

FIGURE 11.

Structural Contour Map of Southeastern Michigan and Southern Ontario Showing the Location of the Deerfield Anticline.

SANILAC COUNTY.

| | | | | | | | |
|---------|-------|---------|-------|---------|-------|-------|-------|
| Trenton | | renton. | | renton. | | | |
|---------|-------|---------|-------|---------|-------|-------|-------|

| | | | | | | | | | | |
|---------|----------|---------|---------|---------|-----------|---------|---------|-----------|-------|---------|
| Locatio | S.E./S.1 | Locatio | S.W./N. | Locatio | S.E./S.W. | N.W./S. | S.W./N. | 600' E. C | N. 1. | S.W./N. |
|---------|----------|---------|---------|---------|-----------|---------|---------|-----------|-------|---------|

SOUTHEASTERN DISTRICT.

The location of the southeastern part of the state along the outer border of the structural basin separates it as a distinctive province. The wells drilled in this area begin in the Devonian formations and possibilities in higher strata are entirely eliminated. Southeastern Michigan has been a region of early prospecting because of the proximity to producing fields in Ohio and Ontario, Canada. The knowledge obtained from outcrops and extensive borings for salt along the St. Clair and Detroit Rivers indicated possible pays and served to partly delineate structure.

Recent activities in this district have centered in southeastern St. Clair County, Northeastern Macomb County, Southeastern Wayne County, and Western Monroe County. Operations were carried on largely by local syndicates and private parties. The most important results took place at St. Clair where the Diamond Crystal Salt Company struck a good sized gas well in the winter of 1927. The St. Clair Oil & Gas Corporation found a small amount of oil in their well northeast of Mt. Clemens, but it was not pumped for any length of time. The test made by W. E. Ellis near Trenton, Wayne County exhibited only a small showing of oil in the Trenton limestone and the well was abandoned as a dry hole. Between Deerfield and Dundee in Monroe County one well was deepened and a second was commenced as an off-set to a near-by producer. No satisfactory results have yet been obtained in either of these projects.

A plunging nose with a sharp dip on its west flank and terrace flattening on its east flank extends into Michigan from Northwestern Ohio. This structure trends northwest and its high follows a course conforming rather closely to the Lenawee-Monroe County line. The nature and size of the fold is shown in Fig. 11, on which map the contours are drawn on the top of the Trenton formation. Another anticlinal structure is indicated which crosses the Detroit River south of Trenton, Wayne County, and seems also to trend in a northwest direction. The map also demonstrates clearly the position of southeastern Michigan in respect to the Cincinnati Arch.

Although considerable testing has been carried on in parts of Monroe County where the Trenton is within reach of the drill, without especially promising results, the possibilities are by no means exhausted. It will be observed that production was obtained near Deerfield where there was a sharp break in the steep dip, and other favorable locations will probably be found to the north of this locality.

MACOMB COUNTY

The St. Clair Oil and Gas Corporation, first known as the Anchor Bay Oil Co., was organized at Mt. Clemens for the purpose of testing and operating for oil and gas in Macomb and St. Clair Counties. The officers of the corporation are Louis G. Wolf, Pres.; D. W. Brown, Vice-Pres., and Albert A. Schultz, Treas. The first well drilled by the company was on the Mary Rosette farm in the northeast corner of the SE $\frac{1}{4}$ of the SE $\frac{1}{4}$ of Section 29, T. 3 N., R. 14 E., Chesterfield township. Operations were commenced in February, 1927, and continued through the greater part of the summer and fall of that year. The location, which was about a half mile northwest of Anchor Bay, measured 1000 feet from

Sugar Bush Road, 675 feet from NW-SE Road, and 35 feet from the east section line. J. H. Mason of Port Huron was contractor and a Standard Steel Rig was used in drilling the well. The top of the Dundee limestone occurred at 679 feet and mineral water was found at 779 feet. Oil was encountered in the Detroit River formation from 1115 to 1195 feet which was drowned out by a hole full of water at 1195 feet. Mineral water was again tapped from 1500 to 1525 feet. The Sylvania occurred at 1210 feet, the Salina at 1575 feet, and the Guelph at 2456 feet. Some gas and oil was found in the barren Salina from 2366 to 2390 feet and the well was shot with 60 quarts of nitroglycerin on August 25, 1927. The hole filled up with 15 barrels over the first night but after being pumped, it made only two barrels during the first day. The oil tested 42.5 degrees Be. gravity and was of high grade. Since pumping operations brought unfavorable results, it was decided to pull the rods and drill deeper. More oil was encountered at several other places in the Guelph formation and the lower Salina. After an unsuccessful attempt to operate, the rig was moved off the location. Steps are now being made to plug and abandon the hole.

