been drilled, one to 5451 ft and the other to 5808 ft. G. D. H.

1193. **Exploration in Nigeria Expected to be Resumed.** Anon. *Oil Wkly*, 6.5.46, **121** (10), 40 (International Section).—Before the war there was search for oil in northern Nigeria, north of Port Harcourt. The results have not been published, but there is a great thickness of gently folded Cretaceous and Tertiary marine and shallow-water deposits which might be expected to contain some oil. G. D. H.

1194. **Philippines Oil Development.** H. F. Bain. *Oil Wkly*, 6.5.46, **121** (10), 16 (International Section).—The oldest beds known in the Philippines are Cretaceous or even Triassic in age, but there may be older rocks in Palawan. Tertiary beds, mainly Miocene, provide the bulk of the remaining outcrops. There are also lavas and intrusives. The sediments are largely terrestrial conglomerates, sandstones, tuffs, and shales. There are some coals, and limestones which are mainly reef types.

On the Tayabas lease Standard of California has drilled 5 wells without finding production. Far Eastern Oil Development Co. found small amounts of oil in shallow horizons penetrated by modified water-drilling equipment. The testing of the large Daanbantayan structure of northern Cebu was undertaken with a modern rig. A depth of 4000 ft was reached without finding oil, the beds having thickened a great deal. A depth of 8300 ft was reached with a new rig, an untested show having been noted at 8250 ft. The war caused a cessation of operations. A test at Barili reached 2200 ft before having to be suspended.

Leasing is briefly discussed. G. D. H.

1195. Oil in Antarctica. F. A. Wade. *Oil Wkly*, 1.4.46, **121** (5), 4 (International Section).—Antarctica may cover 5,000,000 sq ml, and three-quarters of it have not been seen or explored. Most of the coastline has been charted, but the interior is largely unknown.

The mountains of the Palmer Peninsula appear to be a southern extension of the Andes. Overlying the basement complex are Mesozoic beds with sandstones, conglomerate, and slaty rock. There are marine Cretaceous beds, and marine Oligocene and Miocene beds. Volcanic activity seems to have been intermittent since Miocene times. Nearly flat-lying sediments are exposed along the north and west coasts of King George VI Sound. These are of Jurassic age. In the horst bordering the Ross Sea a pre-Cambrian basement complex is overlain by a thick series of Palæozoic sediments. There are Cambrian limestones and Devonian shales and sandstones. The Permo-Carboniferous Beacon formation includes sandstones and many coals. In northern Marie Byrd land and the Edward VII Peninsula are metamorphosed sediments.

It is unknown whether the central area is a lowland or plateau-like. If the former, it has an ice cover of 5000–10,000 ft, the form of the underlying land probably being determinable by seismic survey. If the area has been repeatedly invaded by the sea, source rocks may have been deposited.

Apart from the difficulties of travel and exploration in these ice-covered areas, drilling would present many problems, and possible ice-flow would have to be considered. Any exploration for oil should be on an adequate scale. G. D. H.

Geophysics and Geochemical Prospecting.

1196. Airborne Magnetometer Expedites Geophysical Surveys. G. B. Nicholson. *Oil Wkly*, 3.6.46, **122** (1), 29.—Early airborne magnetometers lacked the sensitivity needed to detect the weaker anomalies, but the use of field-sensitive fluxgates has provided a more satisfactory instrument, which gives a continuous record in association with a continuous strip camera. The U.S. Geological Survey employs a detector towed behind the plane, but the Navy has used a detector in a specially designed tail extension of the plane. The plane height is determined by a radio altimeter. The use of two instruments towed at different levels, or two flights at different altitudes yield valuable data from an interpretative point of view.

Tests were made over areas of known geological structure near Boyertown, Pennsylvania, and later over probable iron ore deposits in Iron County, Michigan. Flights over oil-bearing territory have been made in Oklahoma and the Big Horn Basin.

A standard flying height of 1000 ft is suitable for many purposes, and avoids troubles due to pipe-lines, railways, etc. Horizontal spacing of traverses ranges ¼ to 3 ml. Traverses may be as much as 30 ml long, and flying speeds of 100 to 150 m.p.h. are desirable.

In eight weeks 3170 sq ml of mountainous territory was surveyed by an aerial magnetometer. About 150 times this period would have been required for an equivalent ground survey, and the cost would have been 17 times greater. The airborne magnetometer is suitable for investigations of the continental shelf. In such areas Shoran is employed for determining the plane's position. G. D. H.

1197. Radioactivity Experiments Aim at Finding New Reserves. Anon. *Oil Wkly*, 22.4.46, **121** (8), 50.—Investigations which have been described recently have shown that fatty acids isolated from ocean-bottom mud can be converted into straight-chain hydrocarbons by bombardment in a cyclotron. Apparently there is sufficient radioactive material in oilfield sediments to effect this conversion in 10–100 million years.

In the cyclotron an acid with a ring structure, and occurring in Russian and Californian crudes, when bombarded yielded a mixture of cyclic hydrocarbons. The acid itself may be a product of bacterial or radioactive action on sterols. G. D. H.

1198. Radioactivity Logging of Dolomites. V. J. Mercier. *Oil Wkly*, 15.4.46, **121** (7), 36.—Dolomite is weakly radioactive, and cannot be distinguished from limestone by radioactivity measurements alone. In Kansas operators are faced with the problem of evaluating dolomites such as occur in the Arbuckle, Viola, and Maquoketa formations. Gamma-ray and neutron logs have been extensively used in completing new wells and in re-working old ones. A number of examples of their application are described. G. D. H.

Drilling.

1199. Lateral Drilling of Limestone Reservoirs. W. P. Sterne. *Oil Wkly*, 26.8.46, **122** (13), 34.—The use of lateral, horizontal holes drilled into limestone formations to increase drainage area and production is discussed. Examples of increasing production by this method followed by acidizing are cited. The lateral drill used is composed of an outer housing, inner housing, drive-shaft, torsion limiter, deflector rotator, whipstock, and anchor, and is composed of 206 individual pieces of material. The outer housing has a maximum diameter of 6 in at the deflector window, which limits use of the tool to wells equipped with 7-in or larger casing. The lateral drilling equipment utilizes bits varying in size from 5¼ to 6¼ in, and is sufficiently rugged to permit the application of approximately 12,000 lb weight on the bit. Since tubing is generally used for rotation, it is necessary to obtain the bit weight from drill collars. Located vertically between the outer housing and the anchor is the deflector rotator, which is so constructed that the face of the whipstock can be rotated, thus permitting the drilling of four holes in sets of two holes each, without the removal of the drill-pipe from the hole. One set of holes is several feet higher than the other, and each set is 180° apart. Within the inner housing is a flexible drive-shaft, constructed of universal joints, which has a travel of 25 ft, permitting lateral drilling of a hole 25 ft long. This flexible shaft, which is protected from wall contact by jointed housing, transmits the torque from the drill-stem, which may be tubing or drill-pipe, to the bit through the curving hole. To prevent difficulty that might result from the bit hanging up, a torsion limiter is provided on the drive-shaft. This piece of equipment cuts off the flow of drilling fluid when the torque exceeds a predetermined value. Since the drilling fluid is transmitted to the bit through the universal joint flexible shaft, it is obvious that oil must be used for circulation. The tool is stoutly constructed, and when in good condition can be operated without mechanical difficulty.
A. H. N.

1200. Drilling in California's West Newport Field. W. E. Dunlap and A. L. Hunter. *Oil Gas J.*, 10.9.46, **45** (14), 95.—The field, type of well drilled, and completion methods used are described, and production data are presented. The geology of the field is discussed, accompanied by excellent examples of structural delineation of the strata from electrologs of different wells. The sands of the producing zones of the Lower Ashton series are typically fine to coarse in texture, predominantly rounded, well sorted, and rather loosely consolidated. The pore spaces are well intercommunicating, as evidenced by the high permeability average of 1284 md. Porosity values are also excellent, the average being slightly over 30%. The unconsolidated nature of the oil-sands plus the high vicosity of the oil act as a handicap to production where sand-control methods are not employed. In this connection the most common practice of sand control is afforded by the use of either prepack or float-pack gravel liners. A few wells have tried conventional liners, but they have not proved satisfactory.
A. H. N.

1201. Deep Drilling in Oklahoma. L. L. Jones, Jr. *Oil Gas J.*, 3.8.46, **45** (13), 74.—The average depth of wells drilling in Oklahoma is increasing. Depths of 10,000 to 13,000 ft are now being reached, and one company is contemplating drilling to 17,000 to 18,000 ft. The rigs are consequently becoming large and heavier. Some of the rigs used are described. A. H. N.

1202. Underwater Drilling For Any Depth. A. J. Tucker. *Oil Wkly*, 12.8.46, 122 (11), 60.—The ideas described in this paper are set for the purpose of avoiding expensive platform structures usually used for marine drilling. It is proposed to use a free-floating vessel on the surface of the water, using a flexible connection between ship and well-head, and drilling the hole by some electric or hydraulic motor rotation of the drilling bit. The design of equipment and development of procedure were based on a consideration of these factors: accommodation to ship motions; ship stability; ease of abandonment; ease of recapture; drilling the well; security of the well; safety of personnel; production; and hazards to navigation. These, in turn, established the conviction that there must be complete flexibility between ship and well, except in the calmest weather, and that a submerged wellhead is a necessity. The conditions expected at sea are outlined, followed by details of design to meet the design specifications set above. It is suggested that the best ship to use is one of the largest-size landing-craft, the L.S.T. A. H. N.

1203. An Improved British Mud-Screen for Rotary Drilling. Anon. *Petrol. Times*, 3.8.46, 50 (1279), 796.—A newly-designed mud screen for rotary drilling is described in detail. The structure is heavier than most mud screens, but not cumbersome, and there is no chance of dangerous distortion due to transit over rough ground or operation on uneven standings. The ends of the members which are on the ground are sled-ended, with ample and convenient slinging or towing lugs provided at each end. The special features designed to remove the most frequent sources of trouble are: (1) improved shaft bearings which are identical and interchangeable; (2) the use of compound rubber buffers instead of helical springs, providing mobile stability of the screening basket; (3) the elimination of whip in the screen cloth by the patented tensioning device. R. B. S.

1204. New Power Rig. J. E. Kastrop. *Oil Wkly*, 12.8.46, 122 (11), 47–50.—The rig was designed to simplify transportation and assembling. Some of the special features of the rig are: (1) a sectionalized derrick which is assembled horizontally on the ground and then raised intact into upright position by means of an erection gin pole; (2) the combination of the draw works and transmission into one unit; (3) an enclosed substructure into which have been built a tool-room, a supply room, a mud-mixing and storage room, the generator room, and a crew dressing and shower room. The chief components of the rig are described in some detail and the method of erecting the mast is illustrated diagrammatically. Nine oil-country trucks are required to move the rig. The drilling mast requires two trucks, one for the upper section and one for the lower section. The two mud-pumps have been mounted on skids and are handled by two trucks. One heavy truck will carry the draw-works transmission and rotary skid, while another such truck will transport the engine and compound skid. Each of the two parallel substructure sections requires a truck for moving, and the forward substructure housing the tool-room requires one truck. Smaller items, such as the shale shaker and blow-out preventers, can be added to the lesser loads to move the entire rig with nine trucks. A. H. N.

1205. Drilling with Counterflush Continuous Coring. C. J. Esseling. *Min. Mag.*, 1946, 75, 145–149.—The development of the counterflush system is given in brief, followed by a discussion of its method of use and advantages. In this method the mud stream is pumped in reverse order to that normally employed—*i.e.*, it enters the well through the annulus between casing and drill pipe and comes out of the drill-pipe lifting the core and cutting continuously. Two alternative methods of counterflush drilling may be adopted, With the first, drilling may be continued, once the conductor has been set, with a casing-string used as drill-rods, drilling down as deep as possible with them (with this method the casing string has, of course, to be flush inside). If it is necessary to proceed with a smaller-diameter hole the casing-string used as drill-rods for the first run is left in the hole as the casing; it is caught with the slips in the casing-head or landing flange, and the bore is then continued with a smaller casing-string used as rods. When employing this method it is necessary to use a coring-bit so constructed that the next smaller size of casing-string used as drill-pipes can pass through it. The employment of casings with sufficient wall thickness and provided with special joints enables them to be used as drill-rods with coring-bits, since the coring-bits only cut away a thin ring, and the casing-pipes are, in consequence, subjected to only a small torsional strain. If it is desired to adopt the second alternative method for counterflush drilling a string of drill-pipes for coring is used, but they must naturally be flush inside, using full-hole tool-joints. The hole is started with a fish-tail bit and, dependent on the depth scheduled, an 8-, 6-, or 4-in conductor is set and cemented against the rock, after which drilling is continued with the counterflush coring system. It must be borne in mind that if the diameter of the casing set is too large to permit of drilling the hole to the full desired depth with a counterflush bit, the hole must later be reamed in order to be able to set the next size; moreover, a second smaller string of drill-pipes, with full-hole tool-joint connections, must be available for drilling deeper. Several advantages accruing from using this method are discussed. A. H. N.

1206. **Drilling Time Reduced.** G. Weber. *Oil Gas J.*, 17.8.46, **45** (15), 108.—A discussion of drilling time in the Permian Basin and the reduction shown is ascribed to the following: (1) use of longer intermediate casing strings; (2) partial substitution of clear water for drilling mud; (3) increased weight applied to bit; (4) increased efficiency of drilling crews; (5) improved drilling equipment; (6) more prompt and efficient service; (7) increased knowledge of subsurface conditions; (8) trend towards drilling slimmer holes; (9) better control of corrosion and other causes of drill-pipe failures. Each of the above items is discussed in some detail. A. H. N.

1207. **U-Shaped Drilling Barge.** Anon. *Oil Wkly*, 2.9.46, **123** (1), 40.—The barge described and illustrated consists of two hulls brought together to form a "U" or a "horseshoe." Departing from the conventional design of drilling barges by the addition of protrusions in the aft halves of the two hulls, when the two sections are brought together, offsets or blisters coincide so as to come into contact, being separated only by a small building tolerance, and for practical purposes provide a single hull. By eliminating the usual 8-ft gap between the two barges on one end, additional buoyancy is obtained on the aft section, where the heavy equipment is located and solid steel flooring is furnished for placing pumps and other equipment on space which is ordinarily wasted.

The forward end of the drilling barge is comprised of twin hulls, each 24 ft in beam, separated by an 8-ft slot or key-way. This section of hull, adopting the conventional pattern of barge design, contains two tanks for reserve mud supply, with the deck immediately above the reserve tanks being used for pipe-racks. The barge has an overall length of 140 ft and height of the hull is 12 ft. Each component hull is 24 ft in beam at its forward end, this width extending aft 78 ft, where by means of an offset and a 90° angle, width is increased to 27 ft 10 in, remaining constant for the balance of the 62 ft to the stern. The blisters on the port and the starboard hulls are on the inside bulkheads of the respective hulls, and are contingent when the two sections are brought together, excepting for a separation of 3 or 4 in, which is packed. The two hulls when positioned properly have an overall width of 56 ft.

Other details of the barge and the drilling rig used with it are given. A. H. N.

1208. **Drill Pipe Failures in the Permian Basin.** L. R. Jackson, H. M. Banta, and R. C. McMaster. *Oil Wkly*, 19.8.46, **122** (12), 47.—An investigation of the performance of drill-pipe in the Permian Basin fields revealed that the relatively short service life of the pipe was the result of the severe corrosive conditions encountered. Drilling in this particular area is unique, in that salt beds are encountered from about 1800 to 3400 ft or deeper. The salt content of the drilling fluid attacks the steel pipe, the first stage of deterioration being manifested as corrosion pits. These pits produce a notch effect and concentrate the stresses normally developed during drilling, so that fatigue cracks are developed at the base of the pits. The cyclic stresses cause further propagation of the cracks, which leads to washouts and twist-offs. Three methods are advocated to minimize these effects. The first is to use an inhibitor.

Sodium hydroxide was found completely effective in the laboratory; in the field it was uneconomical because of the large quantities required. Of the numerous inhibitors investigated, sodium chromate—a chemical already widely used to combat corrosion—appears to be the most promising, although it does not afford complete chemical protection. Small quantities of this inhibitor were found to be more effective than similar amounts of any of the other chemical additions studied. For drilling the salt section it is recommended that a sodium chromate concentration of about 3000 parts per million by weight should be maintained, with the pH of the drilling fluid being neutral or slightly on the alkaline side—a pH of 7·0 or more. After the salt section is cased off the mud-pits should be thoroughly cleaned to insure a low salt content in the fresh-water mud. The concentration of sodium chromate should be maintained at the same level as in the salt section, with a pH of 7·0 or higher.

The second method is to coat the pipe with thermal plastic on the inside; the outside is continuously rubbing against rock, and pits are more scarce than inside. The third method is to use a special drill-pipe for the salt section alone. The drill-pipe in all three methods should be maintained in tension. A. H. N.

1209. Patents connected with Drilling. W. T. Cardwell, assr by mesne assignments to California Research Corpn. U.S.P. 2,404,038, 16.7.46. Method of treating mud-laden drilling fluids.—A method of treating aqueous drilling mud to produce a drilling fluid which will possess desirable viscosity, wall building, and water-loss properties, by agitating with a water-insoluble cation selective material which substitutes alkali metal cations for alkaline earth and other polyvalent cations, and then separating unwanted material.

R. R. Waterman. U.S.P. 2,404,114, 16.7.46. Water-feed system for boilers.—A special system for supplying boiler feed-water at a rate equivalent to the rate at which steam is exhausted.

J. T. Hayward. U.S.P. 2,404,132, 16.7.46. Apparatus for use in logging wells.—An apparatus for measuring and recording volumes of well-drilling fluid circulating down a drill-string and up the annulus.

J. A. Maurer, assr to J. A. Maurer Inc. U.S.P. 2,404,137, 16.7.46. Method of and means for recording electrical impulses and impulse record produced thereby.—A method of producing on a film a photographic record of electrical impulses (suitable for use in electrical well logging).

R. L. Doan, assr to Phillips Petroleum Co. U.S.P. 2,404,622, 23.7.46. Well-logging apparatus.—A special type of electrode for direct attachment to the walls of a borehole.

A. O. Roberts and J. J. Wharam, assr to Ford Motor Co. U.S.P. 2,404,657, 23.7.46. Transmission.—A variable-speed transmission of the hydraulic torque converter type.

P. H. Granger. U.S.P. 2,404,876, 30.7.46. Oil-well tool.—A device for use in cementing operations.

R. A. Ward, assr by mesne assignments to R. C. Switzer and J. L. Switzer. U.S.P. 2,405,078, 30.7.46. Method and compositions for locating surface discontinuities.—A method of detecting *subsurface* flaws having *surface* openings: suitable for drill-pipe, casing, tubing, etc.

M. T. Archer, assr to The National Supply Co. U.S.P. 2,405,546, 13.8.46. Well drilling plant: a power plant for a rotary drilling rig combining means for driving rotary table, draw-works, and mud-pumps.

G. L. Loomis. U.S.P. 2,405,794, 13.8.46. Portable derrick.—A portable derrick which can be raised as a unitary structure by the use of an auxiliary mast and hoisting drum: all equipment is on a common foundation, to which the auxiliary mast and derrick are pivotally attached.

A. H. Beal. U.S.P. 2,405,937, 20.8.46. Deviation recording device.—A device for recording the deviation of a well-bore. R. B. S.

Production.

1210. A Factual Analysis of the Effect of Well-Spacing on Oil Recovery. R. C. Crazo and S. E. Buckley. *Oil Gas J.*, 24.8.46, **45** (16), 97.—*Paper presented before A.P.I.* The results of studies on 103 oil-pools are analysed. Correlation is obtained between yield and viscosity, yield and permeability, etc., but it is found that yield is almost independent of well-spacing. The authors discuss the desirability of the ideal in experimentation of keeping all variables constant and varying only well-spacing before a conclusion that well-spacing is of no effect on yield can be drawn. They also point out the impossibility of such an ideal experiment. Accordingly, even though the data are not precise, it is believed that the number of observations is sufficient to afford reasonable statistical support for the position that the absence of a trend with well-spacing is significant rather than accidental. Hence, the further conclusion may be justified that these field data show the ultimate oil recovery to be independent of the well-spacing. For clarification this conclusion needs elaboration and explanation. What has been shown by these data is that distance between wells is not one of the pertinent generally applicable physical factors on which oil recovery is dependent. This conclusion does not imply that a single well will adequately drain an entire structure, nor does it imply that the recovery from any field will necessarily be independent of the number and location of producing wells. The data show an absence of a direct physical dependence, and not an absence of a geometric dependence of recovery on spacing. For example, the field with 2·6 acres/well may be highly faulted or may consist of numerous zones not co-extensive. A well density of 65 acres/well in this field might have yielded materially less oil. Conversely, however, a density of 1 well to 2·6 acres in the field drilled to 63·6 acres/well would not necessarily have increased the ultimate recovery. Although distance of drainage is not a factor controlling ultimate recovery, the geometry of the reservoirs and the location of the wells with respect to such geometry are undoubtedly important. Furthermore, the effects of well location and production rate on gas and water production may also affect the ultimate oil recovery.

Hence, a more comprehensively phrased conclusion must point out that in any reservoir a sufficient number of wells must be drilled adequately to drain the reservoir under the available conditions and type of drive operative and to supply the desired total rate of production without excessive individual well rates. This minimum number of wells required is subject to determination on a sound engineering basis for each reservoir, based upon the reservoir characteristics and the type of operation. Beyond this minimum number of wells further increase of well density will not increase the ultimate oil recovery through shortening the drainage distance. It is in this sense, and this sense only, that oil recovery has been shown to be independent of the well-spacing. A. H. N.