The second test in the vicinity of Mt. Clemens was made by the St. Clair Oil and Gas Corporation on the Otto Coulon farm in the NW $\frac{1}{4}$ of the SW $\frac{1}{4}$, Sec. 4, T. 2 N., R. 13 E., Clinton township. Becker and McRae of Halfway were contractors on the well which reached a total depth of 1105 feet. Drilling was commenced on December 29, 1927, and the location was 500 feet from the north property line and 1000 feet from the west property line (200 feet south of lane and 150 feet east of the line fence between two barns). The Traverse occurred at 295 feet, the Dundee at 555 feet, and the Sylvania at 1060 feet. Mineral water was found at 650 feet, 835 feet and also in the Sylvania and gas was reported at 330 feet and 410 feet. Oil showings were present at 625, 823, and 1087 feet. At the present time the well is partially plugged and temporarily abandoned.

MONROE COUNTY

A renewal of activities which took place during 1920 in the vicinity of Deerfield, Lenawee County and Dundee, Monroe County, occurred in the spring of 1927. The producing well on the Gaertner farm had been pumped at irregular intervals and averaged about 5 barrels per day. In this well two pays were found in the Trenton formation at 20 and 60 feet from the top.

The well on the F. Roe farm in the SW $\frac{1}{4}$ of the NE $\frac{1}{4}$ of Section 19, T. 6 S., R. 6 E., Dundee township, is located about 265 feet west of the producer. A socket was lost in this hole at about 200 feet in the Trenton, and the well was opened up for operations in May, 1927. After fishing for about 8 days they were not successful in clearing the hole and work was suspended because of lack of funds. Other attempts were made later in the summer to fish the material out, but at last reports drilling had not been resumed.

A new location on the Gaertner property was made by the Deerfield Oil Producing Company which was 370 feet east of the oil well and 150 feet south of the north property line. Glen Fields of Saginaw contracted for drilling the well, which was commenced during the fall of 1927. Operations are now in progress but the results are not yet known.

ST. CLAIR COUNTY

The northern part of St. Clair County was discussed under the heading of the Port Huron district, where it would logically fall under such a classification. The southern part of the county, although similar from a geological standpoint, is geographically associated with the region about Lake St. Clair and is therefore included with Southeastern Michigan.

In drilling their Number 12 well the Diamond Crystal Salt Company encountered a flow of gas which prompted them to convert it into a gas well. The location was on the south bank of the Pine River and north-west of the company office building in Section 31, City of St. Clair, T. 5 N., R. 17 E. Operations commenced on the well on June 22, 1927, and the completion date was October 13, 1927. The supply of gas has been used to fire the boilers at the plant and also for fuel in drilling an adjacent well.

The location of well Number 13 of the Diamond Crystal Salt Company is in the northwest corner of Lot No. 3, south of Pine River and 600 feet east of the Number 12 gas well. At the present time this well is still being drilled, and Chester Mason of Port Huron is the contractor.

The St. Clair Oil and Gas Company of Mt. Clemens have commenced drilling on three new locations in the vicinity of St. Clair. The first of these wells is on the Theodore Ruff farm on Private Claim 306, St. Clair township, and is 70 feet south of the north property line and 1310 feet west of the east property line. The Dundee formation was found at 790 feet and a flow of sulphur water was tapped at 950 feet. Geo. H. Becker & Son of Halfway, Michigan, are contracting for drilling the well. The other wells are located on the Fannie McCartney farm in the NW $\frac{1}{4}$ of the NE $\frac{1}{4}$ of Section 26 and on the Mary E. Fitton farm in the SW $\frac{1}{4}$ of the SW $\frac{1}{4}$ of Section 3. No details are available concerning drilling progress on these locations.