1211. Secondary Recovery Production Research (A Monthly Review). R. V. Hughes. *Producers Monthly*, June 1946, **10** (8), 8.—This month's review includes notes on well-shooting practices and on progress in production research at the Pensylvania State College. Shooting practices in England are discussed with reference to the paper entitled "Some Problems Encountered during Well Shooting Operations in the Nottinghamshire Oilfields" in the March 1946 issue of the *Journal of the Institute of Petroleum* (see abstract No. 539). A recent U.S. publication on explosives is also reviewed.

The production research discussed concerns the well-known fact that the routine air-permeability determination performed on cores from oil-producing formations cannot predict in general the ability of such a formation to conduct water, even when the core is completely saturated with water. Two tests were performed to determine the clay content of some Bradford sands. The first was the method of "differential thermal analysis" which has been used for some time in the analysis of clay minerals. The process consists of determining the temperature difference by means of a differential thermocouple between a clay sample and a thermally inert substance, both of which are being heated simultaneously at a constant and equal rate. Any chemical or physical changes in the clay involving the liberation or absorption of heat such as loss of water of hydration or changes in crystalline state will create a temperature difference between the clay and the inert substance. This produces a differential temperature *versus* temperature curve which is characteristic of the clay minerals present.

The second test method used was the X-ray spectrometer. This apparatus subjects the sample to a stream of X-rays at a continuously varying incident angle. The intensity of the refracted beam is measured simultaneously at the same angle as the incident beam with a geiger counter. The curve produced is the scanning angle versus the intensity of the refracted beam, and is characteristic of the material being tested. These tests indicated that some sands contain clay minerals which are likely to swell in contact with water, and this may explain the variable permeabilities encountered. R. B. S.

1212. **Development of Ground Water from Wells.** E. W. Bennison. *Producer's Monthly*, June 1946, 10 (8), 16.—An adequate testing programme is an essential preliminary to any ground-water development scheme: to interpret the results obtained, considerable knowledge of the various forms of ground-water flow, ground-water velocities for different formations, and the basic hydraulic laws governing the movement of water in the formations penetrated is required; these factors are discussed.

The importance of well-screens and gravel packing and the causes of corrosion and incrustation are also discussed. In well screens corrosion is generally direct chemical corrosion, selective corrosion (or dezincification), or some form of electrolytic corrosion. The main causes of corrosion are a high content of free CO_2, low pH value, a high content of dissolved oxygen, the presence of H_2S or similar gases in the water, or the presence of iron sulphate and other less common causes. Incrustation, which is frequently confused with corrosion, is an entirely different phenomena, being primarily due to chemical deposits caused by over-pumping or differences in pressure. Incrustation destroys the efficiency of a well-screen, while corrosion destroys the screen itself. Incrustation is the deposition and collection of mineral salts on the screen and in the formation adjacent to a screen. This deposition is due to the pressure changes and consequent release of CO_2 which occur when the well is being pumped. Inasmuch as these changes are greatest at or near the screen, the release of CO_2 is greatest here, and also the deposition of mineral salts. Incrustation is of two types, hard and soft, dependent on the chemical nature of the water and whether hardness is of carbonate or non-carbonate type. About the only means of retarding incrustation discovered to date is to lessen the rate of pumping and using more wells spaced farther apart. Acid treatment and other means have been used for temporary relief, but are not entirely satisfactory. R. B. S.

1213. **Deep Well Turbine Pumps for Secondary Oil Recovery Operations.** D. R. Rankin. *Producer's Monthly*, June 1946, 10 (8), 22.—The construction and installation of various types of deep-well turbine pumps for raising water from underground sources are discussed. R. B. S.

1214. **Cycling Operations.** H. H. Kaveler. *Oil Wkly*, 2.9.46, 123 (1), 33.—The contrasting viewpoints of present-day production and that of the past are presented. The principles of energy conservation and of increased liquid yield in retrograde fields, when cycling operations are used, are briefly outlined. Finally the advantages of unit operations are discussed. There are generally two main problems involved in unit management. One is that of convincing all the owners interested in such a pool that unitization is essential and will result in maximum benefit; the second is the problem of accomplishing a fair distribution of equities in the unit operation. The basis for equity distribution varies widely as between pools and as between areas. If the methods of equity distribution upon which unit operations are based were examined, a wide variety of methods would be found to be employed. The principle generally adhered to is to distribute equities in substantial proportion to the recoverable petroleum-in-place beneath each separate tract. Sometimes this may be accomplished by basing equity distribution upon the acre-feet of net productive formation. At other times, particularly where more than one pool is involved, it is necessary to base the equity upon the recoverable hydrocarbon-in-place beneath each respective tract. A convenient means where more than one pool is involved in a field, is to compute the amount of condensate and the amount of residue gas-in-place beneath each tract and assign, for purpose of equity calculation only, a dollar value to the condensate and to the residue gas, and base the distribution upon the equity dollar value attributable to each tract. Once unitization is accomplished, cycling becomes more easy to accomplish and more certain of success. A. H. N.

1215. **Extrapolation of Bottom-Hole Pressure Build-Up Curves by Means of Difference Tables.** J. J. Arps. *Oil Wkly*, 22.7.46, **122** (8), 26.—A general discussion of obtaining static bottom-hole pressure for a well without shutting it down too long is presented. The methods available consist, briefly, mainly of: (1) a self-recording bottom-hole pressure gauge or pressure bomb, which records bottom-hole pressures directly; 2 fluid-level observations taken with the bailer on a sand line or a float on a wire line; to be converted by means of the fluid gradient into bottom-hole pressures; (3) indirect fluid-level observations made by means of sound-waves or possibly radio waves; (4) the "Copper Tubing Method," which uses the pressure required to blow compressed air or gas through small-diameter tubing lowered into the well alongside the production tubing; (5) the top-hole pressure build-up in dry gas wells; pressures to be corrected for weight of gas column. The graphical and other methods used to derive the static bottom-hole pressure are given in some detail. Formulae are illustrated by examples which are worked out. A. H. N.

1216. **Production Packers—Their Various Applications.** P. V. McGivern. *Oil Wkly*, 5.8.46, **122** (10), 28–29.—The use of packers for isolation of water from the producing sands, pumping and flowing from separate zones simultaneously, pumping from two zones alternately from the same well, and the disposal of salt water are briefly explained. A diagram illustrates the position of the packer in the various uses. The packer, commonly called a retainer production packer, is permanently set, and is not removable except by drilling, though the tubing may be pulled as often as required for changing pumps, cups or any other necessary repairs to the well. If, after years of service, the packer should go bad, another may be set immediately above the original without its removal. The packer is constructed of cast iron, and resists corrosion to a high degree. The packing element is protected both top and bottom by lead seal rings which prevent any fluid or gas from coming in contact with the rubber and is good for years of service. These rings also prevent the rubber from "flowing" in wells of high temperatures. The procedure adopted in setting this type of packer is described.

The packer may also be used advantageously to lessen corrosion of the casing and tubing by setting the packer in the shoe-joint and filling the annulus with live oil. Entrance of water through holes in the casing may also be prevented by filling the annulus with oil and packing the tubing head, providing of course the water pressure is sufficiently high to prevent the oil from draining off into the water zone. In addition to affording an underground storage for the oil, its presence tends to lessen electrolytic action on the pipe. A. H. N.

1217. **Lacquer Control of Loose Sand.** R. S. Adams. *Oil Wkly*, 12.8.46, **122** (11), 70.—Unconsolidated sands can give trouble either by sanding-up chokes, gravel-packs, etc., or by cutting off sections of screens, control valves, etc. To avoid such trouble lacquer was pumped through a tubing into the sand, and when this set it consolidated the sand grains. In one well a lower pay was abandoned and the operator perforated the casing into a higher oil-zone. Due to excessive amounts of unconsolidated sand, all attempts to produce the well failed. Reverse circulation with water failed to remove the gritty matter. Mud was required to clean the well and hold the sand in place. However, as soon as the mud was removed, the well would be expected to make sand again. After treating the well with the sand-lacquer material it was put on production and flowed pipe-line oil. It has been producing for more than four months, and the operator has had no sand troubles. Other examples are given to show that the method allows the advantages of high porosity and permeability of unconsolidated sands to be enjoyed without the extra troubles usually encountered with loose sand formation. A. H. N.

1218. **Gas Recovery Systems.** D. Rogers, Jr. *Oil Wkly*, 19.8.46, **122** (12), 42.—*Paper presented before A.P.I.* In fields of very low gas content the recovery of gas from the crude is an economical necessity. Such conditions exist in the Bradford field, where gas is salvaged either at low pressures or by vacuum and burnt on the lease. Gas recovery in the Bradford field is effected at the gas–oil–water separators and stock-tanks. A typical set-up is shown. Oil, gas, and water enter the separator tank from the lead line, a bleeder line being used when necessary to take the gas directly to the separator dome, and thus prevent surging. Water is syphoned from the bottom of the separator and oil gravitates to the stock-tanks. The gas-recovery line takes gas from the top of the stock-tanks and from the separator dome. Liquid seals are placed in the line connecting the separator tank to the stock-tanks and in the lines between the stock-tanks. The gas-recovery line delivers the solution gases either directly to a vacuum pump or to a vacuum gathering system. To guard against excessive pressures or vacuum being exerted on the tanks or separator, a pressure-relief device is connected to the gas-recovery line. This is a specially built liquid seal which vents to the atmosphere whenever the pressure or vacuum in the system exceeds predetermined limits. Several diagrams illustrate the system used.

A. H. N.

1219. Helium used by Bureau of Mines to Trace Travel of Injection Gas. Anon. *Oil Gas J.*, 10.9.46, **45** (14), 107.—A summary of the chief findings in the U.S. Bureau of Mines R.I. 3897 by E. M. Frost, Jr., on this subject is given in the paper. The success of the method depends largely on a new instrument which rapidly detects helium in natural gas in concentrations as low as 0·001%. The chief findings are: (1) The helium content of the gas produced from a well was found to vary in a cyclical manner over a period of days. The helium content of gas produced from wells changed somewhat, depending on the way the wells were handled. Invariably the helium content of the gas drawn from a well increased when a well was shut in, as though the helium was stratifying in the casing. Also, it was noted that the helium content of gas from a well was sometimes affected by changes in the operation of the well-pump; (2) the average helium content of the gas differed in one part of the field from that in another relatively near it. A. H. N.

1220. Unusual Pressure Conditions Solved in Oklahoma's Second Triple-Zone Completion. E. H. Short, Jr. *Oil Gas J.*, 17.8.46, **45** (15), 87.—Three sands with different pressures were brought in by a triple completion using packers to isolate the three formations. Special casing pack-off had to be used. A. H. N.

1221. Well Interference and Reservoir Drainage. J. H. Abernathy. *Oil Gas J.*, 10.9.46, **45** (14), 110.—In recent issues of the *Oil Gas J.* this subject was discussed by Barnes, and this paper is a comment on the series, giving the history of the Oklahoma City Pool in the Wilcox sand. The following conclusions are drawn: (1) when conditions of natural water-drive exist, and where withdrawals are restricted to a rate comparable to the rate at which water encroaches, wide spacing can be most effective in obtaining recovery of oil; (2) the inverse of principle 1 is also valid; if pressures are allowed to deplete, quite close spacing is necessary to obtain an efficient recovery of the oil in place; (3) if natural water-drive does not exist, very careful consideration should be given to early down-dip injection of water, since dissolved gas-drive, gas-cap drive, and the gravity drainage mechanisms are poor substitutes for encroaching water. These lesser forces can, however, be so utilized as to materially assist the natural or artificial water-drives.

Comments by others are also given. A. H. N.

1222. Flowing Production *vs* Pumping Production in Water-Flood Operations. R. C. Earlougher. *Oil Wkly*, 26.8.46, **122** (13), 38.—In secondary recovery water-flood operations the operator has the choice of flowing or pumping the producing wells. The advantages and disadvantages of flowing *versus* pumping producing wells in water-flood operations are frequently discussed, although little factual information has been presented. In an effort to determine accurately the relative merits of the two producing methods, an exhaustive study has been made of three leases containing 520 acres, of which 427 acres have been subjected to secondary recovery water-flood operations. Of the 427 producing acres studied, 169 acres have been developed for pumping production, while 258 acres have been developed for flowing production.

The investigation involved detailed study of all operational data obtained from 427 contiguous areas in Township 24 North Range 17 East, Nowata County, Oklahoma. Detailed data on water input, field characteristics, and oil production are presented. Whilst the eleven conclusions listed at the end are cautious in giving preference to either method unreservedly, enough advantages have been obtained with the flowing system over the pumping method to enable it to be recommended that in future flowing should be seriously considered when planning a new water-flooding development. Several other factors—depth and permeability—are important. A. H. N.

1223. Water Treating Equipment Used in Secondary Oil-Recovery Operations. L. E. Douthit. *Producer's Monthly*, June 1946, 10 (8), 28.—The use of pressure filters, chlorine feeders (chlorinators), chemical solution feeders and dry chemical feeders for water-treatment operations is briefly discussed. R. B. S.

1224. Power-pumps for Water-flooding. J. W. Hepburn. *Producer's Monthly*, June 1946, 10 (8), 30.—The selection of the material used in construction and design of pumps for water-flooding work is reviewed. A detailed discussion of power-pump performance follows, particular emphasis being laid on efficiency, horse-power, the influence of gas or air entrained in the water, and suction conditions.

The mechanical losses in a power-pump due to friction of the moving parts is expressed by the mechanical efficiency (Em) which is the ratio of the theoretical horse-power (t.h.p.) output to the brake horse-power (b.h.p.) input at the pump coupling or pulley. The mechanical efficiency can be determined only by test. The loss due to stuffing-box leakage, delay in closing of the valves, leaky valves, and amount of gas or vapour carried by the water is represented by the volumetric efficiency (Ev). The volumetric efficiency is the ratio of the actual capacity discharged in g.p.m. to the plunger displacement in g.p.m.—*i.e.*, the ratio of hydraulic horse-power (h.h.p.) to b.h.p. The volumetric efficiency can be determined only by test. Average values of Ev are 97% for horizontal duplex double-acting plunger pumps and 95% for vertical triplex single-acting pumps. The total efficiency (Et) of the pump indicates the overall efficiency and is determined by $Et = Em \times Ev$, or by delivery in U.S. Gal/min (Q) + piston displacement in U.S. gal/min (D).

B.h.p. is the power actually transmitted to the pump by its driver. When a pump is tested the b.h.p. is measured at the pump coupling or pulley. The h.h.p. is based on the amount of liquid actually discharged by the pump. The t.h.p. is based on the plunger displacement of the pump. The following formulæ are used to calculate pump horse-powers:

$$\text{h.h.p.} = \frac{Q \times psi}{1715} \quad \text{t.h.p.} = \frac{D \times psi}{1715} \quad \text{b.h.p.} = \frac{\text{t.h.p.}}{Em} = \frac{\text{h.h.p.}}{Et}$$

The application of the formulæ to specific problems is simple, and is illustrated by an example.

The installation of power-pumps is then briefly discussed, followed by some piping suggestions and a discussion of suction conditions. Any failure to provide an adequate supply of liquid to the pump will result in failure of the pump cylinders to fill properly, causing noisy operation and pounding, with impact and shock loads being imposed on all parts of the pump, with possible ultimate breakage. In order for liquid to enter the cylinder or plunger-chamber of the pump, the external pressure must be sufficiently high to overcome all the resistances existing between the supply and the plunger-chamber in the pump. A factor which is often overlooked in this connection is the head (Ha) required to accelerate the flow of liquid in the suction line (due to the fact that the velocity of the plungers is constantly changing). This is given by:

$$Ha = \frac{C}{K} \frac{\text{Length of pipe (ft)} \times \text{Velocity of fluid (f.p.s.)} \times \text{r.p.m.}}{\text{acceleration due to gravity.}}$$

The constants C and K depend respectively on the type and pump and the liquid being pumped. This formula is discussed in detail and illustrated by two examples. One reference is given. R. B. S.

1225. Horizontal Triplex Pumps. A. R. Maier. *Producer's Monthly*, June 1946, **10** (8), 38.—The use of horizontal triplex pumps in water-flooding operations, the design and installation, and the advantages and disadvantages of these pumps are described in some detail. R. B. S.

1226. Electrical Drives for Water-injection Systems As Used in the Bradford Oilfield. M. W. Folsour and W. G. Taylor. *Producer's Monthly*, June 1946, **10** (8), 44.—The considerations involved in the proper choice of motors and their control equipment for the various drives in the water-injection system are explained with reference to water wells, then to water-treating plants, pipelines, and injection pumps, and finally to lightning protection of electric power circuits and equipment. R. B. S.

1227. V-Belt Drive on Water-injection Equipment. J. R. Ghent. *Producer's Monthly*, June 1946, **10** (8), 48.—The adaptability of V-belt drives to mechanical equipment used in water-injection operations, the precautions needed in installation, and the methods of making changes are each described. R. B. S.

1228. Pressure Filters. H. Kipp. *Producer's Monthly*, June 1946, **10** (8), 26.—The use of pressure filters in water-treating programmes for water-injection schemes is reviewed. R. B. S.

1229. Pennsylvania Air-Injection Projects. B. F. Grant and R. B. Bossler. *Oil Wkly*, 15.7.46, **122** (7), 38.—In an attempt to convert pumping into flowing wells, experiments are being carried out to repressure a field by means of air. The requirements to be satisfied to ensure success of the scheme and engineering problems to be solved in the design of flow-strings and in the high-pressure equipment are discussed. The effect of flowing the producing wells is known quantitatively on so few air-injection properties that conversion of wells to flowing on other leases should, as a first step, be confined to a few wells grouped to serve both as a pilot operation and, if results are favourable, as a nucleus for expansion. The planning, installation, and operation of these experimental groups preferably should be under engineering supervision, so as to develop the maximum amount of information as to the physical and economic comparison between flowing and pumping. The study is being made by the Bureau of Mines. A. H. N.

1230. Salt-Water Disposal in East Texas Field. Part 1. W. S. Morris. *Oil Gas J.*, 10.9.46, **45** (14), 72.—The brine-injection scheme described is that for the world's largest project of its kind. Conditions in the field that brought about the formation of the East Texas Salt Water Disposal Co. as a field-wide project are recorded. Set-up of the organization is presented for the benefit of operators in other fields. Manner in which the whole field pays for the return of salt water to the Woodbine sand for the maintenance of reservoir pressure is explained fully. The technical problems and engineering solutions dealing with the sub-surface disposal of salt water are presented in the light of the experience of the Salt Water Co., together with the results accomplished to date. Many references to current literature dealing with the problem of salt-water disposal are cited. A. H. N.

1231. Engineering Factors and Operating Problems in the East Texas Field Salt-Water Disposal. Part 2. W. S. Morris. *Oil Gas J.*, 17.8.46, **45** (15), 89.—The gathering systems for the salt-water disposal are described, together with the chemical treatment using chlorine after aeration. The chlorine is generated electrolytically using low-voltage high-amperage direct current in salt water. When electric current is passed through salt water, sodium ions are liberated at the cathode and chlorine ions at the anode. The sodium ions react with water, forming sodium hydroxide, which in turn reacts with calcium to form carbonate, which deposits on the cathode. The chlorine evolved is dissolved in the water as chlorine, or reacts to make chlorites, chlorates, or chlorides. Chlorides are formed by the reaction of chlorine with the cathodic products. There are many possible complicated reactions in the electrolysis that are not considered important in salt-water treatment. The deposits on the cathode—usually calcium carbonate—necessitate the reversal of the current through the electrodes or it will deposit until it connects the two adjacent electrodes, with the result that the efficiency is materially impaired. By reversing the electrode the calcium carbonate reacts with chlorine, going back in solution as calcium chloride. The current is reversed at 4-hr intervals in salt water company's operations. Sedimentation is accelerated by use of alum. The chemistry of the ensuing reaction is briefly given. A. H. N.

1232. **Engineering Factors for Pressure Filters, Pits, Injection Wells, and Other Items Used in the East Texas Field Salt Water Disposal.** Part 3. W. S. Morris. *Oil Gas J.*, 24.8.46, **45** (16), 86.—The problem of corrosion in filters and pipe systems and how it was solved using asbestos cement and plastic coatings are discussed. The construction of the concrete pits and drilling of new wells are briefly described, followed by incidental instruments, meters, pumps, etc., used in the scheme. A. H. N.

1233. **Electric Power for the Oil Industry.** W. H. Stueve. *Oil Wkly*, 15.7.46, **122** (7), 44.—Although the paper discusses the use of electric power in all the major aspects of petroleum production and refining, it will be found interesting for the quantitative data given for the power requirements *vs* depth for drilling and pumping. A graph is given to guide the selection of proper horse-power rating of the equipment, and the information obtained for the energy required at various depths, in terms of kWh/brl of 1·0 specific gravity fluid, is helpful, and indicates that there is not a great deal of choice in the selection of equipment from a standpoint of overall efficiency, for the mean average curve denotes that practically all methods are approximately 37% efficient—that is, from electric energy input to fluid delivered in surface tanks. Central powers are not used for depths much in excess of 2500 ft. Individual beam pumps can be used for almost any depth, and the submerged centrifugal pump can be used for all depths, but since the centrifugal pump is essentially a low-head, large-volume pump, it is more efficient at the shallower depths. A study of some 852 shallow wells, about 600 ft deep, shows that it requires approximately the same amount of power/barrel of fluid as the other methods, when water-flooding is used and wells flow by injection pressure. In using the curves shown, when applied to individual beam-pumps, it is suggested that the horse-power rating of the motor selected be based on the data from the curve and then increased by a factor 1·3 to 1·4. Perhaps the most versatile pumping unit is the centrifugal submerged pump, since it can be used for practically all depths and volumes desired, provided the casing is large enough. In the early Oklahoma City oilfield days this submerged centrifugal pump was used to take potential readings on wells, wherein the pump and motor would be set on the bottom and pump at the rate of approximately 5000 brls/day through a lift of about 300 ft, with the conventional 100-h.p. motor. At the 300-ft off-bottom level a packer would be located and the entire production then brought to the surface by gas lifting. This enabled operators to obtain the greatest potential possible and consequent allowables.