WAYNE COUNTY

W. E. Ellis of Grosse Pointe put down a well in the NE $\frac{1}{4}$ of the NE $\frac{1}{4}$ of Section 35, T. 4 S., R. 10 E., Brownstown township. The location was about 700 feet south of the Miller Road and two miles southwest of the city of Trenton. Frank C. Cheers was the contractor for the project and the well was spudded in on April 11, 1927. J. F. Miller of Newark, Ohio, was in charge of the work, which was carried on throughout the summer. A very careful log and complete set of samples was kept by the drillers and exact details were furnished by Mr. Miller during the progress of the drilling. The top of the Bass Island occurred at 290 feet, the Guelph at 1390 feet, and the Trenton at 2260 feet. A pay was found at about 80 feet in the Trenton limestone, with oil at 2342, oil and gas at 2344, and more oil at 2352. After standing over night there was only about 2 quarts of oil in the hole. The well was continued to 2820 feet with no further pay horizons and was abandoned at that depth.

MACOMB COUNTY.

| Location. | Sec. | T.—R. | Township. | Farm. | Company. | Elev. | Drift. | Dundee. | Mon. | Sylv. Salt. | Guelph. | Trenton. |
|-----------|------|--------|-----------------|-----------------|--------------------------|-------|--------|---------|------|-------------|---------|----------|
| S.E./S.E. | 29 | 3N-14E | Chesterfield... | Mary Rosette... | St. Clair Oil & Gas..... | 587 | 150 | 679 | 825 | 1210 | 2482 | |

ST. CLAIR COUNTY.

| Location. | Sec. | T.—R. | Township. | Farm. | Company. | Elev. | Drift. | Dundee. | Mon. | Sylv. Salt. | Guelph. | Trenton. |
|-----------|------|--------|----------------|------------------|--------------------------|-------|--------|---------|------|-------------|---------|----------|
| St. Clair | 31 | 5N-17E | St. Clair..... | No. 12 Well..... | Diamond Crystal Salt Co. | | | | | | | |

WAYNE COUNTY.

| Location. | Sec. | T.—R. | Township. | Farm. | Company. | Elev. | Drift. | Dundee. | Mon. | Sylv. Salt. | Guelph. | Trenton. |
|-----------|------|--------|--------------|------------------|------------------|-------|--------|---------|------|-------------|---------|----------|
| N.E./N.E. | 35 | 4S-10E | Brownstown.. | W. E. Ellis..... | W. E. Ellis..... | 585 | 20 | | | 180 | 1390 | 2250 |

TYPICAL WELL RECORDS
FROM
SOUTHEASTERN MICHIGAN INCLUDING PORT HURON DISTRICT AND THE THUMB REGION

BLAINE (ST. CLAIR COUNTY).

O. J. RICHARDSON NO. 1.

Sanilac-St. Clair Prospecting Co. No. 1.

Location: On the O. J. Richardson farm, south 120 acres of the N. W. ¼ Sec. 27, T 8 N, R 16 E. Well east of barn and about 25 rods east of road and 100 feet south of lane. Record by W. I. Robinson from samples and log furnished by Geo. T. Bench.

| | Thickness feet | Depth feet | Elevation above sea level |
|---|----------------|------------|---------------------------|
| Pleistocene: No record..... | 206 | 206 | +554 |
| Devonian: Antrim Formation: Black shale, gray when dry; pyrite..... | 259 | 465 | |
| Gray plastic shale..... | 10 | 475 | |
| Black shale; pyrite..... | 20 | 495 | +305 |
| Traverse Formation: Gray cherty limestone; pyrite..... | 15 | 510 | |
| Gray calcareous shale..... | 15 | 525 | |
| Dark gray shaly limestone and brown limestone, crinoidal; pyrite and a green mineral..... | 10 | 535 | |
| Gray calcareous shale..... | 10 | 545 | |
| Dark gray shaly limestone and brown limestone, pyrite and a green mineral..... | 5 | 550 | |
| Gray calcareous shale..... | 15 | 565 | |
| Dark gray shaly limestone and brown limestone; pyrite and a green mineral..... | 35 | 600 | |
| Dark gray shale; some limestone; pyrite, crinoids, bryozoa..... | 10 | 610 | |
| Gray calcareous shale..... | 25 | 635 | |
| No record..... | 165 | 800 | |
| Gray calcareous shale..... | | 800 | |
| Dark gray shaly limestone..... | 5 | 805 | |
| Dark gray shaly limestone (only one sample)..... | 70 | 875 | -115 |
| Dundee Formation: Buff limestone..... | 150 | 1,025 | -265 |
| Monroe Formation: Parting of dark gray shale, anhydrite, and dolomite..... | | 1,025 | |
| Buff limestone (caving Dundee)..... | 20 | 1,045 | |
| Brown dolomitic limestone..... | 10 | 1,055 | |
| Brown limy dolomite..... | 20 | 1,075 | |
| Brown dolomite..... | 15 | 1,090 | |
| Grayish brown dolomite; anhydrite..... | 25 | 1,115 | |
| Gray Plastic shale; anhydrite..... | 15 | 1,130 | |
| Gray calcareous shale and light buff granular dolomite..... | 5 | 1,135 | |
| Gray dolomite and anhydrite*..... | 5 | 1,140 | |
| Buff dolomite, anhydrite..... | 5 | 1,145 | |
| Brown dolomite, anhydrite..... | 10 | 1,155 | |
| Light brown dolomite with increasing amount of anhydrite..... | 25 | 1,180 | |
| Brown dolomitic limestone; gives petroleum odor..... | 5 | 1,185 | |
| Brown dolomite; anhydrite..... | 15 | 1,200 | |
| Brown dolomite; anhydrite; gives petroleum odor..... | 10 | 1,210 | |
| Light brown dolomite; anhydrite. Gives petroleum odor..... | 35 | 1,245 | |
| Light brown dolomitic limestone; anhydrite, petroleum odor..... | 5 | 1,250 | |