Requirements of refineries and pipeline services are briefly discussed. A. H. N.

1234. **Baked-on Plastic Castings Prevent Corrosion.** E. H. Short, Jr. *Oil Gas J.*, 10.9.46, **45** (14), 88.—Oilfield tubular equipment and fittings are coated with thermosetting plastic by dipping, followed with baking, in successive layers, at 300° F and a final polymerization baking at 450° F. A survey of the plastic-coated installations in a number of fields, or a discussion with the field men concerning equipment in wells, indicates that the plastic provides excellent protection against both corrosion and the deposition of paraffin. It is too early to predict the ultimate increase in the life of plastic-coated equipment as compared with uncoated equipment. However, in many cases the plastic-coated material has been in operation for months without showing signs of corrosion, whereas the uncoated equipment previously used under the same operating conditions showed severe evidence of corrosion after only a few weeks in operation. In other cases of plastic-coated material operation, where visual inspection is not possible without dismantling of equipment, the iron content of the water in contact with the plastic-coated equipment has been decreased to practically zero. For example, a 4200-ft 4-in string of plastic-coated tubing was installed in an East Texas salt-water disposal well eight months ago. Periodic tests of the salt water show that the previously high iron content of the water has been reduced to a negligible quantity. Other operators have found that paraffin deposition is minimized with plastic coating. A typical test of this kind was recently conducted by an operator in southern Louisiana. Six joints of plastic-coated pipe were alternately spaced with regular pipe in an under-water flow-line. This test, made during the cold winter months when paraffin deposition is usually the greatest, was conducted over a period of five months. At the end of this time the test portion of the line was inspected. The plastic-coated joints were found to be completely free of paraffin. The adjacent joints of regular pipe were coated with a layer of paraffin which had decreased the inside diameter by 1 in. Other tests and advantages are described. A. H. N.

1235. Patents Connected with Production. J. O. Lewis, assr, by direct and mesne assignments, of one-half to E. C. Will and one-sixth to P. R. Haas. U.S.P. 2,403,987, 16.7.46. Well-flowing apparatus. A well-flowing system comprising well-head and bottom-hole equipment.

J. A. Zublin. U.S.P. 2,404,341, 16.7.46. Method of producing oil and retaining gas through deviating bores.—A method for improving the production of oil by gas-cap drive comprising drilling at least one bore deviating from a vertical well-bore below the level of the oil-producing strata and extending upwards into it, the rate of oil removal is so controlled that a liquid seal always exists therein between the oil-producing strata and the vertical well-bore.

J. N. Norton, assr to W. C. Norris Manufacturer Inc. U.S.P. 2,404,524, 23.7.46. Pumping mechanism.—A well-pumping apparatus consisting of an accumulating chamber and an elongated expansible sack. A conductor pipe, connected to the surface, alternately supplies and exhausts a pressure fluid from the sack, and thereby pumps liquid from the accumulating chamber through a tubing string to the surface.

W. L. Church. U.S.P. 2,404,692, 23.7.46. Packer anchor.—An expansible sleeve-like packer designed so that a slight upward movement of the tubing retracts the slips which hold it in place and allows the packer to be withdrawn from the well.

L. E. Brown. U.S.P. 2,404,825, 30.7.46. Well-tester.—A device for taking a bottom-hole sample of reservoir fluids.

L. Leiserson. U.S.P. 2,404,913, 30.7.46. Agent for reducing the surface tension of liquids.—A solution of an alkyl naphthalene sulphonate and a saturated aliphatic ketone.

W. T. Smith. U.S.P. 2,404,930, 30.7.46. Well-pump.—A well-pump of the hydraulic tubing type.

A. Leyer, assr to A. G. Brown, Boveri and Cie. U.S.P. 2,404,968, 30.7.46. Regulating device for pressure fluid-controlled prime movers.—Suitable for controlling hydraulic well-pumps.

R. A. Ward, assr by mesne assignments to R. C. Switzer and J. L. Switzer. U.S.P. 2,405,078, 30.7.46. Method and compositions for locating surface discontinuities. (See abstract no. 1209).

J. D. Nixon. U.S.P. 2,405,323, 6.8.46. System and apparatus for flowing wells.—A special form of gas lift in which the " pressure fluid " is admitted at two separate points of the tubing.

J. D. Nixon. U.S.P. 2,405,324, 6.8.46. System and apparatus for flowing wells.—A special form of stage gas-lift in which the reservoir fluid is periodically moved from the bottom of the well into an accumulation chamber until a quantity of reservoir fluid has been collected : this is then displaced and elevated to the surface in the normal way.

H. G. Houston and J. B. Humphrey. U.S.P. 2,405,697, 13.8.46. Oil-well sand-pump.—A sucker-rod pump equipped with means for injecting a desanding fluid through the travelling valve to various points in the barrel. R. B. S.

Oilfield Development.

1236. World Crude Reserves. L. J. Logan. *Oil Wkly*, 3.6.46, **122** (1), 20 (International Section).—At the beginning of 1946 world oil reserves were estimated to be 58,911,813,000 brl. Past production is 49,329,171,000 brl. U.S.A. has reserves of

20,826,813,000 brl, or 12·2 years supply in terms of the 1945 production. The world reserves are equal to about twenty years' supply in terms of the 1945 output.

The reserves of the Middle East are estimated conservatively at 18,500,000,000 brl. These reserves have been discovered by less than 150 wildcats.

The west hemisphere possesses 51·24% of the known reserves. U.S.A. capital controls 33,232,615,000 brl, foreign holdings being 13,238,875,000 brl, of which 6,152,000,000 brl is in South America. British capital controls about 20% of the world reserves, about two-thirds being in the Middle East. U.S.S.R. holds 13·7% of the reserves.

Tables give reserves by countries, together with the ownership, and 1945 and cumulative production. G. D. H.

1237. Deepest Production Established by Louisiana Well at 13,778 ft. Anon. *Oil Wkly*, 15.4.46, **121** (7), 26.—The world's deepest oil production was obtained at Weeks Island, Louisiana, on 11.4.46. Production is through perforations at 13,763–13,778 ft in the Miocene. 530 brl/day of 33-gravity oil was obtained with a gas/oil ratio of 1425. This well lies 400 ft from the previous record-holder. G. D. H.

1238. Upward Drilling Trend Maintained in April. Anon. *Oil Wkly*, 20.5.46, **121** (12), 54.—During the four weeks ended 27.4.46, U.S.A. had 2210 completions. 1199 found oil and 199 found gas. 8575 wells were completed in the first four months of 1946, compared with 7665 in the same period of 1945. Texas, Oklahoma, Louisiana, Illinois, Kansas, and Ohio showed the greatest increase over 1945.

The April completions are summarized by states and districts, and classified according as they were productive or dry. Similar data are given for the first four months of 1946. G. D. H.

1239. May Completions Lag but Year's Total Leads 1945. Anon. *Oil Wkly*, 24.6.46, **122** (4), 134.—During May 2583 wells were completed in U.S.A. 1401 obtained oil and 236 gas. The completions for the first five months of 1946 total 11,173, compared with 9990 for the same period of 1945. Texas had 3338 completions in the first five months of 1946—an 11·2% rise compared with the previous year.

The well completions are summarized by States and districts for May and for the first five months of 1946. G. D. H.

1240. Exploratory Drilling Slowed by Shortages. Anon. *Oil Wkly*, 24.6.46, **122** (4), 129.—During May 371 exploratory tests were completed in U.S.A. 1745 were completed in the first five months of 1946, compared with 1722 in the same period of 1945. 88 wildcats were successful in May, and 383 during the first five months of 1946. 28 new oilfields were found in May, and 8 new gas-fields.

Tables summarize the completion results by States and districts for May and the first five months of 1946, and the May discoveries are listed with a brief statement of salient data. G. D. H.

1241. Argentina's Y.P.F. J. E. Thomas. *Oil Wkly*, 1.4.46, **121** (5), 13 (International Section).—Oil was discovered in Argentina in 1907 in a water-well at Comodoro Rivadavia. Development was slow for a number of years. Comodoro Rivadavia has given 79% of Argentina's oil.

Plaza Huincul was discovered 30 years ago, but no substantial production was obtained before 1922. Last year it gave 5300 brl/day.

The Salta area yielded 3500 brl/day in 1942, but has declined to half that rate. The area has untested structures. Mendoza is Argentina's second most important producing area.

Argentina has produced 340,000,000 brl and has reserves of 260,000,000 brl. A number of oil refineries have been built, but no trunk pipelines. Wet gas reserves of 322,264,387 cu.m and dry gas reserves of 59,622,570 cu.m have been discovered.

Tables compare the activities of Y.P.F. and of the private companies. G. D. H.

1242. Bolivian Production. Anon. *Oil Wkly*, 13.5.46, **121** (11), 72.—Bolivia produced 32,365 brl of crude in December 1945. G. D. H.

1243. Ecuador's 1945 Production Shows 9% Decline. Anon. *Oil Gas J.*, 13.4.46, **44** (49), 73.—In 1944 Ecuador produced 2,892,188 brl of crude, and in 1945 2,622,724 brl. In 1945 exports were 2,118,323 brl. During 1945 2,475,113,000 cu.ft of natural gas was processed, yielding 41,768 brl of gasoline. G. D. H.

1244. Daily Production in Mexican Fields Gains during February. Anon. *Oil Wkly*, 20.5.46, **121** (12), 68.—During February the Poza Rica, Naranjos, and Panuco fields gave 3,030,183 brl of oil. The January production was 2,037,724 brl. G. D. H.

1245. 1945 Production of Europe's Big Four is Estimated at 210 Million Barrels. Anon. *Oil Wkly*, 17.6.46, **122** (3), 31.—It is estimated that Russia produced 175,000,000 brl in 1945, Roumania 32,480,000 brl, Austria 3,850,000 brl, and Hungary 4,550,000 brl. Apparently 5000 wells with an annual yield of 35,000,000 brl per year were destroyed by the Russians as part of the scorched-earth policy. G. D. H.

1246. Current Activity Reported in New Polish Fields. Anon. *Oil Wkly*, 1.4.46, **121** (5), 49 (International Section).—Polish oil production is currently about 890,280 brl/year. 10 new wells are being drilled near Cracow, in Pomerania, in the Poznan area, and in Kiezeckie. G. D. H.

1247. Japan. B. F. Linz. *Oil Wkly*, 6.5.46, **121** (10), 10 (International Section).—In 1924 Japan's oil reserves were estimated to be 56 million brl, with a probable maximum figure of 500 million brl. 20–25 million brl have been produced since 1924. The chief field is in the prefecture of Akita on Honshu. This yielded 1,799,310 brl in 1936. The production in Niigata prefecture in 1936 was 584,813 brl. Hokkaido (76,226 brl) and Formosa (45,440 brl) contributed towards the 1936 total of 2,546,344 brl. Each of the areas noted has a group of fields. Production is generally fairly shallow.

A map shows the location of the oil-producing areas. G. D. H.

1248. Iranian Oil Production Averages 400,000 brl Daily. Anon. *Oil Gas J.*, 13.4.46, **44** (49), 73.—During December 1945 the Iranian oil production was about 12,354,000 brl. The total 1945 production was 123,873,000 brl, compared with 92,919,701 brl in 1944. G. D. H.

1249. Government Drilling Company Differ on Australian Field. Anon. *Oil Wkly*, 3.6.46, **122** (1), 43 (International Section).—A recent Government report on the Lakes Entrace field, Victoria, states that the oil-producing formation covers 400 acres and is 16 ft thick, with an oil content of 560,000 brl, only 15% of which is recoverable. Consequently it has decided to cease work. The managing director of Austral Oil Drilling Syndicate, however, maintains that 5000 acres have been proved, and that 7,000,000 brl of oil is available. G. D. H.

Transport and Storage.

1250. Capacities of Spherical Tanks. R. T. Monson. *Oil Gas J.*, 3.8.46, **45** (13), 90.—A chart is provided to determine the volumetric content of spherical tanks with an accuracy of within 1%. Two sets of scales permit the determination of total volumes of tanks whose diameters are between 2 ft and 80 ft. Examples are given and worked out. G. A. C.

1251. Shifting Sands in Monahans Desert are Headache for Pipeliners. Anon. *Pipe Line News*, June 1946, 10.—The difficulties encountered in laying and maintaining pipeline in the Monahans Desert of West Texas are briefly discussed. When the pipe was laid it was buried 18 in below the surface, as the law prescribes, but severe dust-storms remove sand from under-portions of the line, leaving the pipe exposed and swinging with danger of breaking from lack of support. Three remedial methods for such a situation are in general use: (1) placing stanchions under the pipe—this method is especially satisfactory when the pipe may be continually buried and exposed by subsequent dust-storms; (2) using bulldozers to push the sand under and over the exposed areas—this method is not satisfactory when dust-storms are frequent; (3) cutting the line and reburying it. The latter method is used only on rare occasions when the amount of erosion is extremely large. The method of reducing hazards involved in periodic inspections of the line is also described. R. B. S.

1252. **Interstate Takes to the Air!** Anon. *Pipe Line News*, June 1946, 15.—A description is given of the planes used by the Interstate Oil Pipeline Co. for general transport, pipeline patrol work, and emergency location of leaks. During his patrol the pilot looks for and reports oil-stains and other evidence of leaks, washouts, excavations close to the pipelines, deposits of debris along the right-of-way, exposure of line crossing creeks and rivers, fires of any nature adjacent to the line, and any other irregularities. The course of the lines can be easily distinguished from the air. Although they have been buried for many years and ground conditions are undisturbed, there is a certain discoloration visible from above which cannot be detected from the ground, which makes it a comparatively easy matter to follow the course of the line. Oil discoloring the terrain as the result of a break, and other abnormal conditions, stand out like the proverbial sore thumb. R. B. S.

1253. **Panhandle Eastern Pipeline Co's Two Way Radio Telephone.** F. J. McElhatton. *Pipe Line News*, June 1946, 17.—The radio telephone system operated by the Panhandle Eastern Pipeline Co is described. With this system it is possible to perform the following emergency functions: (1) in the event of failure of transmission facilities superintendents, foremen, and repair crews can be promptly notified and dispatched to the point of failure; (2) operating personnel who cannot be reached by regular means of communication can be speedily warned of sudden changes in weather or flood conditions which might cause danger to property or endanger the employee's welfare; (3) production of gas from the wells can be controlled either for reduction or increase in quantity during periods of rapidly changing operating conditions, when sufficient time is not available to dispatch special crews from the central operating point, or to handle through the routine of regular operations; (4) compressor station operation can be controlled when regular means of communication are out of service. R. B. S.

1254. **Cost Behaviour in Transportation of Natural Gases.** J. E. Flanders. *Pipe Line News*, July 1946, 11.—*Paper presented at Federal Power Commission Natural Gas hearing.* A method is proposed for determining the capital and operating costs of gas-transmission lines of various sizes and lengths. The method is illustrated by evaluating these costs for two hypothetical systems, and the results, which are shown tabularly and graphically, are discussed. The following general conclusions can be drawn:—

(i) For any given length and size of transmission line, delivery cost per Mcf increases as the load factor at which the line is operated decreases;

(ii) Delivery cost per Mcf increases approximately in proportion to the length of the transmission line for any given size line;

(iii) For any given length of transmission line with given load factor, the larger the line the less the delivery cost of natural gas. R. B. S.

1255. **Patents Connected With Transport and Storage.** W. F. Aller, assr to The Sheffield Corporn. U.S.P. 2,403,897, 16.7.46. Leakage gauging device.—A gauging device for measuring fluid leakage.

A. L. Ellis, assr to Vickers Inc. U.S.P. 2,403,913, 16.7.46. Power transmission.—A control device comprising means for varying pump displacement and regulating same in response to pump-discharge pressure variations.

H. O. Parsons. U.S.P. 2,404,087, 16.7.46. Gauging and sampling device.—A gauge suitable for determining the level of liquid in a container under pressure greater than atmospheric.

W. C. Buttner and S. L. Sundstrom, assr to The Bastian Blessing Co. U.S.P. 2,405,998, 20.8.46. Liquified petroleum gas equipment.—A means for storing liquified natural gas. R. B. S.

Refinery Operations.

Refineries and Auxiliary Refinery Plant.

1256. Waste Heat Recovery in Refinery Process Equipment. Part 12. G. Armistead, Jr. *Oil Gas J.*, 10.8.46, **45** (14), 100.—In this part of the series methods in common use for the recovery of waste heat in various types of modern processing systems are quantitatively discussed.

Recovery systems are classified as those in which heat recovered is returned directly to the system, and those wherein heat being rejected from one process system is utilized to fill the requirements of some other system. Factors conducive to high recovery rates per unit of equipment include those which favour high-temperature differential and those which permit realization of the high overall heat-transfer coefficients of the fluids involved.

Available quantities of heat and temperature differences should be balanced throughout the system.

A flow-sheet shows the heat recovery on a multi-stage crude-distillation unit, heating of crude and the required flashing temperature being conventionally accomplished.

A combustion crude and cracking unit operating at a relatively low crack per pass over-all has large amounts of waste heat to dissipate—enough to effect distillation of crude up to a considerable portion of the gas-oil range by heat exchange. Heat withdrawal is mainly effected on high-temperature vessels through a reflux condensate intermediate of the fractionators.

Difficulties are likely to arise due to fouling of the exchanger by tar from the evaporator surface on the vapour side. In transfer exchangers on thermal cracking systems the effluent from the cracking or polymerization coil is exchanged with feed to the same system, the exchangers operating at pressures up to 2000 lb. Deposition and building up of coke must be avoided by control of phase relations in the transfer-line exchange system.

In the Houdry catalytic cracking process operation is at a conversion per pass far higher than thermal cracking units and usually at lower temperature, independent of crude running facilities. The heat-recovery system is similar to that of independent thermal cracking units. The heat-absorbing medium in the catalyst cases is a molten nitrate–nitrite salt mixture at 800 to 900° F, which furnishes endothermic heat of reaction to the cases then on process, the remaining heat dissipation being effected by steam generation and superheating.

In the Fluid catalytic cracking process the two principal heat-recovery means are catalyst heat exchanger on the regenerator and absorption of heat by the feed introduced into the catalyst from the entrance to the reactor.

The Thermofor catalytic cracking heat-recovery system removes heat from the combustion of carbon in the burning zone through boiler-water exchange in a tube system. Steam is generated at 5–7 lb/hour per pound of carbon burnt. G. A. C.

1257. Continental Oil Co. Streamlines Wichita Falls Refinery. R. B. Tuttle. *Oil Gas J.*, 17.8.46, **45** (15), 84.—The streamlining of the Company's combination unit on overhaul is described.

The unit processes 6,000 brl/day of North Texas crude averaging about 40·7° A.P.I. gravity and containing 150 lb of salt per 1000 brl, a Petreco 3-unit installation achieving the desalting. A new electrically driven desalter pump has been installed, and a new 895 sq.ft heat exchanger unit added.

The bubble-tower was constructed from the shell of the existing one, 32 new Glitch truss-type stainless-steel trays being fitted. A bank of previously used tubular cooler-condensers is used to cool the product from the reflux receiver. 300 brl of diesel oil per day is obtained. Steam-stripped naptha enters the reforming unit at 1000 brl/day, and 550 brl of kerosine per day is produced.

No alterations were made to the vis breaking furnace or coils, but new floor tubes were fitted in the naphtha reforming furnace and coil. An evaporator operating at 75–80 p.s.i. and at about 800° F have been added, the fuel oil from the bottom being used as a quench material. G. A. C.

Distillation.

1258. **Pipe-Still Duty.** W. L. Nelson. *Oil Gas J.*, 17.8.46, **45** (15), 117.—No. 106 in the *Refiner's Notebook* series concerns the computation of the thermal capacity of a pipe-still, referred to as its "duty," which is the heat required to raise the temperature of the material to the tower vaporizer temperature, plus the heats of vaporization and reaction of the products vaporized. An example is given and worked out based on data from previous notes in the series. G. A. C.

1259. **Pipe-Still Combustion Charts.** W. L. Nelson. *Oil Gas J.*, 24.8.46, **45** (16), 127.—No. 107 in the *Refiner's Notebook* series deals with the computation of heat balances for pipe-stills and boiler installations. Two charts are provided showing three fuels, but these may be used for normal fuels ranging from 8° to 25° A.P.I., and for any of the gas compositions common in refineries.

Two examples are given and worked out. G. A. C.

1260. **Pipe-Still Arrangements.** W. L. Nelson. *Oil Gas J.*, 24.8.46, **45** (16), 128.—No. 104 of the *Refiner's Notebook* series lists 10 types of pipe-still arrangements, including convection, radiant circular, down, centre, and overhead convection, single and double up-fired, A-frame, circular, and straight up varieties. Diagrams of each are given, with notes. G. A. C.

Absorption and Adsorption.

1261. **South Coles Levee Unit Pressure Maintenance and Cycling Project.** L. P. Foote. *Oil Gas J.*, 3.8.46, **45** (13), 70.—An oil-absorption cycling plant is described. The South Coles Levee oilfield, in San Joaquin Valley, California has 67 completed wells, divided equally between black oil and condensate production. Study of the conditions resulted in the installation of a cycling programme for the gas-cap to prevent loss of liquid recovery, due to pressure decline in the reservoir, concurrently with a pressure maintenance scheme in the black oil area.

The plant is of the oil-absorption type with a capacity of 60,000,000 cu.ft/day of wet gas, and recovers 7000 brl/day of liquified products, 4650 brl of 50° A.P.I. condensate; and 17,000 brl of other products. Gas is transported from the fields in 3-in and 4-in pipes, at pressures of about 1800 p.s.i. at 110 to 140° F, reduced to 1500 p.s.i. and passed through cooling coils to emerge at 90° F, and thence to a high-pressure separator, liquid continuing to a fractionation system. The gas is fed to a high-pressure absorber and contacted with sufficient oil. A high-pressure residue scrubber takes the gas before it goes to the second-stage repressure compressors, after which it is cooled to 160° F and returned to the sand through five injection wells. The compressors can deliver 54,500,000 cu.ft/day of absorber gas at 4000 p.s.i. to the injection system.

Gas from black oil production arrives at the plant at three different pressures, 450, 60 p.s.i., and 6-in vacuum. The 450 p.s.i. gas is passed through separators, absorbers, coolers, and residue scrubbers, finally mixing with the 60 p.s.i. black oil gas which has passed through a low pressure gas compressor.

The rich adsorption oil is stripped after heating to 500° F passed through heat exchangers, and eventually the lean oil is pumped back to the absorbers. The overhead product is raw natural gasoline. Total absorption oil circulation rate is 500 gal/min, make-up oil being 80 gal/day.

Two cooling towers are provided, heat loads being 38,000,000 B.Th.U. and 70,000,000 B.Th.U/hr. Nine 600-h.p. two-cycle gas-driven compressors are installed, the suction and discharge piping being free from expansion loops, special type clamps are used. A patent pulsation dampener is fitted to all cylinders discharging at 1500 and 4000 p.s.i.

The well effluent is metered, and a gas stream is diverted through a test separation unit, and from data obtained a gas–oil ratio and per cent water cut determined, and from analyses the effluent composition is found. G. A. C.

Cracking.

1262. Improved Design of Houdry Reactor Results in Higher Gasoline Output. R. C. Lassiat and C. H. Thayer. *Oil Gas J.*, 3.8.46, **45** (13), 84.—Improvement in the Houdry catalytic-cracking process due to changes in design of reactor tubes and of the physical composition of the catalytic mass is described.

Although the conventional design has proved satisfactory over several years, analysis of heat transfer in the reactor and study of difficulties in maintenance and changing of catalyst have led to the new design.

The changes were made in the 12-case cracking plant at the Toledo, Ohio, refinery of the Sun Oil Co. Previously catalyst changes in a six-case plant required 20 days from offstream to onstream for the first change, and 6 to 7 weeks for the second change during, which all the tubes are removed. With the new design tube catalyst changes require only 7 to 10 days from stream to stream. The interlocking features of the fins have been eliminated and replaced by heavily welded fins, which facilitate removal of catalyst and the metal temperatures are reduced. Increased production of gasoline has resulted.

The heat capacity of the catalyst has been increased by mixing the pellets with a granular inert material of high heat capacity. Coke-burning capacity is increased, and maximum burning temperatures are reduced by the new design of reactor tubes. Figures are given for typical temperature pattern and heat liberated and absorbed in the conventional design. G. A. C.

1263. Modern Refining Processes. Part 13. The Hydroforming Process. G. Armistead. *Oil Gas J.*, 31.8.46, **45** (17), 85.—First commercially used in 1940, the hydroforming process became of importance during the war for the production of toluene and high-octane aviation base-blending stocks. At the present time 8 hydroforming plants exist, which are employed for improving the octane values and reducing the sulphur content of naphthas for motor gasoline production. The usefulness of the process is that the reactions induced by the coprecipitated catalyst, Al_2O_3 and 10% MoO_2, are: (1) basically those of dehydrogenation with some cyclization of straight-chain hydrocarbons, dehydrogenation of naphthenes and other molecular rearrangements, which result in large octane increase, accompanied by conversion of olefins into paraffins or ring compounds favourable to lead susceptibility; (2) the controllable production of certain selected aromatics such as toluene from a selected feed stock; (3) the decomposition of sulphur compounds present in the feed with resultant improvement in product quality.

In producing toluene from selected stocks the dehydrogenation reaction predominates, and there is no other reaction to balance the absorption of heat, such as the hydrogenation of olefins; consequently the tendency for temperature drop through the reactor is greatest, and the higher catalyst inlet temperatures are thus required for toluene operation. On the other hand, high-octane improvement operations on straight-run naphthas generally do not employ the highest inlet temperatures, although average reaction temperatures may be higher than those in the toluene operation.

A flow diagram is given and the operation is described, the naphtha feed is passed through a column for rerunning and oxygen elimination, then through a vaporizing coil to raise temperature from 950 to 1050° F and to the reactor, in which it meets a stream of recycle gas containing 60 to 80 mol % hydrogen, heated to 1050–1070° F and passes through the catalyst bed at a space velocity of from 0·5 to 1·0 at about 150 to 300 p.s.i. The product stream from reactor passes through an accumulator drum in which the hydrogen and recycle gases are separated, and the hydroformate and gas production then pass to a conventional gas-recovery system to produce a depropanized hydroformate. The recycle gas and hydrogen are passed through an absorber for hydrogen concentration before actual return to recycle gas heater. The catalyst in the reactor may be divided into a plurality of beds operated in series with reheating furnace coils between them or so arranged to effect parallel operation in 3-ft beds. The reactor is kept on stream from 4 to 8 hours; the stream is then turned to another reactor, and the former is then regenerated, after purging, with flue gases plus 1–2% oxygen inlet at 700° F with outlet at 1000 to 1100° F and 250 p.s.i. The yield–octane relationships and related features, including Reid vapour pressure, are discussed and compared with normal polyforming and thermal reforming operations; hydroforming giving far superior octane improvements and yields. Coke formation ranges from 0·7% to 1·77% and the butanes produced from 3% to 7% according to severity of operation. The total C_4 hydroformates from 100% C_4 recovery, usually have a Reid vapour pressure of less than 10 p.s.i., and can be pressured with 3% to 9% butane to 10 p.s.i. to give a hydroformed gasoline of 400° F E.P. with nearly 100% yield on the feed, with no loss. It has an A.S.T.M. octane value of 68·5—*i.e.*, with an increment of 34·5. On this basis, hydroformed gasolines are producible with octane values up to 80, or by C.F.R.R. about 85, and having good lead susceptibility, 3 cc of T.E.L. raises the value to 89 A.S.T.M. or 93 C.F.R-R. The bromine number ranging from 1 to 5. Desulphurization is discussed, 90% of the sulphur present is said to be eliminated, the MoO_2 forming a sulphide which is burned off in the regeneration. The actual measure of reaction severity is the average catalyst temperature rather than the composite vapour inlet temperature. W. H. C.

Special Processes.

1264. Action of Ethylene Oxide on Benzenoid Hydrocarbons. J. Colonge and P. Rochas. *Comptes Rend.*, 1946, **223**, 403.—Ethylene oxide reacts with aromatic hydrocarbons at 0° C in the presence of catalysts—*e.g.*, aluminium chloride, ferric chloride, boron trifluoride—to form arylethanols, and at higher temperatures with a second molecule of hydrocarbon to form symmetrical diarylethanes. The best yields of arylethanols—*ca.* 50%—are obtained by using ethylene oxide, aromatic hydrocarbon, and aluminium chloride in the molar proportions 1 : 10–11 : 0·9 and by working at 0–5° C. A part of the ethylene oxide (35–45%) is recovered as chlorethanol, and the reaction is believed to proceed by reaction of catalyst with ethylene oxide, liberating hydrogen chloride and forming a complex which then reacts with the aromatic hydrocarbon. The hydrogen chloride reacts with excess ethylene oxide to form chlorethanol, which does not participate further in the reaction.

With alkylbenzenes—*e.g.*, toluene, ethylbenzene, xylenes—the isomeric arylethanols formed are in accordance with theory.

The reaction is inhibited by the presence of halogen or nitro-groups in the benzene ring. G. H. B.

Safety Precautions.

1265. Chemical Health Hazards in Modern Petroleum Refining. R. G. Benson and P. M. Van Arsdell. *Oil Gas J.*, 17.8.46, **45** (15), 95.—A summary of the known physiological reactions to hydrocarbons in general is given, together with available facts regarding the reactions of other compounds in frequent plant use.

The first of eight tables summarizes possible effects of the paraffin and olefin series on the human body. Light hydrocarbons of the aliphatic series and members of the aromatic group are likely to be present in one gasoline, with all their varied physiological effects.

Table II lists the effects of the diolefines and members of the alicyclic groups. Frequent blood-tests and urine analyses should be made of operators on plants producing aromatic compounds.

Lower members of the aromatic series are dealt with in Table III, whilst Table IV shows petroleum fractions and the hydrocarbons contained therein. It is noted that the skin irritant action increases as the number of carbon atoms increases from C_5 to C_{12}, whilst aromatic hydrocarbons add toxic and cumulative effects to the gasolines.

Table V gives the toxicity of various concentrations of hydrogen sulphide, and the possible effects of catalysts are shown in Table VI.

The dangers of the treating processes, such as Thylox, Unisol, Duo-Sol, and Phenolate, are summarized in Table VII, whilst additives such as tetraethyl lead and ethyl nitrite are the subject of Table VIII. G. A. C.

Products.

Chemistry and Physics.

1266. **Heats of Formation and Combustion of the Normal Alkyl*cyclo*pentanes and *cyclo*-Hexanes and the Increment per CH_2 Group for Several Homologous Series of Hydrocarbons.** E. J. Prosen, W. H. Johnson, and F. D. Rossini. *Bur. Stand. J. Res. Wash.*, 1946, **37**, 51.—Values are given for the heats of formation and combustion at 25° C for *cyclo*pentane and 16 alkyl*cyclo*pentanes together with *cyclo*hexane and 16 alkyl*cyclo*hexanes, in the liquid state through normal butyl and in the gaseous state through normal hexadecyl, with equations to yield values for all the higher members of both series in the gaseous state.

The increment per CH_2 group is compared for the lower members of several normal alkyl homologous series, including paraffins, mono olefins (1-alkene) alkylbenzenes, alkyl*cyclo*pentanes, alkyl*cyclo*hexanes, and alkyl acetylenes (1-alkyne).

A comprehensive bibliography is included. T. M. B. M.

1267. **Heats, Equilibrium Constants, and Free Energies of Formation of the Mono-Olefin Hydrocarbons.** J. E. Kilpatrick, E. J. Prosen, K. S. Pitzer, and F. D. Rossini. *Bur. Stand. J. Res. Wash.*, 1946, **36**, 559.—For ethylene, propylene, each of the 4 butenes, 6 pentenes, and 17 hexenes, and for the higher normal 1-alkenes, values are presented for the following thermodynamic properties to 1000° or 1500° K: The heat of formation from the elements, $\Delta Hf°$; the free energy of formation from the elements, $\Delta Ff°$; and the logarithm of the equilibrium constant of formation from the elements, $\log_{10} Kf$. For each of the 6 pentenes and 17 hexenes values are also given to 1000° or 1500° K, for the following properties: the heat-content function $(H° - H_0°)/T$; the free energy function $(F° - H_0°)/T$; the entropy, $S°$, the heat content, $H° - H_0°$; and the heat capacity, $C_p°$.

Equilibrium constants and concentrations are given in tabular and graphical form for the isomerization of the 4 butenes, 6 pentenes, and 17 hexenes, as a function of the temperature to 1000° or 1500° K. Equilibrium constants are also given in tabular and graphical form for some reactions of hydrogenation, dimerization, and alkylation. 16 references to the literature are appended. T. M. B. M.

1268. **Heats of Formation, Hydrogenation, and Combustion of the Mono-Olefin Hydrocarbons through the Hexenes, and of the Higher 1-Alkenes, in the Gaseous State at 25° C.** E. J. Prosen and F. D. Rossini. *Bur. Stand. J. Res. Wash.*, 1946, 36, 269.—For ethylene, propylene, the four butenes, the 6 pentenes, and the 17 hexenes, and all the higher 1-alkene hydrocarbons, in the gaseous state at 25° C, values are given for the heats of formation (from the elements solid carbon (graphite) and gaseous hydrogen), the heats of hydrogenation in the gaseous state, and the heats of combustion (in oxygen to form gaseous carbon dioxide and liquid water). The values for 2 of the pentenes, 14 of the 17 hexenes, and all the higher 1-alkene hydrocarbons were calculated by a method involving correlation of the heat of hydrogenation with structure and the use of constants evaluated from the available experimental data on 4 butenes, 4 pentenes, 3 hexenes, and 1 heptene. 23 references to the literature are appended. T. M. B. M.

1269. **On the Course of the Reaction at 100° C in the Systems Xylene/Oxygen and Aromatic-Free Mineral Oil/Xylene/Oxygen.** D. J. W. Kreulen. *J. Inst. Petrol.*, 1946, 32, 525–528.—The oxidation of xylene and of mixtures of aromatic-free mineral oil and xylene has been investigated. The formation of both peroxides and aldehydes is linear with respect to time, whole acid formation appears to increase with the square of the time. A gradual change in oxidation behaviour with increasing percentage of one of the components is observed in mixtures of xylene and aromatic-free oil. In this case less aldehydes are formed than might be expected, which is explained by some retardation effect. If copper is present, the peroxides are destroyed during the oxidation and a corresponding increase in aldehydes is found. In the case of the oxidation of pure xylene an insoluble cuprous salt of toluic acid settles from the reacting liquid. A. H. N.

1270. On the Course of the Reaction at 100° C in the System Aromatic-Free Mineral Oil/Oxygen. D. J. W. Kreulen. *J. Inst. Petrol.*, 1946, **32**, 515–524.—The course of the reaction at 100° C in the system aromatic-free mineral oil/oxygen has been investigated. A new apparatus for the oxidation under standard conditions of mineral oils is described. This makes it possible to introduce oxygen into the oil at such a rate that real reaction velocities are measured. The data obtained were analysed with the aid of the Kreulen–Ter Horst method. The underlying principles of this method are reviewed; it enables one to decide whether a substance is formed directly or via one or more intermediate stages. It appears that peroxides represent the first, carbonyl-containing compounds the second, and acids the third reaction stage. As the second reaction stage appears to occur to a greater extent than the first reaction stage it is very probable that the peroxides exert a catalytic action (chain mechanism) during the oxidation. During the oxidation of the oil the saponification number increases. It was found that this "saponification number" does not relate to esters or lactones, but only to peroxides. A linear relationship between dipole moment and oxidation time was found and explained. A mode of procedure is described which enables the accuracy with which the dielectric constant can be measured to be improved. It is based on the linear relationship which was found to exist between density and dielectric constant. A. H. N.

1271. Motions of Molecules in Condensed Systems. II. The Infra-Red Spectra for Benzene Solid, Liquid, and Vapour in the Range from 3 to 16·7 μ. R. S. Halford and O. A. Schaeffer. *J. Chem. Phys.*, 1946, **14**, 141.—Infra-red spectra are compared throughout the interval from 600 to 3300 wave-numbers for the same amount of benzene existing separately as solid at 3°, liquid at 8°, and vapour at 20° C. The comparison demonstrates convincingly that: (1) predictable selection rules for the solid are obeyed strictly; (2) there are no selection rules operating in the liquid phase; (3) the shift of molecular frequencies induced by successive stages of condensation is small and can be ignored in the approximation that regards the vibrations of an isolated molecule as harmonic ones; (4) the intensification of components of the spectrum accompanying changes of state proceeds as predicted qualitatively in an earlier paper; (5) all proposed complete assignments of the fundamental frequencies of benzene require revision. The components appearing in the several spectra are classified in accordance with a scheme suggested by the selection rules for the vapour and solid. J. T.

1272. Absorption Spectrum of Fluorbenzene in the Near Ultraviolet. S. H. Wollman. *J. Chem. Phys.*, 1946, **14**, 123.—The absorption spectrum of C_6H_5F at 2750–2380 A was photographed in the first order of a three-metre grating spectrograph. As in C_6H_5Cl, the band system corresponds to an electronic transition A_1, B_1. This is an allowed transition, and O, O band is stronger than in C_6H_5Cl because of the greater perturbation by the fluorine. Several progressions of totally symmetric vibrations are observed. The vibration whose excitation brings the corresponding benzene spectrum into appearance, and which shows up relatively intensely in C_6H_5Cl, appears in C_6H_5F, but is not particularly prominent. In contrast to C_6H_5Cl, transitions to the carbon–halogen vibration in the upper electronic state are quite strong. J. T.

1273. The Addition of *cyclo*Hexene to Some Polycyclic Aromatic Hydrocarbons. M. M. Buu-Hoï and P. Gagniant. *Comptes Rend.*, 1945, **220**, 326–328.—Selenium dehydrogenation of a di*cyclo*hexylnaphthalene (I) m. pt. 150–151° C, previously prepared by Pokrowskaja and Stepanzewa, gave a diphenylnaphthalene, m. pt. 235° C, which was not identical with the known 1 : 2 and 2 : 7 isomers, and which was considered to be the 2 : 6 isomer. The parent compound (I) was therefore identified as 2 : 6-di*cyclo*hexylnaphthalene, this structure being consistent with the known rules of substitution in the naphthalene series. By analogy a di-*tert.*-butyl naphthalene, m. pt. 132° C described by Zuckerwanik and Terentjewa was also assigned the 2 : 6 structure.

The main product of the *cyclo*hexylation of acenaphthene was a solid, m. pt. 84°; picrate, m. pt. 98° C, believed to be 5-*cyclo*hexylacenaphthene, and a mixture of liquid di*cyclo*hexylacenaphthenes, b. pt. 270–275° C/10 mm.

The main product from phenanthrene was a di*cyclo*hexyl derivative (II), m. pt.

210° C, picrate m. pt. 210° C decomp. Oxidation with chromic acid eliminated one *cyclo*hexyl group (from position 9 or 10) and converted the other into phenyl, the product being formulated as 3-phenyl-9 : 10-phenanthraquinone. Selenium dehydrogenation of (II) gave a diphenylphenanthrene (III) of high m. pt. (304° C), indicating a symmetrical structure. From these observations and by analogy with previous work on di-*tert.*-butylphenanthrene, (II) and (III) were assigned 3 : 9-di*cyclo*hexyl and 3 : 9-diphenyl structures respectively. It was concluded that in some cases the addition of *cyclo*hexene to polycyclic hydrocarbons follows the rule of least symmetry previously proposed for di-*tert.*-butylation. G. H. B.

1274. Aromatic *cyclo*Dehydration. C. K. Bradsher. *Chem. Revs.*, 1946, **38**, 447–499.—*cyclo*Dehydration reactions which yield a new fully aromatic ring through the acid-catalysed attack of a ketonic or aldehyde carbonyl group on an aromatic nucleus are defined as aromatic *cyclo*dehydrations. The known examples are classified as bicyclic and tricyclic, depending on the nature of the final product. They are further divided into naphthalene, benzofuran, thianaphthene, indole, quinoline, and isoquinoline bicyclic systems, and phenanthrene, anthracene, and acridine tricyclic systems. The general mechanism of aromatic *cyclo*dehydration reactions is discussed, the phenanthrene and anthracene systems being considered separately in greater detail. The effect of substituents on the ease of cyclization in the various systems is summarized in 12 tables of experimental results, and 154 literature references are cited. G. H. B.

1275. Surfaces of Solids XV. First-Order Phase Changes of Adsorbed Films on the Surfaces of Solids : The Film of *n*-Heptane on Ferric Oxide. G. Jura, E. H. Loeser, P. R. Basford, and W. D. Harkins. *J. Chem. Phys.*, 1946, **14**, 117.—Two-dimensional first-order changes, in which a gaseous film of normal heptane is transformed into another phase of lower molecular area with evolution of heat, have been discovered on subphases of ferric oxide, silver, and graphite. All the critical phenomena observed in three-dimensional systems are found to be duplicated. For *n*-heptane on ferric oxide the critical constants are : σ_c (area) 900 A^2 per molecule ; π (film pressure) 0·45 dyne cm^{-1} ; and Tc, 29° C. The critical constants are found to depend on the nature of the solid as well as on that of the vapour. The heat of transformation at 25° C is estimated to be 12,000 $\pm$ 5000 cal. mole^{-1}. This value appears to be considerably higher than the 6150 cal. mole^{-1} required for the formation of three-dimensional liquid *n*-heptane from its vapour at the same temperature. The volume–pressure relations are considered for the adsorption isotherm in the case in which a second- or third-order phase change occurs. J. T.

1276. Studies in Vapour–Liquid Equilibria. Part 1. T. T. Puck and H. Wise. *J. Phys. Chem.*, 1946, **50**, 329–339.—A new dynamic method—the condensation method—for the measurement of saturated vapour densities of liquids is presented. It may be conveniently applied to liquids with vapour pressures at least as great as 23 mm Hg and at least as small as 0·001 mm Hg. Vapour-pressure determinations at 25° C are presented for six liquids : water, 1-propanol, 1-butanol, nitrobenzene, 1 : 2-propanediol, and triethylene glycol. These values are compared with the corresponding vapour-pressure measurements obtained by other methods. In general, excellent agreement is obtained. A. H. N.

1277. Heat-Capacity Lag in Gas Dynamics. A. Kantrowitz. *J. Chem. Phys.*, 1946, **14**, 150.—The existence of energy dissipations in gas dynamics, which must be attributed to a lag in the vibrational heat capacity of the gas, has been established both theoretically and experimentally. The flow about a very small impact tube is discussed. It is shown that total-head defects due to heat-capacity lag during and after the compression of the gas at the nose of an impact tube are to be anticipated. Experiments quantitatively verifying these anticipations in carbon dioxide are discussed. A general theory of the dissipations in a more general flow problem is developed and applied to some special cases. It is pointed out that energy dissipations due to this effect are to be anticipated in turbines. Dissipations of this kind might also introduce errors in cases in which the flow of one gas is used in an attempt to simulate the flow of another gas. Unfortunately, the relaxation times of most of the gases of engineering importance have not been studied. A new method of measuring the relaxation time of gases is introduced in which the total-head defects observed with a specially shaped impact tube are compared with theoretical considerations. A parameter is thus evaluated in which the only unknown quantity is the relaxation time of the gas. This method has been applied to carbon dioxide, and has given consistent results for two impact tubes at a variety of gas velocities. J. T.