*Flakes of bluish white mineral in this and later samples are probably of celestite. Black Water, 1020.

Water, 1190.
Water near bottom of the hole which packer did not shut off.
Top of oil at 1,250—15 feet of pay.
Total Depth—1265.
Casing record—13 inch—21 (pulled).
10 inch—265.
6¼ inch—1130.
5 3-16 in—1195.

MINERAL RESOURCES OF MICHIGAN

BLAINE (ST. CLAIR COUNTY).

MICHIGAN PETROLEUM COMPANY WELL.

O. J. RICHARDSON No. 2.

(Formerly Sanilac-St. Clair Prospecting Co.)

Location: on O. J. Richardson farm, about 600 ft. from Sanilac-St. Clair Prospecting Company well No. 1, on south 120 acres of N. W. ¼ Section 27, T. 8 N., R. 16 E.
Elevation: About 728.53 feet above sea level.

| | Thickness feet | Depth feet |
|--|-------------------|---------------|
| No record to | | 1,260 |
| Devonian and Silurian: | | |
| Monroe Formation: | | |
| Buff to brown dolomite | 155 | 1,415 |
| Buff dolomite (with some anhydrite) | 30 | 1,445 |
| Buff dolomite (with some gypsum) | 130 | 1,575 |
| Buff dolomite (considerable black shale) | 10 | 1,585 |
| Buff dolomite | 30 | 1,615 |
| Light gray dolomite (considerable iron stain, probably from drill) | 75 | 1,690 |
| Light buff dolomite | 5 | 1,695 |
| No record | 25 | 1,725 |
| Buff to gray dolomite (iron stained) | 17 | 1,742 |
| Gray dolomite | 38 | 1,780 |
| Buff dolomite | 8 | 1,788 |
| Gray dolomite (with considerable anhydrite) | 22 | 1,810 |
| Dark brownish gray dolomite (with anhydrite and considerable iron) | 20 | 1,830 |
| Gray to buff dolomite | 30 | 1,860 |
| Light gray shaly dolomite | 10 | 1,870 |
| Dark brown to black dolomite | 5 | 1,875 |
| Gray shaly dolomite | 5 | 1,880 |
| Black and dolomite | 5 | 1,885 |
| Buff dolomite | 5 | 1,890 |
| Buff dolomite, anhydrite | 35 | 1,925 |
| Dark gray to brown dolomite | 5 | 1,930 |
| Buff dolomite (much anhydrite) | 18 | 1,948 |
| Buff dolomite (somewhat shaly in places) | 57 | 2,005 |
| Gray dolomite (some anhydrite) | 25 | 2,030 |
| Anhydrite and gray dolomite | 10 | 2,040 |
| Gray dolomite | 5 | 2,045 |
| Brown dolomite | 5 | 2,050 |
| Gray dolomite | 5 | 2,055 |
| Gray dolomitic shale | 5 | 2,060 |
| Gray dolomite | 25 | 2,085 |
| Light gray to light buff dolomite | 25 | 2,110 |
| Gray dolomite | 15 | 2,125 |
| Brown dolomite | 10 | 2,135 |
| Gray dolomite | 5 | 2,140 |
| Salina Formation: | | |
| Gray to brown impure salt | 40 | 2,180 |
| Reddish and greenish shale | 10 | 2,190 |
| Gray salt | 10 | 2,200 |
| Green shale | 10 | 2,210 |
| Red and green shale | 20 | 2,230 |
| Greenish gray shale | 15 | 2,245 |
| Gray salt | 5 | 2,250 |
| Gray shale | 5 | 2,255 |
| Mixed shale and salt | 15 | 2,270 |
| Brown salt | 20 | 2,290 |
| Shale and salt mixed | 30 | 2,320 |
| White and brown salt | 65 | 2,385 |
| Gray shale | 5 | 2,390 |
| Brown and gray impure salt | 30 | 2,420 |
| Gray shale | 10 | 2,430 |
| Salt and shale | 35 | 2,465 |
| Gray to brown shale | 25 | 2,490 |
| Salt, some shale | 25 | 2,515 |
| Shale and salt | 10 | 2,525 |
| Salt | 20 | 2,545 |
| Buff and gray shaly dolomite | 35 | 2,580 |
| Salt | 25 | 2,605 |
| Gray shale | 5 | 2,610 |
| Shale and salt | 10 | 2,620 |
| Salt | 20 | 2,640 |
| Gray shaly dolomite | 5 | 2,645 |
| Salt | 10 | 2,655 |
| Gray shale | 5 | 2,660 |
| Red shale | 10 | 2,670 |
| Gray to buff dolomite (somewhat shaly) | 75 | 2,745 |