1278. Application of the Methods of Molecular Distribution to Solutions of Large Molecules. B. H. Zimm. *J. Chem. Phys.*, 1946, **14**, 164.—The equations for the thermodynamic potentials of the solvent in solutions of ordinary organic molecules are extended to solutions of large molecules by methods using continuous molecular distribution functions. Particular attention is given to the coefficient, A_2, of the second term in the expansion of the osmotic pressure in terms of the concentration, since this coefficient has a simple molecular meaning and is sufficient to describe the deviation of the system from ideality at low concentrations. A_2 is calculated by direct integration for two rigid shapes, the sphere and the long thin rod. A general expression is then developed for A_2 for flexible chain molecules in terms of the interactions of the segments of the chains. In favourable cases it is found possible to relate A_2 for a chain molecule to the solution properties of its small molecule homologues by an equation very similar to those developed by Flory, Huggins, and Miller. In general, however, interactions that depend both on the local structure and also on the overall shape of the chain molecules seriously modify such a relationship. The nature of these interactions, including the effects of branching and of limited flexibility, is discussed. It is also shown that higher coefficients in the expansion of the osmotic pressure in terms of concentration can be treated in a similar way. Comparison with experimental data confirms the general predictions of the theory both for proteins and chain polymers. J. T.

1279. The Statistical Mechanical Theory of Transport Processes. I. General Theory. J. G. Kirkwood. *J. Chem. Phys.*, 1946, **14**, 180.—Outlines are sketched for a general statistical mechanical theory of transport processes—*e.g.*, diffusion, heat transfer, fluid flow, and response to time-dependent external force fields. In the case of gases the theory leads to the Maxwell–Boltzmann integro-differential equation of transport. In the case of liquids and solutions it leads to a generalized theory of Brownian motion, in which the friction constant is explicitly related to the intermolecular forces acting in the system. Specific applications are postponed for treatment in later articles. J. T.

1280. A Note on the Theory of Diffusion Controlled Reactions with Application to the Quenching of Fluorescence. E. W. Montroll. *J. Chem. Phys.*, 1946, **14**, 202.—The principles of Smoluchowski's collision theory of reactions in solution are outlined. This theory is applicable to reactions which occur immediately on the collision of two reactant particles—that is, diffusion controlled reactions. The rate of such reactions depends on the collision frequency of reactants. In this paper an expression for the collision frequency is derived as a function of time when initially there is a Boltzmann distribution of particles around any particular reactant molecule. Both the Brownian motion of and the forces between reactant molecules are considered in the calculation. The general results are applied to the theory of quenching of fluorescence. It is shown that the quenching constant, k_Q, defined by

$$\left(\frac{I_0}{I} - 1\right) \Big/ n_Q = k_Q$$

(where I_0 is the intensity of fluorescence in the absence of quencher and I the intensity in the presence of quencher of concentration n_Q) can be expressed as a sum of two terms, one proportional to the reciprocal of the viscosity of the solvent and the other to the reciprocal of the square root of the viscosity. J. T.

1281. Viscosity and the Hydrogen Bond. Hydroxyl and *ortho* Effects. J. N. Friend and W. D. Hargreaves. *Phil. Mag.*, 1945, **36**, 731.—Two important factors are found to influence the relative viscosities of the isomerides—namely, intramolecular structure and intermolecular association. It appears that the more symmetrical the molecule the lower are its viscosity and density, and in the case of intermolecular association, whether as the result of hydrogen bonding, dipole attraction or Van der Waals' forces, the viscosity is increased. Since the liquids containing " free " hydroxyl are often highly associated, the viscosity is greatly increased when introducing hydroxyl into the molecule. The *ortho* effect due to hydrogen bonds differs from that due to symmetry in that the viscosity, density, latent heat, and rheochor of the *ortho* derivative are reduced, and may even be less than those of its *meta* and *para* isomerides.

The rheochor is defined as $M(10^3\eta)^{\frac{1}{8}}/(D + 2d)$, where M is the molar weight, D and d the density of the liquid and vapour, η being the viscosity. When the rheochor is plotted against the temperature it is found that the curve falls off as the temperature rises from the melting point, reaching a constant value, and this is independent of whether the substance is associated or monomeric. This is attributed to the breaking down of ordered liquid structure or molecular orientation, such as normally occurs prior to solidification. When the rheochor is constant it may be taken that both the symmetry and degree of association are constant. If, however, the observed rheochor is equal to the sum of the constituent rheochors the substance is essentially monomeric. The rheochor thus offers useful indications of the presence or absence of association.

J. T.

1282. On the Application and Derivation of the New Viscosity–Temperature Relationship of Liquids. M. S. Telang. *J. Phys. Chem.*, 1946, **50**, 373–386.—In a previous paper the formula

$$\frac{1}{\eta} = \frac{m}{(1 - T_r)^{3/10}} - k$$

was derived, where η and T_r are the viscosity and the van der Waals reduced temperature respectively, and m and k are constants. This equation is now changed to

$$\frac{1}{\eta} = \frac{A}{(T_c - T)^{3/10}} - k$$

where T_c and T are the absolute critical and observation temperatures respectively. The viscosity of several liquids as it is represented or not by the latter formula and the probable interpretation of the deviation of the actual behaviour of liquids from that predicted by the formula are discussed. The literature on the mechanism of liquid viscosity and derivation of different formulæ is summarized. A. H. N.

1283. Fuel Combustion Characteristics. *Refiner's Notebook*, No. 105. W. L. Nelson. *Oil Gas J.*, 10.8.46, **45** (14), 115.—The calorific values, ratios of air to fuel required for combustion at 0% excess air and the per cent carbon dioxide after combustion, the ultimate analysis, and A.P.I. gravity are given for 20 liquid fuels derived from different cracked and straight-run crude oils, petroleum coke, and 2 bituminous coals. Similar data are shown for 13 gaseous fuels, including both wet and dry, cracked gases, and 3 natural gases, for which the density is given in place of A.P.I. gravity.

W. H. C.

Analysis and Testing.

1284. Precision Semimicromethod for Gas Analysis. L. K. Nash. *Industr. Engng Chem. Anal.*, 1946, **18**, 505–508.—An apparatus is described which is capable of complete analysis of small samples of carbon dioxide, carbon monoxide, methane, hydrogen, nitrogen, and/or oxygen. The operations of analysis are simple and reliable, and the danger of loss of a valuable sample is reduced to a minimum. With a sample of volume approximating 1 c.c. at N.T.P. an accuracy of a few tenths of a per cent of the total gas sample may be anticipated; but an accuracy of about 1% is maintained with samples as small as 0·1 cc N.T.P. The conditions for a satisfactory fractional combustion on a platinum catalyst of hydrogen and carbon monoxide in the presence of methane and excess oxygen are defined. A. H. N.

1285. Assembly, Testing, and Operation of Laboratory Distilling Columns of High Efficiency. C. B. Willingham and F. D. Rossini. *Bur. Stand. J. Res. Wash.*, 1946, **37** (1), 15.—An account is given of the assembly, testing, and operation of the laboratory distillation columns used at the National Bureau of Standards in the work of the A.P.I. Research Project 6 on analysis and purification of hydrocarbons and in the work on the preparation of standard samples of hydrocarbons.

These distillation columns have charging capacities of from ½ to 15 litres, with separating efficiencies in the range 100 to 200 equivalent theoretical plates at total reflux. Distillations are performed continuously 24 hr/day, 7 days/week, with reflux ratios of from 125/1 to 180/1 and rates of removal of product ranging from 2–12·5 ml/hr. Total distillation time given ranges up to 1800 hr.

A description is given of assembly of columns, including pot, rectifying system, jacket, head, reflux regulator, receiving assembly, electrical heating system; thermometric systems, and controlled pressure system; testing of columns, including test mixtures and results; and operation of columns, for both regular and azeotropic distillations.

Drawings of the equipment and apparatus are given, including the arrangement of the 15 distillation columns, measuring instruments, and auxiliary equipment in the distillation room. A photograph of the distillation room is given. T. M. B. M.

1286. Molecular Weight and Mercaptan Content of Mixtures of Primary Mercaptans. H. A. Laitinen, A. S. O'Brien, and J. S. Nelson. *Industr. Engng Chem. Anal.*, 1946, **18**, 471–472.—The mercaptan sulphur content of a mixture of primary mercaptans is determined by titration with silver nitrate, and the weight of silver mercaptide formed during the titration is determined. From these data the average molecular weight of the mercaptans and the percentage of mercaptans is calculated. The percentage of non-mercaptan material is found by difference. A table of experimental results against corresponding calculated values from other evidence shows that the method yields the correct molecular weight to an accuracy of 1 to 2 units of molecular weight (0·5% to 1%). The method is reproducible to $\pm$ 1 unit of molecular weight. A. H. N.

1287. Movement of a Thin Plate in Non-Newtonian Liquids. E. W. J. Mardles. *Nature*, 1946, **158**, 199.—The rate of fall of a steel ball through non-Newtonian liquids such as grease decreases to zero at some depth below the surface dependent on the weight of the ball. This effect is attributed to the rigidity of the system at greater depths, at which more energy is required. A thin plate should be free from this volume-displacement difficulty. When such a plate—a double-edge razor blade—was drawn edgewise through grease with constant force its velocity was constant; and by using different forces the yield value of the grease could be determined.

The viscous drag on such a plate, even by liquids like water, can be demonstrated by suspending it from a balance beam by a quartz thread in the liquid, which is then run out from the bottom of the containing vessel. H. C. E.

1288. Viscosity by Various Instruments—Low Range. *The Refiner's Notebook*, No. 108. W. L. Nelson. *Oil Gas J.*, 31.8.46, **45** (17), 103.—A tabular comparison is given for kinematic viscosities from 1·5 to 40 cs, with Saybolt Universal viscosities at 100, 130, and 210° F, and Engler degrees and Redwood Standard No. 1 viscosities for the range 4·0 to 40 cs; and the approximate viscosity values for the range 1·5 to 3·5 cs. The comparison with Saybolt Furol and Redwood Admiralty No. 2 are given as approximate values for the ranges 21 to 40 and 30 to 40 cs respectively.
W. H. C.

1289. A Viscometer with Constant Working Volume, Suitable for Measurements over a Wide Range of Viscosities. W. D. Hargreaves. *Phil. Mag.*, 1945, **36**, 756. J. T.

1290. Measurement of Viscosity. Anon. *Nature*, 1946, **158**, 244–5.—The errors associated with various types of viscometer are pointed out, and discrepancies in the results of different observers attributed to differences in surface tension of the standard calibration liquids. The viscosity of non-Newtonian liquids might be measured by studying the wave motion of a vibrating liquid system. X-ray photography confirms the fact that balls falling through non-Newtonian liquids may eventually remain suspended (see Mardles, *Nature*, 1946, **158**, 199.—Abstr. No. 1287). H. C. E.

1291. Application of Variance Analysis to Some Problems of Petroleum Technology. H. M. Davies. *J. Inst. Petrol.*, 1946, **32**, 465–491.—The importance of measuring variation in experimental data is emphasized and some methods of handling variable material and coping with variable conditions are described, in particular the statistical technique developed by R. A. Fisher and known as the analysis of variance. The fluctuation of octane ratings is typical of the variation met with in experimental work. After an indication of the underlying statistical ideas the arithmetical procedures involved in variance analysis are briefly outlined, using 20 rich mixture ratings by the British 3-C method as an example. These are first treated as 2 groups of 10 results (grouped data), and then as 10 pairs (paired data), to show how the appropriate form of analysis depends on the way in which the results have been obtained.

Efficient experimental designs based on statistical methods have been developed. The randomized block arrangement illustrated by means of kerosine-burning test results secures the separation of major causes of heterogeneity so that their effects do not interfere with the comparisons the experiment is designed to make. The Latin square carried this a stage farther, giving control of error in two directions simultaneously. This is illustrated by a test of the m.p.g. performance of 7 motor fuels, and the example is also used to introduce the idea of covariance. It is shown how the results themselves can be made to supply whatever correction is appropriate for the effect of a concomitant variate. Stress is laid on the unity of experiments, their plan, operation, analysis, and final interpretation. A. H. N.

Engine Fuels.

1292. British Aviation Fuel Manufacture in the Middle East—Part II. Anon. *Industr. Chem.*, 1946, **22**, 518–524.—An account is given of the various new (1939/42) manufacturing processes conducted at Abadan and the modification of redundant plant and spares to construct the units, made necessary by war conditions. F. S. A.

1293. Processes for Octane Improvement. D. Read. *Petrol. Times*, 20.7.46, **50** (1278), 757.—The various processes for improving the octane rating of gasolines are reviewed. Among the most important of these are : (1) desulphurization of gasoline ; (2) conversion of gasoline hydrocarbons by reforming ; (3) conversion of hydrocarbons heavier than gasoline by cracking.

Polymerization or alkylation of the gases produced by cracking or reforming may be classified as complementary processes, which also increase the octane rating of the total gasoline blend.

The paper describes several processes which may be used to increase octane rating by the above methods, and discusses the application of each process. Some attempt is made to compare the processes which are discussed, but the type of crude to be refined and the yield and quality of products other than gasoline which are to be produced will affect the application of each process for octane improvement.

R. B. S.

Gas Oil and Fuel Oil.

1294. Combustion of Catalytically Cracked Distillates, and New Burner Design Widening Markets for these New Fuels. S. R. Cauley and H. R. Linden. *Oil Gas J.*, 10.8.46, **45** (14), 80.—Difficulties are encountered when burning catalytically cracked fuels in pot-type burners where the carbon and soot formation is brought about by cracking through unsatisfactory combustion conditions. The cracking characteristics and oxidation reactions of paraffins and aromatics are discussed, and it is shown that paraffins are primarily decomposed by cracking to products of smaller molecular weights than the original material cracked, whilst aromatics (benzene and naphthalene) under moderate cracking give products of higher boiling-points ; under severe cracking both higher and lower boiling-point products are formed. Complete oxidation of paraffins even at moderate temperatures is relatively easy without the formation of carbon. The oxidation of aromatics without the formation of carbon is shown to be possible by only one procedure—a progressive oxidation (of benzene), which is discussed. It is difficult without the aid of a catalyst, as the temperatures required were nearly the same as those at which decomposition of benzene takes place.

The carbon deposits on the bottom and sides of a pot-type burner are discussed from the aspects of the preceding information, and indicated the need for accomplishing the following in a burner modification : (1) vaporization of fuel with as little cracking as possible ; (2) intimate mixing of primary air and oil vapours as soon as possible following vaporization ; (3) reduction of temperature in the lower sections of the pot so as to attempt a progressive type of oxidation of the aromatics with a minimum soot formation. A pot-type burner of 50,000 B.Th.U per hour rating was modified with a view to accomplish these factors, and is described with the reasons for the changes to the several components—viz., the central oil inlet, the radiation shield, the central baffle, and the secondary air ducts (see Abstract No 978). The performance of the original and modified burners when burning the heaviest catalytically cracked fuel are given and shown in graphs. Comparisons of draughts required ; carbon accumulations ; plots of air distribution study and operating draft curves found necessary for good burner performance ; covering fuel rates of 1 to 3·5 lb/hr., stack drafts of 0·02 to 0·08 in water, percentage CO_2 in flue gases, stack temperatures, per cent efficiency, and smoke per cent (I.C.H.M.). The I.C.H.M. (Institute of Cooking and Heating Appliance Manufacturers) smoke-rating method is described. The conclusions drawn from the studies are : (1) a burner modification of a pot-type burner has been effected which has been shown to operate satisfactorily with a highly cracked distillate fuel over a major portion of the oil-burning rates normally employed in such equipment and found to give full rated capacity of the burner ; (2) the method of modification indicates some reorientation of ideas and experimentation on the part of pot-type burner manufacturers ; they may be able to modify their equipment so as to handle less expensive grades of fuel oil than those currently required.

W. H. C.

1295. Diesel and Boiler Fuel. Anon. *Motor Ship*, Oct. 1946, **27** (321), 265.—A review is given of the present prices and probable trend, together with the factors influencing cost. An interesting comparison is made between boiler fuel, diesel oil, and coal on August 1 and September 1 at various ports. The Petroleum Press Service is quoted in disabusing any fears of a shortage of oil fuel. I. G. B.

Bitumen, Asphalt, and Tar.

1296. Commercial Evaluation of French Asphalts. M. Louis. Paper presented to L'Association Français des Techniciens du Petrole. Undated. Pp. 22.—The six regions of France in which asphalt occurs in amounts sufficient for exploitation were described, with maps and geological sections showing the location of test borings, asphalt indications, mining operations, and the geological structures of the regions.

The composition of asphalts was briefly discussed with respect to elementary composition and the principal constituents, based on Marcusson's classification, using both previous and new data on French asphalts. Comparative figures for a Trinidad asphalt were quoted to show the generally higher oil contents of the French asphalts.

Crude liquid products were obtained in 55% to 65% yield, based on asphalt by the pyrolysis of 2 asphalts, 3 asphaltic limestones, and an asphaltic sand at an optimum temperature of 370° C. The products were fractionated at atmospheric pressure to remove crude gasoline and kerosine components and the residue boiling above 300° C redistilled under high vacuum to give, after chemical refining, luboils with viscosity indices of *ca.* − 20, in yields of 15% to 30% based on the crude pyrolysis products.

Two asphaltic limestones and 2 sands were pyrolysed at 360° C with injection of superheated steam to give crude oils in 70% to 75% yield based on their asphalt contents. The products were fractionated and the heaviest fractions redistilled under high vacuum and chemically refined to give lubricating oils with viscosity indices ranging from − 45 to + 47, the products of highest V.I. being obtained from Gard asphaltic limestone. Lubricating oil yields were 40% to 60% based on the crude steam-assisted pyrolysis products.

It was concluded that a complete range of industrial lubricants could be produced in significant amounts from selected French asphalts, but with chalk as the principal product from asphaltic limestones. The importance of such an industry to France and the French colonies was suggested. G. H. B.

Derived Chemical Products.

1297. Phthalic Anhydride from o-Xylene. Anon. *Chem. Industries*, July 1946, **59** (1), 68.—A flow diagram of the plant used and a brief outline of the process for the manufacture of phthalic anhydride from *o*-xylene are given. *o*-Xylene derived from petroleum is fed by gear-pumps at approximately atmospheric pressure to a steam-heated vaporizer, after which it is injected into a heated air stream; the ratio of air to hydrocarbon which is dictated by the explosive limit of the mixture is kept on the lean side to avoid excessive temperature rise. The mixture then passed to a tubular converter containing a fixed bed of a vanadium-base catalyst. The reaction is controlled by cooling with a stream of molten salt which maintains it at about 1000° F, the contact time being less than 1 second. Heat is removed from the molten salt stream by passage through a waste-heat boiler for steam generation. The product issuing from the converter is passed through a vapour cooler and then to box-like condensers with cone bottoms, down which the crystals of crude phthalic anhydride fall into an underground melting-tank, containing steam coils. The product from the melting-tank is pumped to the first of two distillation columns, the centre cut from the first being passed to the second. The bottoms and overhead stream from the first are recycled to the converter feed. The overhead from the second column passes to an aluminium tank and, still molten, is sent to the chiller in which it solidifies on a water-cooled stainless steel drum. The finished phthalic anhydride is scraped off by a knife arrangement. The yield is greater than 70%. W. H. C.

Miscellaneous Products.

1298. Butul May Entirely Replace Natural Rubber for Tubes. Anon. *Oil Gas J.*, 3.8.46, **45** (13), 94.—Production of butyl rubber in 1945 was 55,000 tons, and this synthetic, chemically unlike any other type rubber, is highly resistant to the effects of sunlight, weather, air, oxygen, ozone, water, acids, alkalies, animal, and vegetable oils. Its other properties ensure long life. It is used for inner tubes, high-pressure steam hose, conveyor belts for hot materials, and pump linings. A flow chart shows the basic steps in manufacture of butyl rubber from isobutylene and normal butylene. G. A. C.

1299. Effect of Short Contact with D.D.T. Residues on *Anopheles Gambiæ*. L. Kartinan and M. M. Da Silveira. *J. Econ. Entom.*, June 1946, **39** (3), 356.—Experiments are described on *Anopheles gambiæ* carried out in a U.S. Army base laboratory, Dakar, French West Africa, during the period July to September 1944.

A mosquito aspirator of glass, coated on the inside surface with a density of 125 mgm D.D.T. per sq.ft, was used, a similar untreated tube being used as control.

Female *Anopheles gambiæ* were obtained from a stock colony fed on humans. Observations were taken on 60, 30, and 5 second contacts with the D.D.T. residues. Typical D.D.T.-toxicity was exhibited in less than 10 min after contact, the majority showing symptoms at between 10 and 30 min after contact. All mosquitoes were affected after 80 to 90 min contact. The females after contact with D.D.T. gave an average of over 95% mortality 8 hours after contact. 100% mortality was given by the 60-second group 9 hours after contact and by the 30-second group at between 10 and 24 hours after contact. The 5-second group showed 97% mortality at between 10 and 24 hours after contact. An extremely short contact with D.D.T. residues will kill most females, and the data also indicate that an extremely short contact with D.D.T. residues will inhibit them from taking a blood meal at between 1 and 2 hours after contact. G. A. C.

1300. D.D.T. to Control Insects Affecting Man. E. F. Knipling. *J. Econ. Entom.*, June 1946, **39** (3), 360.—The use of D.D.T. for controlling insects including mosquitoes, lice, fleas, and bedbugs, which affect man, is discussed.

D.D.T. can be applied as a dust, or as solution, emulsion, or suspension. Solutions of D.D.T. in petroleum oils, including lubricating oil, fuel oil, kerosine, and lighter fractions, are widely used, as also have been other types of solvents such as xylenes. Aqueous solutions have also found employment. Emulsions use xylene and other solvents.

Against mosquito larvæ and adults D.D.T. is effective at a dosage of 0·1 lb/acre, using various types of spray equipment. Airplane sprays have been effectively used for controlling both mosquito larvæ and adults.

A 10% D.D.T. powder will control all three types of lice attacking man. Control of body-lice can be obtained by using clothing impregnated with D.D.T., even after the fabrics have been washed several times. Against flies D.D.T. in sprays and aerosols is highly efficient.

Fleas on the person and in infested quarters can be effectively eliminated; and sprays applied to beds will destroy an entire infestation of bed-bugs and prevent re-infestation for many months. G. A. C.

1301. D.D.T. for Insect Control at Army Installations in the Fourth Service Command. S. C. Dews and A. W. Morrill. *J. Econ. Entom.*, June 1946, 39 (3), 347.—A review of the problems of insect control in U.S. Army posts, camps, and stations is given.

Insecticides in general use in the period 1940–43 for control of insects and rodents infesting Army installations were a general-purpose spray containing pyrethrum and a sodium fluoride–pyrethrum roach powder. Flies and mosquitoes were dealt with by diesel oil and used motor oils.

By 1942 bedbug control became a serious problem, and in 1943 fumigation with HCN was authorized. 26 schools were established for training of pest-control operatives, and instruction in the use of D.D.T. followed. Costs of operations were reduced; for example, for the fumigation of company mess halls the costs were reduced from $30 to $9·20. In 1944 D.D.T. was used in practical control work in the camps, mosquitoes, flies, bedbugs, roaches, ants, flies, termites, lice, and ticks being successfully controlled. D.D.T. was applied as sprays, emulsions, and dusts, hand-operated apparatus giving the best results. Latrines, garbage racks, interiors of mess-halls, and dairy-barns were very effectively treated with 5% D.D.T. in emulsion, kerosine solution, and with 10% dust.

Termites attacking wooden posts were controlled with 5% D.D.T. in kerosine, by dipping the 4 in by 4 in uprights in the insecticide and by spraying the soil in the hole as it was refilled. Comparative tests with chlorinated toluenes, pentachlorophenol, creosote–diesel oil mixtures, and 10% sodium arsenate solution in water showed D.D.T. to be the best, whilst failures occurred with the latter two substances. G. A. C.

1302. D.D.T. to Control Insect Pests Affecting Livestock. Bruce and Blakeslee. *J. Econ. Entom.*, June 1946, 39 (3), 367.—Observations are made on the effectiveness of D.D.T. insecticides against several species of insects affecting livestock in the south-eastern United States during the period 1944–45.

Preliminary tests were made on 3000 head of livestock and in 14 dairy-barns, large-scale operations were conducted on 26,000 head of livestock and in 120 dairy-barns. Spraying the backs of cattle and passing the animals through a wading vat containing 2% D.D.T. emulsion successfully controlled a serious outbreak of stable flies, *Stomoxys calcitrans* (L), in central Florida. Hornflies, *Siphona irritans* (L), were controlled by two applications of 2·5% D.D.T. emulsion used as a spray, whilst one application to the interior of dairy buildings controlled houseflies, *Musca domestica* (L).

For the large-scale tests on 26,000 head of livestock water-dispersible D.D.T. powder was used at 0·23%, 0·5%, 1%, and 2·3% suspensions. The best results were obtained with 2·3% D.D.T. suspension, complete control of hornflies being obtained for 4 to 7 weeks, of the houseflies for more than 3 months when sprayed on barns, and it was effective for 3 weeks against this pest in hog-pens.

It was also completely effective against fresh-water mosquitoes and was effective against cockroaches in barns and against cattle lice. Screw-worm flies and Gulf Coast ticks were also reduced.

The use of D.D.T. on the animals did not result in any apparent injury. G. A. C.

Engines and Automotive Equipment.

1303. High Speed 18000 B.H.P. Fiat Engine. Anon. *Motor Ship*, Oct. 1946, 27 (321), 266.—A description is given of a new type of Fiat double-acting engine developing 18000 b.h.p. at 310 r.p.m. The published details are:

No. of cylinders	8
Cylinder diameter	25·59 in
Piston stroke	33·86 in
Mean effective pressure approx. . . .	85 lb/sq.in
Piston speed approx.	1800 ft/min
Weight of engine	200 tons
Weight per b.h.p.	25 lb

I. G. B.

1304. A Small Diesel for Light Aircraft. Anon. *Aeroplane*, 1946, **71**, 298.—A small air-cooled oil engine has been designed for use in light aeroplanes in the U.S. This is the 100 h.p. 4-cyl Thaheld-Shaffer power unit, flown recently a distance of 105 air miles in 55 minutes with a consumption of 2½ gal of light diesel fuel. It has freedom from induction icing troubles and may be opened up immediately for take-off in the same way as a gas turbine. By efficient air cooling the head temperature is 350° C at take-off and 300° C at cruising conditions. The compression ratio is 16 : 1 at sea-level and 11 : 1 at cruising altitudes, giving a 40% higher ceiling than the equivalent gasoline engine. The weight is given as 235 lb and a 6-cyl version is projected.

I. G. B.

1305. Jet Propulsion and its Application to High-Speed Aircraft. D. J. Keirn and D. R. Shoults. *J. Aero. Sci.*, 1946, **13**, 411.—The article explains the principles of the apparatus involved in jet propulsion for aircraft. The early development of the Whittle design is traced, together with developments in the U.S. The typical measures of efficiency of jet propulsion are developed and detailed calculations given of the thrust and pressure cycle, including ram intake, compressor performance, combustion equations, and turbine and nozzle thermodynamic equations. Typical thermal jet-propulsion cycles are illustrated by diagrams, including specific engine performance in all its complicated forms. I. G. B.

1306. Bristol Theseus 1. Anon. *Aeroplane*, 1946, **71**, 307.—The Theseus has an axial plus centrifugal compressor driven by the first two turbine stages. The third-stage turbine drives the airscrew through an epicyclic reduction gear. Heat from the exhaust gases is transferred to the air leaving the compressors by a heat exchanger situated inside the triangulated engine mounting. The residual gases form additional jet thrust. The engine has recently completed a 100-hour endurance test, and is now being prepared for flight testing in an Avro Lincoln.

The heat exchanger weighs about 500 lb, and it is claimed that after several hours flying it can save this weight in fuel. The main power is transmitted from the third-stage turbine to a conventional 4-bladed tractor propeller. The ratio of power used is 80% to the propeller and 20% as jet thrust at 300 m.p.h. The compressors give a compression ratio of 5 : 1 at 300 m.p.h. and 20,000 ft altitude. At sea-level static conditions the compressor runs at 8200 r.p.m. and delivers 30 lb/sec of air for a power consumption of about 3500 h.p. The gas temperature at turbine inlet does not exceed 800° C.

Leading particulars are :

Length 112 in
Diameter 48 in
Weight (net dry) 2310 lb
Performance : Output at S.L. 1950 s.h.p./hr + 500.lb S.T.
Fuel consumption at S.L., 300 m.p.h., 0·57 lb/s.h.p./hr max. cruise or 0·5 lb/s.h.p./hr at 20,000 ft at 300 m.p.h.
Oil consumption 3 pints/hr. I. G. B.

1307. Mamba Gas Turbine. Anon. *Aeroplane*, 1946, **71**, 293.—Preliminary details are given of the Armstrong-Siddeley Mamba gas turbine. The engine has been produced to give a sea-level take-off performance of 1000 s.h.p. plus 320 lb static thrust. This is approximately equivalent to a take-off power of 1120 h.p. in a reciprocating engine. The diameter over cowling is 27 in and weight 750 lb or a frontal area of some 30% of the equivalent piston engine and a weight saving of 25%. The installed weight of the Mamba is expected to be about 50% that of a corresponding piston-engine installation.

The compressor is the axial type, and flow is straight through, the combustion chambers being six in number. I. G. B.

1308. Marine Gas Turbines. Anon. *Motor Ship*, Oct. 1946, 27 (321), 243.—Reviews projected gas turbine sets for ships.

1. An authoritative statement by the chairman of John Brown and Co. indicates the design of gas turbines in the near future;
2. A 3000-b.h.p. turbine is being installed in a converted Liberty ship in America, and two more vessels are under construction for the U.S. Navy in which gas turbines will be fitted;
3. A British tanker is being built to be equipped with four diesel generating sets supplying current to a single propeller, and one of these units will be replaced by a 1200-h.p. gas turbine when the necessary tests have been carried out. This is being built by the B.T-H. Co.;
4. Metro-Vickers are building a gas turbine to replace one gasoline engine in a motor-torpedo boat;
5. C. A. Parsons have built a 500-b.h.p. plant;
6. Brown Boveri have completed tests on a 15,000-h.p. gas turbine driving a 10,000-kW generator;
7. Sulzers will have a 7000-h.p. marine unit available for trials next year;
8. Escher-Wyss have run an experimental plant for some years;
9. In Sweden a 2500-h.p. gas turbine will be completed within a year.

Hitherto thermal efficiencies above 25% have not been exceeded. Sulzers hope to exceed 30%. Competition between diesel and gas turbines depends on the exclusive use of boiler oil with gas turbines, and this is claimed to be a feasible proposition by all the manufacturers concerned. The claim has yet to be substantiated over a long period, and a relatively low ash content may have to be specified with the oil utilized. I. G. B.

1309. Comparison of Propeller and Reaction-Propelled Airplane Performances. B. Hamlin and F. Spenceley. *J. Aero. Sci.*, 1946, 13, 425.—For this paper four power-plants having distinctly different performance characteristics were chosen:—1. A V-type reciprocating liquid-cooled engine incorporating water injection for emergency power; 2. A turbo-jet engine having about 23% less sea-level static thrust than the former; 3. A hypothetical subsonic ram-jet; 4. A bi-propellant liquid fuel rocket motor.

Since the characteristics of the four power plants were so different, it was necessary to relate their performance to specific airplane designs, and these hypothetical designs were specified. The conclusions reached are:

"1. Propeller Airplane. (*a*) A practical maximum speed limitation not much in excess of 500 m.p.h. is apparent. Maximum speeds obtain in the 20,000 to 30,000-ft range; (*b*) Because of superior range, the propeller type of propulsion cannot be supplanted at the present time. Maximum range is relatively insensitive to altitude up to engine critical altitude; (*c*) Greater pay loads possible in addition to range make commercial application and long-range bombers most attractive; (*d*) Cruising and climbing speeds are slow; (*e*) Operation above 40,000 ft appears impractical except possibly in the case of power plants incorporating the gas turbine; (*f*) Maximum rate of climb occurs at sea level; (*g*) Further improvements, adaptations, and variations will be widely developed in terms of compound and gas-turbine engines and various combinations of them.

"2. Turbojet Airplane. (*a*) High maximum speeds where relatively short range is required make this airplane mandatory for military application. Maximum speed occurs at sea level; (*b*) again, for short-range premium operation in commercial fields this power plant is attractive. Range improves markedly with altitude, and economical cruising speeds are relatively high; (*c*) relatively high operating altitudes—at least up to 50,000 ft—are feasible. At high altitudes respectable range is obtained; (*d*) maximum speed of the order of 550 to 600 m.p.h. and above at sea level is ideally suited for air-to-ground military operation; (*e*) maximum rate of climb occurs at sea level; (*f*) speeds for maximum rate of climb are reasonably high.

"3. Ram-Jet Airplane. (a) Maximum speed, of the order of 650 m.p.h., occurs at sea level; (b) climbing speeds are exceptionally high, being within 5 to 10% of maximum level-flight speeds; (c) range is extremely limited, representing some 50% of that for the turbojet, and also increases considerably with altitude; (d) maximum rate-of-climb at sea level is exceptionally high, but falls off rapidly with increase in altitude, resulting in a rather low ceiling—below 40,000 ft; (e) auxiliary take-off means are required; (f) performance characteristics indicate that the ideal application would be in the field of low-altitude, flat-trajectory missiles against such targets as battleships and aircraft carriers in particular. Air launching would probably be more practical than surface launching.

"4. Rocket Airplane. (a) This is the only man-carrying airplane capable of flight at supersonic speeds, which distinguishes this type of propulsion from the others considered; (b) range is extremely limited, and increases slightly with altitude; (c) as in the case of maximum speed, so also does rate-of-climb increase phenomenally with altitude; (d) ceiling, speed, and climb performance are limited only by the amount of fuel it is possible to carry; (e) performance characteristics indicate ideal application to missiles following a trajectory. Peak altitudes greatly exceeding the capability of any other man-made mechanisms are possible. Missile ranges can be vastly extended; (f) highly specialized applications in terms of research airplanes and interceptors are evident. A research airplane could be used to conduct tests in level flight for application to high-speed and diving problems encountered on other types of airplanes. Target-seeking interceptor missiles powered by rocket motors should be most effective.

I. G. B.

1310. Turbines at the S.B.A.C. Show. Anon. *Flight*, 1946, **50**, 275.—Details of the performances of the following engines are given: Armstrong Siddeley Python, X., and Mamba; Bristol Theseus I; Metrovick F2/4; D. H. Goblin I, Series II; Rolls Royce Derwent V, and Nene I; De Havilland Ghost I, Series II. I. G. B.

1311. Piston Engines Displayed at S.B.A.C. Show. Anon. *Flight*, 1946, **50**, 275.—Details of the following engines are given: Alvis Leonides; Blackburn Major III; Blackburn Minor II; Bristol Centaurus 57; Bristol Hercules 630; De Havilland Queen 70; De Havilland Major 50; De Havilland Major 10; Monaco; Napier; Rolls Royce Merlin 620; Rolls Royce Griffon 67. I. G. B.

1312. Aero Engines on Show at Radlett. Anon. *Aeroplane*, 1946, **71**, 370.—Type, dimensions, weight, and performance of the following engines are listed: Alvis Leonides; Armstrong Siddeley Python; Armstrong Siddeley A.S.X.; Armstrong Siddeley Mamba; Armstrong Siddeley Cheetah X; Bristol Theseus; Bristol Hercules 630; Bristol Centaurus 57; Bristol Pegasus 38; Cirrus (Blackburn) Minor Series II; Cirrus (Blackburn) Major II; Cirrus (Blackburn) Major III; De Havilland Goblin II; De Havilland Ghost II; De Havilland Gipsy Major 10; De Havilland Gipsy Queen 51 and 70; Metro-Vickers F2/4; Monaco; Napier Sabre VII; Rolls Royce Derwent V; Rolls Royce Nene; Rolls Royce Civil Merlin 620; Rolls Royce Griffon 67. I. G. B.

1313. British Aircraft at Radlett. Anon. *Aeroplane*, 1946, **71**, 368.—Technical details are given of the civil and military aircraft on show. Information is given under the following headings: Manufacturer; aircraft; type; accommodation (crew and passengers): span O.A.; length O.A.; height O.A. at rest; gross wing area; all-up weight; standard fuel capacity; max. W.M. cruising speed; representative range and payload; engines; sea-level take-off b.h.p. per engine; max. r.p.m.; airscrew reduction gear; airscrews; diameter; no. of blades. I. G. B.

1314. Precision Sheet-Metal Work. Anon. *Aircraft Production*, Oct. 1946, 8 (96), 45.—The first article on the manufacture by Joseph Lucas, Ltd., of sheet-metal assemblies for gas turbines appeared in the September issue of *Aircraft Production*, and reviewed the production of the combustion-chamber flame-tubes. This second and final article is concerned with the turbine nozzle-ring assemblies and the exhaust units. Some of the operations on the machined parts of the assemblies are also briefly described. I. G. B.

Miscellaneous.

1315. Shell Planning to Build New Refinery in British North Borneo. Anon. *Oil Gas J.*, 10.8.46, **45** (14), 61.—A brief outline is given of the Royal Dutch Shell Co's reconstruction of their properties in the Far East since their liberation from the Japanese occupation. The companies concerned, location, state of fields and refineries when recovered, and the progress made since in production and refinery operations, together with new wells to be drilled and new refineries planned, are shown and discussed, covering Sarawak, Borneo (Brunei, Tarakan, Malikpapan, Miri), and New Guinea (Vogelkop fields). What is known of the condition of properties and refineries in Sumatra is noted. Technicians are gathered at Batavia, Java, awaiting the political settlement of Sumatra's difficulties, to take up the work of reconstruction at Palembang, Pladjoe, Soengaigerong, and the oilfields in the Djambi district. W. H. C.

1316. Oil in France. Anon. *Petroleum*, 1946, **9**, 133.—A review of the present position in the French oil industry. K. C. G. K.

1317. Petroleum Statistics of Argentina. Anon. *Bull. S. Amer. Inst. Pet.*, 1946, **2**, 285–304.—Annual production of crude oil in the Republic for the last 38 years is given, together with details of refinery operations and movements of refined products. A. C.

1318. Full-Scale Petroleum Refining in the United Kingdom. Anon. *Times Trade and Engineering*, 1946, **59** (991), 8.—A reply to the arguments put forward by Lord Bearsted in his recent annual statement to "Shell" stockholders. The arguments against U.K. refining are quoted and individually critically examined. It is considered that the cheaper rates for crude transport, as against those applicable to refined products, compensate for refining losses and fuel consumption. Specialized refining, as advocated by Lord B., would deprive the U.K. of valuable refinery by-products. U.S.A. practice favours large refineries at the consuming centre; such a policy is rendered feasible by the flexibility of modern refining operations. V. B.

1319. U.K. Petroleum Imports in June and the Half Year. Anon. *Petrol. Times*, 3.8.46, **50** (1279), 805.—Statistical data on imports and exports (including oil fuel bunkering of shipping) of crude oil and refined products for June and the first half of 1946 are presented, together with comparative figures for 1945 and 1938. R. B. S.

1320. U.K. Petroleum Consumption and Customs Yields. Anon. *Petrol. Times*, 3.8.46, **50** (1279), 820.—Statistical data on hydrocarbon oils retained for home consumption and the customs duty yield are presented for the calendar years 1940 to 1944 inclusive. R. B. S.

1321. Light on Decline in U.K. Oil Export Trade in Wartime. Anon. *Petrol. Times*, 17.8.46, **50** (1280), 868.—Statistical data on exports of refined products are presented for the calendar years 1938 to 1944 inclusive. R. B. S.

1322. How Smoke Screens were Rapidly Developed in Britain. S. R. Dight. *Petrol. Times*, 17.8.46, **50** (1280), 876.—The wartime use of petroleum for smoke screens is discussed. R. B. S.

REVIEWS AND BOOKS RECEIVED.

Metodui Ispuitaniya Nefteproduktov. (Methods for the Testing of Petroleum Products). 1946: Moscow-Leningrad. Pp. 415. 26 rubles.

This publication is the Russian equivalent of our own "Standard Methods" and of the A.S.T.M. "Methods of Testing." It is issued by the Petroleum Division of the Council of Peoples Commissars of the U.S.S.R. It is of interest to note, as some indication of the scope of the oil industry in the U.S.S.R., that the edition amounts to 7000 copies. The present issue has been compiled by A. A. Al'tman and E. V. Starikova. The methods quoted are those laid down as General Union Standards (O.S.T. or G.O.S.T.) by either the All-Union Standards Committee (V.K.S.) or the People's Commissariat for Heavy Industry (N.K.T.P.).

The volume is divided into four sections, dealing with general testing methods (66 methods), methods for the examination of solid and anti-corrosive lubricants (greases) (25 methods), methods for the testing of petroleum by-products (25 methods) and finally a section on sampling. All the test methods are laid out according to a standard plan, comprising a brief introductory paragraph, an indication of the scope of the method, an outline of the procedure, a list of the reagents and equipment required, and finally instructions for carrying out the test and reporting the result. As is usual, each method is identified by a combination of letters indicating the body under whose authority it is issued, a number, and the date on which it was approved. Limits of accuracy and repeatability are given in most cases. The tests in the main follow the usual pattern—in some cases they are an exact duplicate of tests standardized in Great Britain and in the U.S.A., as for instance the methods for octane value (C.F.R. Motor Method) Vapour Pressure (Reid), closed flash-point (Pensky-Marten) and others. The determination of octane value is the only engine test in the book. In the case of the measurement of absolute values, such as specific gravity, there is of course but little scope for variation; in the U.S.S.R. when the specific gravity of petroleum products is determined it is converted to density (d_4^{20}) which is the standard. It is unfortunate that this should be sufficiently removed from the British standard of S.G. $\frac{60° \text{ F}}{60° \text{ F}}$ to require conversion even for the interpretation of test results, not to speak, of course, of the calculation of oil quantities, whilst yet being sufficiently close to give a misleading impression at a first glance. Now that, at long last, the stoke and poise are giving an international significance to viscosities hitherto hidden behind the empirical nomenclature of Redwood, Saybolt, and Engler, is it too much to hope for that agreement will be reached on a common temperature for density (or specific gravity) measurements, even if the irrational A.P.I. scale further confuses the issue ?

Two minor points of interest may be mentioned in connection with the specific gravity methods given in the publication under discussion, the first that a definite viscosity limit of 25° Engler at 50° C (approx 170 cs) is quoted as the limiting value for the determination of specific gravity by a hydrometer, and the other that for oils thicker than this it is permitted to determine the gravity by hydrometer after dilution (1 : 1) with a light kerosine.

Apart from the conventional Engler method, which is stated to be limited to works control and other non-scientific purposes, two methods are given for viscosity determinations, utilizing Ubbelohde U-tubes for the measurement of dynamic viscosity and a modified form of Fenske tube for kinematic viscosity. In the former case provision is made for carrying out the determination under pressure, provided by a small head of water or mercury. A test procedure is laid down for the determination of viscosities at low temperatures (below 0° C). In view of the discussions that have taken place on the choice of a suitable liquid for viscometer calibration, it is of interest to note that the Russian methods allow of a wide choice of chemically pure liquids such as water, formamide, ethylene glycol, aniline, etc., for the calibration of the Ubbelohde viscometer : in the case of the Fenske instrument, however, water is used as the primary standard.