O. J. RICHARDSON No. 2—Continued

| | Thickness feet | Depth feet |
|--|-------------------|---------------|
| White salt | 10 | 2,755 |
| Brown dolomite | 5 | 2,760 |
| Salt | 20 | 2,780 |
| Gray shale | 60 | 2,840 |
| Buff shaly dolomite | 10 | 2,850 |
| Gray dolomite | 35 | 2,885 |
| Salt | 25 | 2,910 |
| Gray dolomite | 5 | 2,915 |
| Dolomite and salt | 40 | 2,955 |
| Salt | 70 | 3,025 |
| Gray dolomite | 5 | 3,030 |
| Brown dolomite | 75 | 3,110 |
| Salt | 25 | 3,115 |
| Brown dolomite | 25 | 3,140 |
| Salt | 20 | 3,160 |
| Brown dolomite | 175 | 3,335 |
| Gray to buff dolomite | 10 | 3,345 |
| White salt | 10 | 3,355 |
| White salt (mostly crystalline and transparent) | 20 | 3,375 |
| Light pink salt | 55 | 3,430 |
| White to light gray salt | 85 | 3,515 |
| Pink to salmon pink salt | | |
| (3435 to 3440 missing) | | |
| Greenish gray sandy shale fragments in bottom | 25 | 3,540 |
| White salt | 20 | 3,560 |
| Pink salt (dark shale fragments) | 10 | 3,570 |
| White salt | 40 | 3,610 |
| Light to salmon pink salt | 5 | 3,615 |
| Dark pink salt | 15 | 3,630 |
| Buff dolomitic limestone (anhydrite?) | 10 | 3,640 |
| Light brown dolomite (quite calcareous and drills fine) | 95 | 3,735 |
| Dark gray bituminous limestone and dolomite with light gray and buff streaks | | |
| Nigaran Formation: | | |
| Guelph and Lockport dolomites | 5 | 3,740 |
| Fine buff to gray dolomite | 15 | 3,755 |
| Gray dolomite | 10 | 3,765 |
| Brown bituminous dolomite | 25 | 3,790 |
| Gray dolomite | 15 | 3,805 |
| Buff white dolomite | 5 | 3,810 |
| Yellow dolomite (color apparently due to rust) | 10 | 3,820 |
| Buff white dolomite | 5 | 3,825 |
| Light yellow dolomite (color apparently due to rust) | 5 | 3,830 |
| Gray dolomite with some shale | 5 | 3,835 |
| Grayish buff dolomite | 20 | 3,855 |
| Gray shale, calcareous (Rochester?) | 10 | 3,865 |
| Buff gray dolomite (Clinton?) | | |
| Gray dolomite | 5 | 3,870 |
| Buff bituminous dolomite | | |
| Cataract Formation: | | |
| Cabot Head Shale | 5 | 3,875 |
| Bright green shale | 20 | 3,895 |
| Red and green shale | 15 | 3,910 |
| Red shale, some greenish shale | 5 | 3,915 |
| Red and gray shale | 5 | 3,920 |
| Red shale, some gray | 20 | 3,940 |
| Greenish gray and red shale | 5 | 3,945 |
| Red shale, some gray | | |
| Red with gray shale grading downwards into greenish gray shale with some red shale | 15 | 3,960 |

CARO (TUSCOLA COUNTY)

COMMUNITY.