The Russian method for pour point (" setting point ") appears to be comparable to that used in Great Britain, being defined as the temperature at which the oil shows no movement during one minute on being examined in a test-tube inclined at an angle of 45°, although the determination of the exact figure appears to be a laborious process, as the oil is heated and re-cooled after every inclination of the tube, which is carried out at specified temperature intervals.

Corrosive sulphur in lubricating oils is determined by the usual type of copper test, the particular choice of time and temperature in this case being 12 hours and 85° C respectively. An oxidation test for transformer oil is laid down, the governing conditions being a duration of 14 hours at a temperature of 140° C in the presence of both iron and copper catalysts and with air blowing. After such oxidation the oil is examined for sludge, acid value, and saponification value. If it is desired to determine the initial formation of water-soluble acids, this is carried out by a similar test, but at 120° C and for a time of 6 hours.

Among the methods included are some which in Great Britain are not usually to be found in a standard work, being more in the nature of tests carried out in a works control laboratory rather than on finished products ; among such determinations are those of the presence of traces of solvent in oils refined by the furfural, nitrobenzol, and phenol processes. The inclusion of tests of this type is perhaps due to the fact that whereas in the U.K. and U.S.A. their choice is left to the individual refiner, the standard methods of test being intended more to ensure that buyers' requirements are determined in a uniform manner, the State operation of all industry in the U.S.S.R. has made it desirable that all producers who are units in a single combine should conform to a uniform works control technique.

The section on the examination of greases is fairly comprehensive, and in addition to the usual physical tests such as penetration, drop point, etc., it includes numerous methods for the chemical examination of greases, the determination of free fatty acids, soaps, rosin, being among the points which are covered. Tests are laid down both for evaluating the protective action of greases in preventing corrosion and also to ensure that the greases themselves are free from corrosive action. In the section dealing with petroleum by-products the traditional Russian interest in sulphonic and naphthenic acids is evinced by the numerous methods for the examination of these materials. Methods are described for the determination of oil, sulphonic acids, and sulphuric acid in " Kontakt," and also for evaluating the fat-hydrolysing activity of this material.

Products dealt with in this section include paraffin wax and bitumen : the setting point of paraffin wax (often referred to as " melting point ") is taken as the flat portion of the time–temperature cooling curve. The oil content of paraffin wax is determined by a mechanical expression method. The tests described for bitumen are those usually given in British and American publications, and do not merit any special mention ; likewise the description of sampling procedure is conventional.

In general the publication follows the lines that are to be expected in a work of this sort. The majority of the empirical conventional tests of petroleum products appear to follow very closely on British and American practice, which is a commendable feature, since the greater the degree of international agreement on matters such as these, the greater are the facilities for the mutual interpretation of specifications and the interchange of technical information. V. B.

Dictionnaire Technique des Termes du Pétrole en Francais, Anglais, Russe, Allemand. 2nd edn. Berlin : Groupe Français du Council de Contrôle Mission des Carburants, 1946. Pp. 488.

The first edition of this Glossary of Technical Terms of the Oil Industry was published in French, English, and German in 1937 on the occasion of the second World Petroleum Congress in Paris. It has now been revised and extended to include Russian.

The main glossary of over 3400 terms are arranged in alphabetical order in English, the corresponding terms in the three other languages being given in adjoining columns. Alphabetical indexes in the three other languages are provided. Conversion tables for various weights and measures are included in an appendix.

British Standard 1312 : 1946. Fuel Fired Regenerative Tank Furnaces for Melting Glass. London : British Standards Institution, 1946. Pp. 66. 5*s*. post free.

This test code has been framed to cover the testing of regenerative tank furnaces for the melting of glass. Two forms of test are provided : (1) simplified industrial tests for evaluating the performance of furnaces as effective and economic units ; and (2) a comprehensive code for complete evaluation of the performance and the efficiency of furnaces.

British Standard 1316 : 1946. Florescent and Phosphorescent Materials (excluding radio-active materials). London : British Standards Institution, 1946. Pp. 27. 2*s*. post free.

This specification refers to luminiscent (*i.e.*, fluorescent and phosphorescent) materials in the form of paints, painted panels, plastics, vitreous enamel, etc., for indoor and outdoor use (but not in the form of treated fabrics, armbands, paper, etc.).

The British Electrical and Allied Industries Research Association Annotated List of Published Reports October 1945. London: B.E.A.I.R.A., 1946. Pp. 112. 5*s*. net.

A complete annotated list of reports published by the association, or in co-operation with, the Electrical Research Association. Reports are classified by subject, which include: Geophysics (Properties of the Ground); Insulating Materials (Liquids, Bituminous Filling Compounds, Hydrocarbon Resins, and Waxes); Miscellaneous (Rheology).

C.S.I.R.—1945. G. Lightfoot. Melbourne: Government Printer, 1945. Pp. 98.

This report of the Council for Scientific and Industrial Research of the Commonwealth of Australia states that the Lubricants and Bearings Section has developed apparatus and methods for studying the mechanism of boundary lubrication. This work has yielded valuable information and fluids have been developed for such purposes as the drawing and pressing of metals, cutting oils, and extreme pressure lubricants.

Annual Report of the Research Council of Alberta 1945. Edmonton: King's Printer, 1946. Pp. 21. 5 cents.

Summarizes the work of the Council during 1945 and deals with investigations concerning bituminous sands, fuels, natural gas, etc. A list of publications is appended.

Proceedings of the Institution of Mechanical Engineers. Vol. 153. War Emergency Issues, 1–12, 1945. London: Institution of Mechanical Engineers, 1946. Pp. 517 + xi.

Among the papers included in this first volume of War Emergency Proceedings are: "Controlling Pipe Line Surges," by J. S. Blair; "An Investigation into the Laws of Flow of Fluids through Beds of Granular Materials," by H. E. Rose; "The Isothermal Flow of Gases through Beds of Granular Materials," by H. E. Rose; "On the Resistance Coefficient–Reynolds Number Relationship for Fluid Flow through a Bed of Granular Material," by H. E. Rose; "Combustion in the Gas Turbine," by R. G. Voysey.

Reports on Fuel Economy since 1939. U.S. National Committee of World Power Conference. London: World Power Conference, 1946. Pp. 12. 7*d*. post free.

First of a series of reports prepared by National Committees of the W.P.C. on experiences in connexion with fuel economy in their respective countries since 1939 and which will constitute material for the Fuel Economy Conference at the Hague in September 1947. The present report covers the United States and includes 72 references to published literature.

Handbook of the Scientific Instrument Manufacturers' Association of Great Britain, Ltd. London: Scientific Instrument Manufacturers' Association of Great Britain, Ltd., 1946. Pp. 48 + 73.

The principal part of this handbook consists of a classified list of scientific instruments indexed in relation to the announcements of various manufacturers contained in the second part of the book. In the foreword the aims and objects of the association are outlined and the growth of the British scientific instrument making industry is reviewed.

Technical Missions To Germany.

The following reports have been received in addition to those listed on pp. 226 A–230 A and 316 A–318 A:

B.I.O.S. REPORTS.

160. Luftfahrtforschungsanstalt Hermann Goring, Volkenrode, Brunswick. 40 pp.
171. Catalyric Hydrogenation of Acetylene to Ethylene, Dr. Alexander Wacker Ges. fur Elektrochemische Industrie, Burghausen. 5 pp.
413. Primary Cells, by Prof. A. Schmid. 4 pp.
474. German Wool-Combing Industry and Wool-Grease Extraction Processes. 57 pp.

531.* German Steel Drum Industry. 110 pp.
534. The Organization of the German Chemical Industry and its Development for War Purposes. 40 pp.
554. Ampoule and Vial making Machines: Improvements and Developments in Germany. 12 pp.
556. H. Walter Kommanditgesellschaft, Kiel (Materials for bi-fuel rockets). 20 pp.
560. Distillation of Phenols at I.G. Farbenfabrik, Wolfen. 5 pp.
562. The German Phosphorus Industry at Bitterfeld and Piesteritz. 52 pp.
572. Investigation into Manufacture and Use of Carbon Blacks and Lamp Blacks in Germany. 120 pp.
577. German Car Industry Special Servicing Equipment for Cars. 7 pp.
582. Interrogation of Dr. Loahfert Rhenania Phosphat Werke, Brunsnuttelkoog, Germany. 8 pp.
585. Aircraft De-Icing at A.V.A., Gottingen. 13 pp.
586.* Ernst Schliemann's Oelwerke Und Export-Cerecin-Fabrik, Hamburg, Germany. 32 pp.
596. Gesellschaft für Teerverwertung Varziner-Strasse, Duisburg-Meiderich, Ruhr. 13 pp.
597.* Interrogation of Dr. C. H. N. Bensmann, October 10, 1945. 3 pp.
598.* Oelwerke Julius Schindler G.m.b.H, Hamburg, Germany. 15 pp.
604. The Shellac Industry in Germany. 17 pp.
612. Klein Schanglin and Becker A.G. Hydraulic Couplings and Torque Converters. 8 pp.
616. Inspection of Krupp-Lurgi Plants for the Carbonization of Coal at Low Temperatures. 41 pp.
621. The Manufacture of Wofatit Base-Exchange Resins. 20 pp.
623. Lurgi Gesellschaft für Warme technik, Frankfurt-am-Main. 14 pp.
626. Drying, Briquetting, and Low-temperature Carbonization of Brown Coal in Lurgi-Spülgas Retorts. 18 pp.
633. Manufacture of Oxalic Acid at I.G. Farbenindustrie, Bitterfeld. 12 pp.
635.* Mineralölwerke Albrecht Lubricants. 22 pp.
636.* Mineralölwerke F. Harmsen Kiel—German Lubricants. 11 pp.
637.* Olex Deutsche Benzin und Petroleum Gesellschaft: Fuels and Distribution. 13 pp.
638.* Deutsche Erdol A.G., Hamburg, Germany: Crude Oil and Products. 12 pp.
639. Deurag-Nerag Gewerkschaft Deutsche Erdol Raffinerie und Neue Edol Raffinerie: Fuels and Lubricants. 31 pp.
679. I.G. Farben Works at Bitterfeld. Manufacture of Potassium Dichromate and Chromic Oxide. 20 pp.
680. Manufacture of Caustic Soda, Chlorine, and HCl, I.G. Farbenfabrik, Wolfen. 24 pp.
683. Hydrogen Peroxide. Production by Electrolysis of 35 per cent Solutions. Deutsche Gold und Silber Austalt. 26 pp.
711. Interrogation of Dr. Haus-Albrecht Kind of Böhme Fettechemie and Henkel and Cie, Dusseldorf. 78 pp.
713. Notes on Items of Chemical Plant at Works of: I.G. Farbenindustrie, Knapsack; Dr. Alexander Wacker, Burghausen; Anargana, Gendoy; I.G. Farbenindustrie, Hoechst. 15 pp.
715. Microanalytical Methods Employed in the Analytical Laboratories of I.G. Farben., Elberfeld-Wuppertal, Germany. 7 pp.

C.I.O.S. REPORTS.

XXIII–14. Turbine Engine Activity at Ernst Heinkel A.G. 69 pp.
XXVI–30. Gas Turbine Development by B.M.W. 34 pp.
XXVIII–18. The Universal Faitj System Extraction Process. 3 pp.
XXIX–12. The Production of Tetrahydrofuran Intermediates. 47 pp.
XXIX–12. (Appendix.) Polyurethanes, Dr. O. Bayer (I.G. Farbenind., Leverkusen). 21 pp.
XXXII–17.* Underground Factories in Central Germany. 154 pp.
XXXII–52.* Gas Utilities in Germany. 34 pp.
XXXII–56. Pyrotechnic Anti-pathfinder Devices. 36 pp.

XXXII-58. The Chemical Compositions of German Pyrotechnic Smoke Signals. 6 pp.
XXXII-68.* The Manufacture and Application of Lubricants in Germany. 46 pp.
XXXII-124. Items Selected from the Minutes of the Meetings of the I.G. Technische Ausschuss. 5 pp.
XXXIII-37. Coke-Oven Installation of Reich-Werke A. G. Hermann Göring Werke at Watenstedt near Brunswick. 32 pp.
XXXIII-40. Nordstern Coke-Oven Plant Gelsenkirchner Bergwerks A.G. 5 pp.

F.I.A.T. REPORTS.

8. Investigation of Textiles, I.G. Farbenindustrie, Bobingen. 9 pp.
67. Chemical Developments and Applications in the Synthetics Industry of Germany. 69 pp.
93.* Interrogation of Professor Franz Fischer. 3 pp.
183. Reinhold and Co. G.m.b.H., Frankfurt A.M. Sued. 3 pp.
213. Summary of Field Investigations: Fats, Oils, and Oilseeds. 25 pp.
239.* Fischer–Tropsch Plant of Hoesch Benzin A.G., Dortmund, Germany. 3 pp.
261. Gas Compressors Manufactured by Griederic Uhde K.G., Dortmund, Germany. 6 pp.
273. Interview with Dr. J. W. Reppe, I.G. Farbenindustrie A.G. 20 pp.
292. The Manufacture of Laboratory Apparatus, Instruments, and Equipment. 15 pp.
293. I.G. Farbenindustrie, Leverkusen, Germany. 11 pp.
297. Fats, Oils and Oilseeds. 23 pp.
362. Synthetic Fatty Acids I.G. Farbenindustrie A.G., Ludwigshafen. 3 pp.
364. German Fats, Oils, and Oilseed Processing Plants. 19 pp.
365. Industrial Proteins Karl Freudenberg A.G. 5 pp.
388. Counting Devices Germany. 9 pp.
423. Synthetic Lubricating Oil Manufacture, Rhenania-Ossag Mineralowerke A.G. Harburg Refinery. 6 pp.
429. Development Work for Manufacture of Caustic Soda and Sulfuric acid from Sodium Sulfate. 5 pp.
447.* Study of Production of Shale Oil from Shale in Wurtenberg. 98 pp.
464. Survey of German Coated Fabrics Industry. 20 pp.
489. Survey of Fans and Turbo Blowers. 51 pp.
511. Acetylene Generator Designs in Germany, 1945. 22 pp.
528. Light Sensitive Reproduction Materials. 89 pp.
546. Wool Scouring, Wool Grease Recovery and other By-Products Recovery. 10 pp.
577. Survey of the Leading Manufacturers of Pressure Vessels. 52 pp.
612. Carburettors for Automobiles as Produced in Germany. 12 pp.
624. Robert Bosch Development of a Low Tension Spark Plug (System " Smits "), Robert Bosch A.G., Stuttgart. 6 pp.
645. The Dyeing of Spun Rayon and Rayon Filament Yarn in Mechanical Apparatus in Germany. 7 pp.
678. German Scientific Literature Published During the War. 120 pp.
681. The Paint, Varnish and Lacquer Industry of Germany. 64 pp.
685. Ferdinand Porsche—10 Cylinder Vee-Type Air-Cooled 300 H.P. Gasoline Engine. 5 pp.
704. Final Summary of the Sub-Committee for Shipbuilding in Germany. 16 pp.
712. Manufacturing Process for Desmodur R. 8 pp.
737.* Economic Study of German Synthetic Waxes. 32 pp.
741.* Catalysts for Coal Hydrogenation. 4 pp.
810.* Activated Clay Bleaching Adsorbents. 20 pp.

J.I.O.A. REPORTS.

11. German Military Water Supply Equipment (Research and Development). 30 pp.
40.* German Oil Refineries. 98 pp.
45. Industrial Safety in Germany. 150 pp.

INSTITUTE NOTES.

November, 1946.

AMERICAN AWARD TO SIR ANDREW AGNEW.

Sir Andrew Agnew, C.B.E., President of the Institute, has been awarded the American Medal of Freedom with Silver Palm for "exceptionally meritorious achievement which aided the United States in the prosecution of the war against the enemy in Continental Europe, as Chairman of the Petroleum Board, from August 1942 to May 1945. He displayed marked leadership, sound knowledge and outstanding ability in expediting necessary petroleum supplies to both the British and American forces. Because of his tenacity of purpose, his close and understanding co-operation with American authorities and his helpfulness in providing many of the necessary warehouse and transportation facilities, American operational requirements were met in a minimum of time and with a maximum of efficiency, thus contributing in large measure to the success of the war effort."

SCOTTISH BRANCH.

The Scottish Branch of the Institute of Petroleum held its first meeting of the current session in the Hall of the Pharmaceutical Society, Edinburgh, on October 11, 1946, Mr. Robert Crichton, Chairman of the Branch, presiding.

Mr. A. C. Hartley, C.B.E., Vice-President, delivered a lecture on "Operation Pluto" to an audience of about 120, including visitors from local chemical and engineering societies and employees of the Petroleum Board.

PERSONAL NOTES.

Norman F. Brown (Fellow) has recently terminated his post as Fields Chief Engineer of the Indo–Burma Petroleum Co. Ltd., to take up the position of Director and Technical Manager of the N.F.B. Displacement Pump Co. Ltd.

G. E. Rose, who first joined the firm of B. & R. Redwood in 1895 and was taken into partnership by the late Mr. Robert Redwood fifteen years ago, died on October 15, 1946, after a short illness. He was a well-known figure in the oil measurement world and his passing will be regretted by many on British storage and similar installations.

APPLICATIONS FOR MEMBERSHIP OR TRANSFER.

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

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

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

Applications for Membership.

ARCHER, Geoffrey Thyne Valentine, Distribution Trainee, Anglo-Iranian Oil Co. (*A. E. Dunstan ; R. B. Southall.*)

CHISHOLM, Archibald Hugh Tennent, General Department, Anglo-Iranian Oil Co. (*H. Medlicott ; G. H. Coxon.*)

CODY, Cecil Thomas Kingsborough, Distribution Trainee, Anglo-Iranian Oil Co. (*A. E. Dunstan ; R. B. Southall.*)

COLLIER, Kenneth Dowsett Gould, Director of Equipment, Air Ministry. (*J. Mason ; E. LeQ. Herbert.*)

EYRES, John James, Director, Alfred Hopps, Sons & Co., Ltd., Liverpool. (*E. R. Redgrove ; S. H. Bean.*)

HOWE, Harry Guy, Distribution Trainee, Anglo-Iranian Oil Co. (*A. E. Dunstan ; R. B. Southall.*)

JACK, Thomas Anthony Maclean, Distribution Trainee, Anglo-Iranian Oil Co. (*A. E. Dunstan ; R. B. Southall.*)

MAPSTONE, George Edward, Chief Chemist, National Oil Pty. Ltd., Australia. (*B. A. Raper.*)

MITCHELL, Derek Fenton, Distribution Trainee, Anglo-Iranian Oil Co. (*A. E. Dunstan ; R. B. Southall.*)

MITCHELL, William Arthur, Laboratory Assistant, Lobitos Oilfields Ltd. (*V. Biske ; F. S. Archer.*)

NIGHTINGALE, John Charles, Distribution Trainee, Anglo-Iranian Oil Co. (*A. E. Dunstan ; R. B. Southall.*)

STILLMAN, Herbert, Technical Representative, Edward Joy & Sons, Ltd., Leeds. (*T. J. Metcalf ; R. Todd.*)

WALKER, Kay John Seymour, Assistant Research Engineer, Anglo-Iranian Oil Co. (*E. T. C. Spooner ; H. Thirkhill.*)

WELFARE, Ivy Marjorie, Chemist in charge (Liverpool Works), C. C. Wakefield & Co., Ltd. (*G. H. Thornley ; E. A. Evans.*)

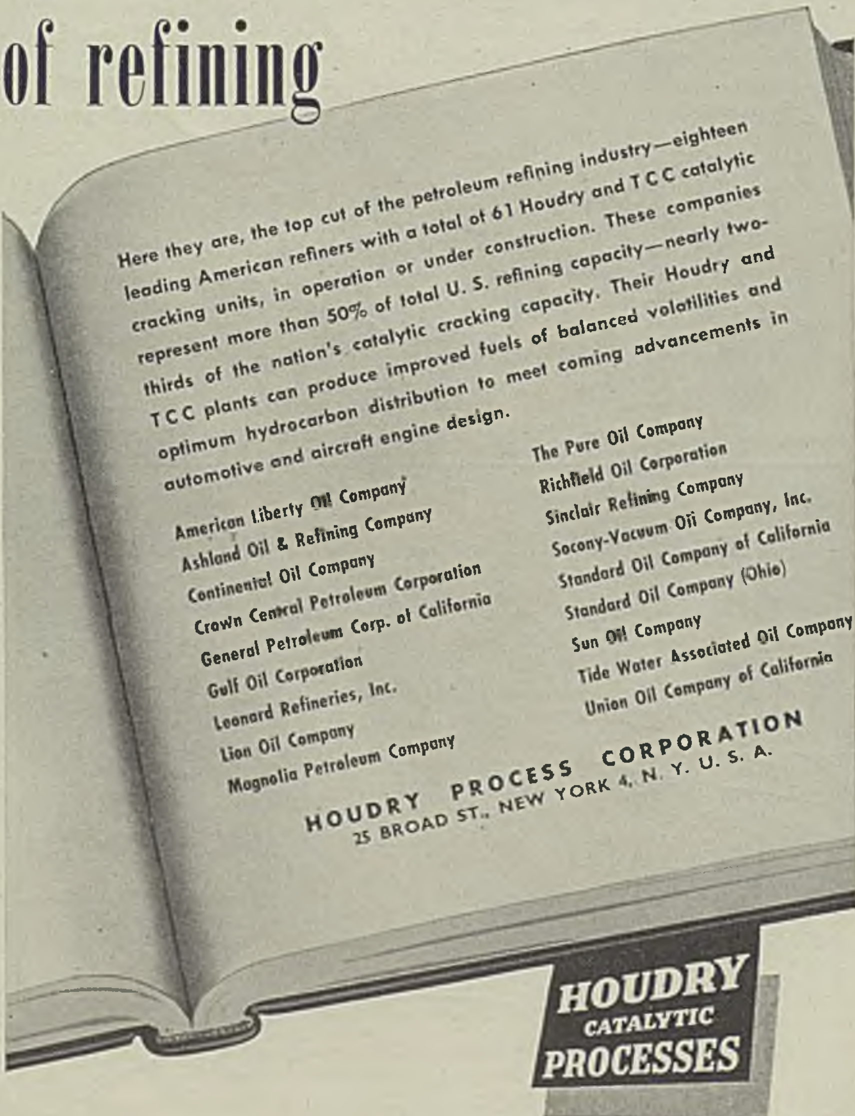
WRIGHT, Herbert, Drilling Engineer, The Uganda Government. (*M. Robertson.*)

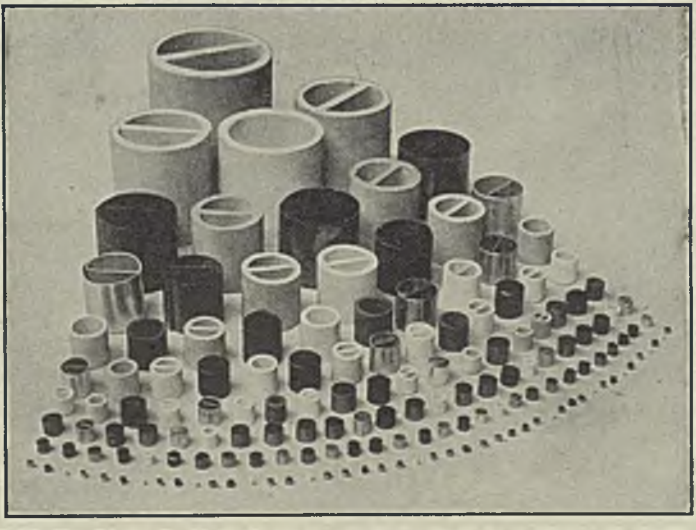
YRIBERRY, Eduardo Jorge, Engineer, Shell-Mex Chile Ltd. (*R. G. Mitchell ; S. Hunn.*)

Application for Transfer.