TUSCOLA OIL COMPANY No. 1.

Location: S. W. ¼ of N. E. ¼ Sec. 27, T. 13 N., R. 9 E. David Taylor farm, 2 miles north of Caro City Hall.

Elevation: 780 feet above sea level.

Driller's log to 205 feet. Samples below 205 feet from J. W. Pattison.

| | Thickness feet | Depth feet |
|---|-------------------|---------------|
| Pleistocene: | | |
| Soil | 3 | 3 |
| Sand, water | 12 | 15 |
| Clay | 17 | 32 |
| Gravel, water | 2 | 34 |
| Clay with pebbles | 8 | 42 |
| Coarse gravel, water | 13 | 55 |
| Clay | 30 | 85 |
| Fine sand and gravel, water | 7 | 92 |
| Blue clay | 33 | 125 |
| Boulders (used 20 sticks of dynamite) | 1 | 126 |
| Fine sand and boulders, water | 3 | 129 |
| Blue clay | 46 | 175 |
| Gray hardpan | 15 | 190 |
| Gravel, water | 1 | 191 |
| Blue shale | 15 | 206 |
| Mississippian: | | |
| Michigan Formation: | | |
| White sandstone with fragments of limestone and gray shale and pyrite | 5 | 211 |
| White sandstone with a few limestone fragments* | 6 | 217 |
| Green plastic shale | 6 | 223 |
| Gray limy shale, spots of green and pink | 6 | 229 |
| Gray and green shale with pink spots; limy | 4 | 233 |
| Shaly and limy sandstone | 11 | 244 |
| Gray plastic shale with fine quartz pebbles | 15 | 259 |
| Sandstone with limestone and shale fragments | 6 | 265 |
| Fine grained gray limy sandstone | 2 | 267 |
| Sandstone and pyritic shale | 24 | 291 |
| White sandstone | 12 | 303 |
| Gray limy sandstone | 32 | 335 |
| Gray-brown sandy limestone | 11 | 346 |
| Light gray limy shale | 14 | 360 |
| Pure white fine grained quartz sand with fragments of shaly dolomite | 12 | 372 |
| Pure white fine grained quartz sand with small amount of lime | 18 | 390 |
| Greenish gray limy grit | 7 | 397 |
| Greenish gray shaly limestone with pyrite | 6 | 403 |
| Dark gray plastic limy shale with green tinge | 93 | 496 |
| Limy dark gray shale | 10 | 506 |
| Dark gray plastic limy shale | 12 | 518 |
| Gray shaly limestone | 6 | 524 |
| Gray plastic shale with greenish tinge | 19 | 543 |
| Dark gray calcareous shale | 11 | 554 |
| Dark greenish gray shale | 6 | 560 |
| Gray shale and white sandstone | 12 | 572 |
| Napoleon Formation: | | |
| Yellowish white sandstone, medium to fine grained | 103 | 675 |
| Marshall Formation: | | |
| Light greenish gray sandy shale (grit) | 32 | 707 |
| Red sandy shale | 8 | 715 |
| Red sandy shale | 13 | 728 |
| Greenish gray sandy shale | 18 | 746 |
| Gray shale | 18 | 764 |
| Greenish gray sandy shale | 7 | 771 |
| Red sandy shale | 24 | 795 |
| Gray shale | 16 | 811 |
| Gray and dark gray sandy shale | 4 | 815 |
| Red sandy shale | 17 | 832 |
| Dark greenish gray and red sandy shale | 21 | 853 |
| Gray shale | 8 | 861 |
| Dark greenish gray and red sandy shale | 7 | 868 |
| Gray shale | 7 | 875 |
| Red to gray sandy shale | 39 | 914 |
| Greenish gray shale | 18 | 932 |
| Red sandy shale | 67 | 999 |
| Greenish gray shale | 34 | 1,033 |
| Red sandy shale | 35 | 1,068 |
| Red and dark greenish gray sandy shale | 8 | 1,076 |
| Greenish gray shale | 7 | 1,083 |

*206-217 may belong with Bayport formation, which sometimes shows a Basal sandstone.