HORNE, Donald, Research Chemist, British Diesel Oil & Petrol Co., Ltd. (*G. S. Pound ; B. W. Smith.*) (*Associate Member to Member.*)

The list of Houdry licensees is the Blue Book of refining

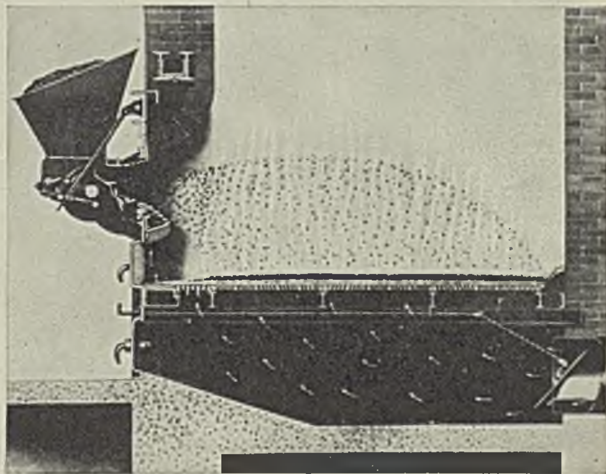




BABCOCK - DETROIT

ROTOSTOKER

WITH
STATIONARY
GRATE



THE Babcock Detroit Spreader Stoker with Stationary Grate as shown in these illustrations is suitable for Marine boilers or small installations on land. No basement for ash handling purposes is required.

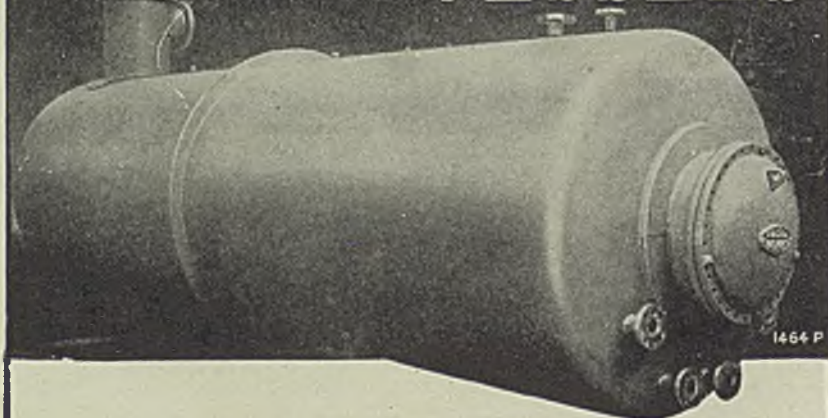
The drawing shows such a Stoker installed under a single pass Marine boiler. The air chamber under the grate is divided longitudinally so that each feeder and its related section of grate may be isolated for cleaning of the grate. Steam output is maintained during ashing by an increase of fuel to the adjacent feeder.

FRONT & REAR VIEWS
OF ROTOSTOKER WITH
STATIONARY GRATE

BABCOCK & WILCOX LTD., 34-35 FARRINGDON STREET, LONDON, E.C.4

THE MOST ADVANCED TECHNIQUE IN—

Welded PROCESS VESSELS



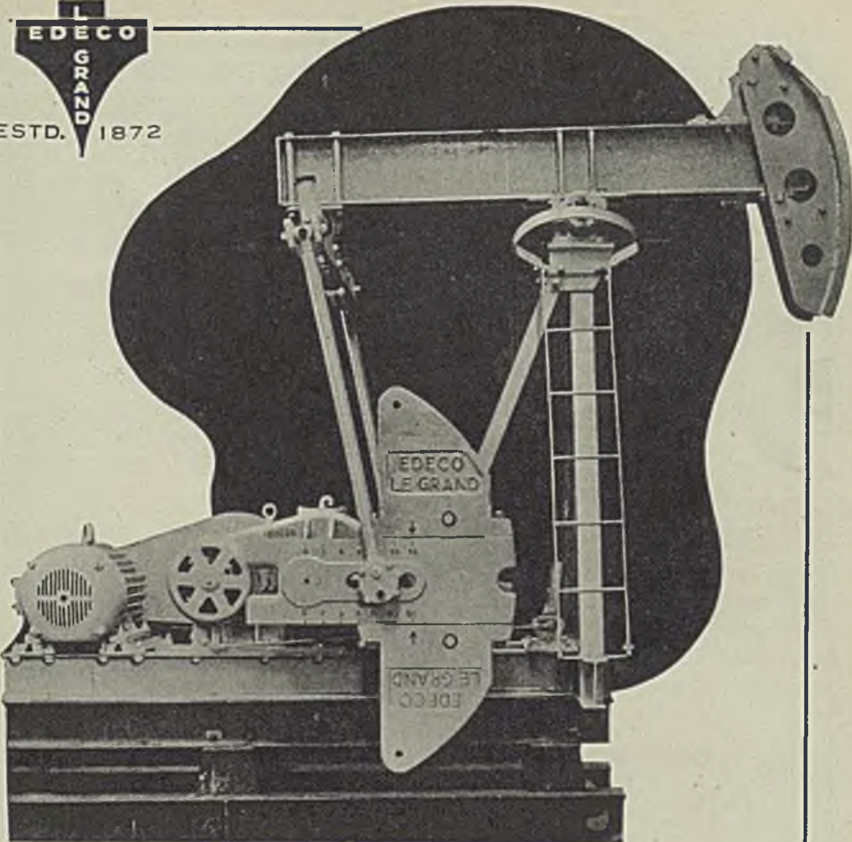
Our facilities for X-ray examination of welds are of particular value in the case of vessels to contain Petroleum products during heat, pressure, or high vacuum processing.

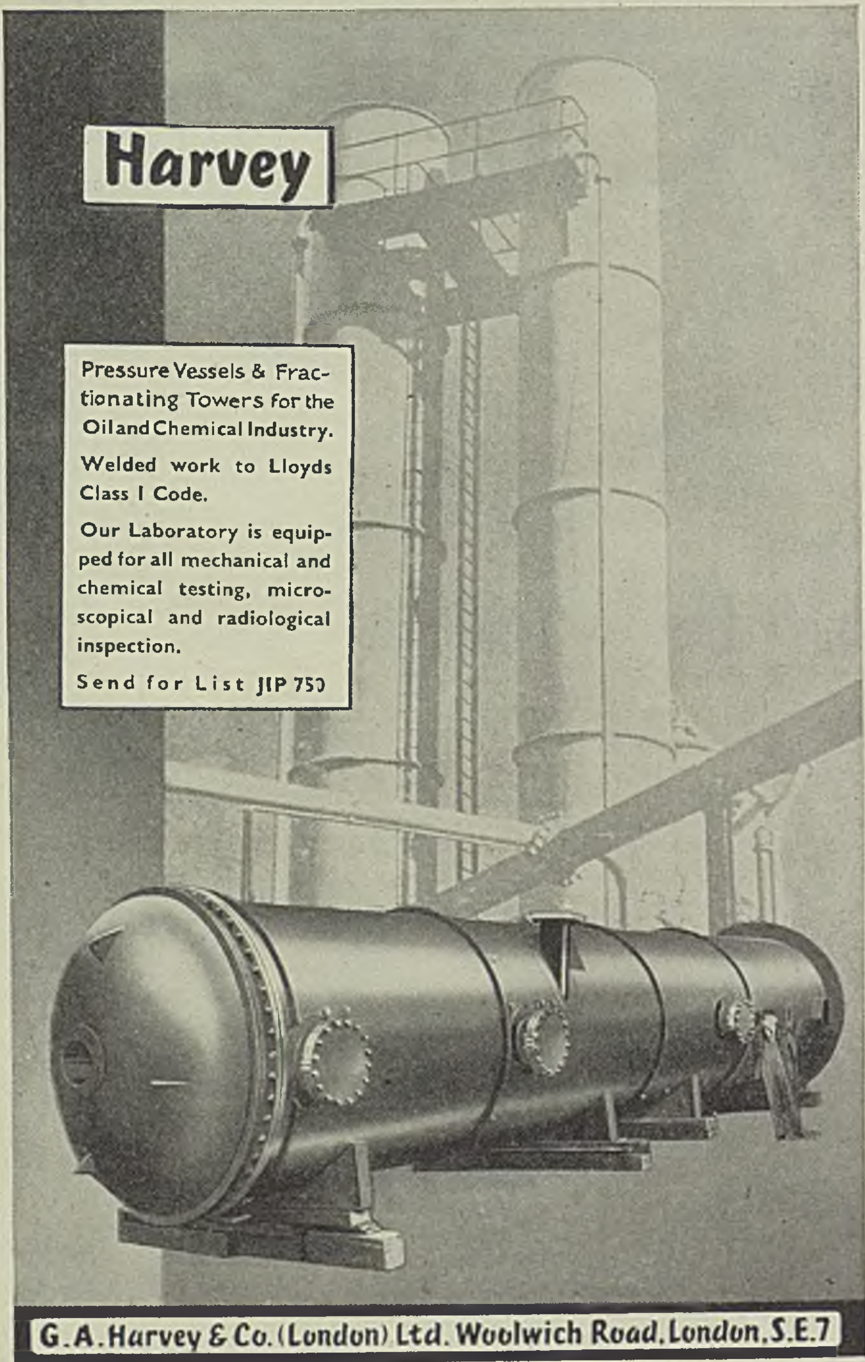
FRASERS OF DAGENHAM

W. J. FRASER & CO. LTD., DAGENHAM, ESSEX.

TAS/FS.262

Kindly mention this Journal when communicating with Advertisers.

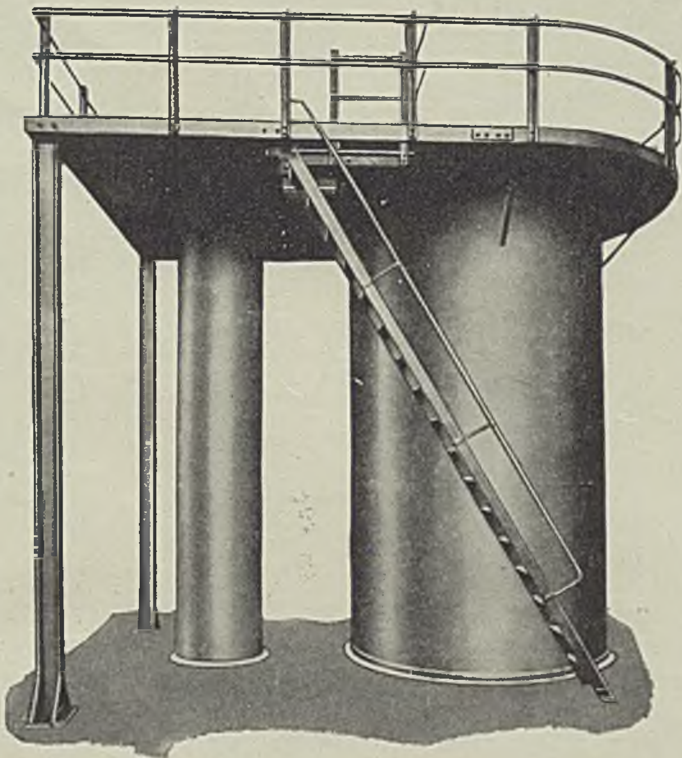

EDECO
LE GRAND



Kindly mention this Journal when communicating with Advertisers.


Waste Heat Recovery
SENIOR ECONOMISERS
For all types of Boilers and all Operating Pressures
TWINTUBE TYPE
FOR THE CENTRAL POWER STATION AND THE LARGE INDUSTRIAL POWER PLANT
In each type the straight gas passages are self-cleaning. Efficiency of heat recovery remains constant and the cost of attention and maintenance is reduced to the minimum.
WELDED TYPE
For Pressures up to and exceeding 2000 lb. per sq. in.
SENIOR ECONOMISERS LTD., 11 SOUTHAMPTON ROW, LONDON W.C.1

WELDED VESSELS



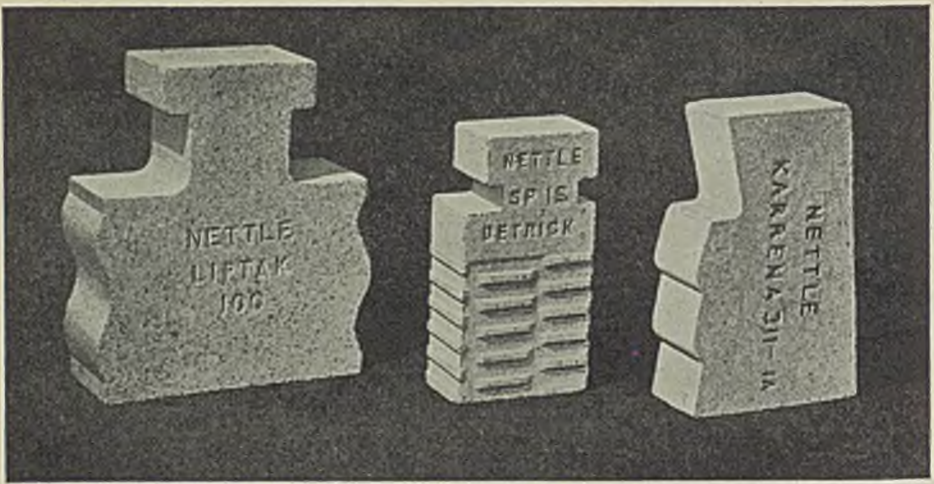
WELDED STEEL STORAGE AND PROCESS VESSELS

LARGE DIAMETER PIPES, ETC.

Robert Jenkins & Co. Ltd

IVANHOE WORKS ROTHERHAM

Estd. 1856



FOR OIL FIRED FURNACES

THISTLE (35/37% Al_2O_3) Firebrick is a general purpose first quality firebrick which enjoys a wide reputation for regularity of quality.

NETTLE (42/44% Al_2O_3) is a super grade brick of exceptional uniformity manufactured under close control in a modern plant and fired in Tunnel Kilns. The brick to brick variation in quality and shape is reduced to the absolute minimum. Recommended for those parts of the lining where conditions are more severe.

STEIN SILLIMANITE (62% Al_2O_3) has outstanding resistance to spalling, hot-load strength and volume stability. Recommended for any parts where unusually severe conditions are experienced.

SUSPENDED ARCH AND WALL TILES. We specialise in the manufacture of the various well-known types of these tiles in which accuracy of shape is an important consideration.

PLASTIC REFRACTORY.

MAKSICCAR PATCH is supplied in "ready to use" consistency. Will be found valuable for repairing damaged brickwork, etc.

EXPORT PACKING.

Standard crates 34" × 29" × 24" overall hold 100—9 × 4½ × 3" squares or 112—2½". Gross weight approximately 8¾ cwts. each.

REFRACTORY CEMENTS.

The following range offers a wide selection according to users requirements :—

NETTLE CEMENT (42% Al_2O_3) Refractory test Seger Cone 34 = 1750° C.
Contains a proportion of pre-calcined material which eliminates shrinkage in drying and in use.

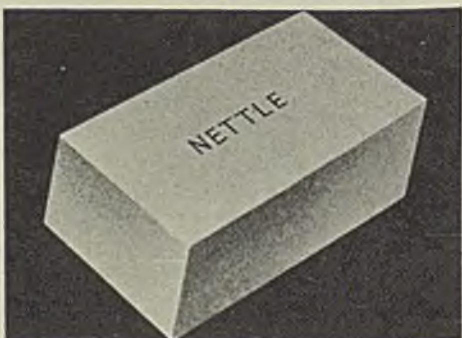
THISTLE FIRECLAY is a finely ground fireclay of similar characteristics to Thistle brick.

MAKSICCAR 11 DRY REFRACTORY CEMENT. Refractory test Seger Cone 31 = 1690° C. Moderate air-setting bond.

MAKSICCAR 11 PLASTIC REFRACTORY CEMENT. Refractory test Seger Cone 30 = 1670° C. Strong air-setting bond.

STEIN SILLIMANITE CEMENT has similar characteristics to Sillimanite brick. Also recommended as a wash-coating over brickwork to protect against corrosion.

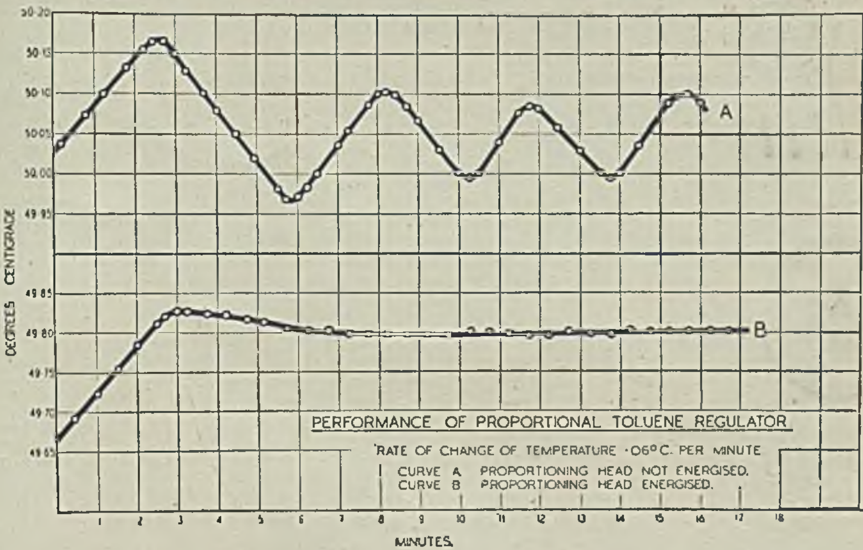
Approximately 6 cwts of Refractory Cement per 1,000 9 × 4½ × 3" is required for jointing.



STEIN

JOHN G. STEIN & CO., LTD.

BONNYBRIDGE SCOTLAND



TENFOLD IMPROVEMENT IN TOLUENE REGULATOR PERFORMANCE

This record of an actual experiment shows how the SUNVIC Proportioning Head, used with any standard Toluene Regulator, improves the fineness of regulation, giving a stability of the order of 5 milli-degrees.

The SUNVIC Proportioning Head is normally used in conjunction with a SUNVIC Type EA2/T Electronic Relay.

This apparatus is fully described in Technical Publication EA11/13. Please request a free copy today.

SUNVIC CONTROLS LTD., STANHOPE HOUSE, KEAN ST., LONDON, W.C.2

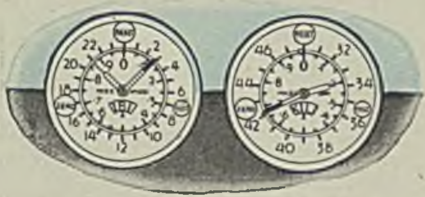
THE THERMOSTATIC **SUNVIC** CONTROL EXPERTS

TAS/SC. 100

Kindly mention this Journal when communicating with Advertisers.

cutting survey time to a tenth

The Decca Navigator is the latest development of radio science for survey work. With it in use any estimated surveying time can be divided by ten. Vast areas of land or sea can be mapped out to a degree of accuracy and at a time-cost so low as to revolutionize the whole practice of surveying. The Decca Navigator is extremely simple to operate and, working from an easily erected transportable transmitting station it gives a *continuous fix* of position on direct reading dials for boat, 'plane, or mobile party. In fact one form of receiver can be carried by one man and set up at any point in desert or jungle. Thus, areas previously inaccessible come easily within the scope of economical survey. For highly accurate survey, in a tenth of the time, choose the Decca Navigator.



The Decca Survey Department will gladly quote you for a Navigator equipment to suit your specific needs if you will tell them the nature of your business and the areas you propose to survey. If required, a Decca Engineer will be sent to discuss the matter with you. No obligation will be incurred.

The Decca Navigator Company, Limited

survey department 1-3 Brixton Road, London, S.W.9 England

telephone : Reliance 3311 *telegrams and cables :* Decnav, London