TUSCOLA OIL COMPANY No. 1—Continued

| | Thickness feet | Depth feet |
|--|-------------------|---------------|
| Coldwater Formation: | | |
| Dark gray shale (this sample contains brick fragments) | 9 | 1,092 |
| Dark and light gray sandy shale | 5 | 1,097 |
| Gray sandy shale | 52 | 1,149 |
| Gray sandy shale | 33 | 1,182 |
| Olive brown highly plastic shale | 21 | 1,203 |
| Very fine grained shaly sandstone | 8 | 1,211 |
| Very fine grained sandstone increasingly shaly | 33 | 1,244 |
| Gray shale | 30 | 1,274 |
| Gray shaly sandstone | 24 | 1,298 |
| Olive brown highly plastic shale | 60 | 1,358 |
| Gray shaly sandstone | 14 | 1,372 |
| Dark olive brown highly plastic shale | 14 | 1,386 |
| Dark and light gray sandy shale | 10 | 1,396 |
| Olive brown highly plastic shale | 24 | 1,420 |
| Gray shaly sandstone | 7 | 1,427 |
| Olive brown highly plastic shale | 52 | 1,479 |
| Gray shaly sandstone | 11 | 1,490 |
| Iron gray plastic shale | 22 | 1,512 |
| Gray plastic shale | 39 | 1,551 |
| Gray sandy shale | 9 | 1,560 |
| Gray plastic shale | 23 | 1,583 |
| Gray sandy shale | 24 | 1,607 |
| Dark gray plastic shale | 16 | 1,623 |
| Gray and dark gray shaly sandstone | 9 | 1,632 |
| Gray shaly sandstone | 42 | 1,674 |
| Dark gray shale | 9 | 1,683 |
| Gray shaly sandstone | 17 | 1,700 |
| Dark gray shale | 105 | 1,805 |
| Gray shaly sandstone | 17 | 1,822 |
| Dark gray plastic shale | 8 | 1,830 |
| Gray sandy shale | 13 | 1,843 |
| Gray plastic shale | 12 | 1,855 |
| Dark gray and dark red shale | 5 | 1,860 |
| Gray shale | | |
| Sunbury Formation: | | |
| Dark gray to black shale | 37 | 1,897 |
| Black pyritic shale with white sandstone | 9 | 1,906 |
| Dark gray sandy shale; pyrite, white sandstone* | 30 | 1,936 |
| Berea Formation: | | |
| Very fine grained white sandstone (several samples stained red from rusted drill fragments) | 34 | 1,970 |
| Dark gray gummy shale | 10 | 1,980 |
| White sandstone, very fine grained | 2 | 1,982 |
| Dark gray gummy shale | 4 | 1,986 |
| Very fine grained white sandstone | 7 | 1,993 |
| Fine grained white sandstone with a few large sand grains and a few grains of black shale. Stained red, probably from rusted drill fragments | 15 | 2,008 |
| Fine grained white sandstone | 12 | 2,020 |
| Fine grained white sandstone with some light gray shale | 13 | 2,033 |
| Mississippian: | | |
| Bedford Formation: | | |
| Light gray sandy shale (sand from above) | 10 | 2,043 |
| Light gray shale | 23 | 2,066 |
| Light gray plastic shale | 12 | 2,078 |
| Light gray sandy shale | 19 | 2,097 |
| Light gray plastic shale | 25 | 2,122 |
| Gray shale, laminated | 46 | 2,168 |
| Devonian: | | |
| Antrim Formation: | | |
| Black laminated shale with pyrite | 164 | 2,322 |
| Black shale with pyrite and fossil spore cases | 30 | 2,352 |
| Black shale and pyrite with streaks of bluish gray shale with pyrite | 13 | 2,365 |
| Black shale with pyrite | 26 | 2,391 |
| Black shale and pyrite with thin layers of limestone | 18 | 2,409 |
| Traverse Formation: | | |
| Brown crystalline limestone with pyrite, chert and fossils | 22 | 2,431 |
| Plastic gray shale | 12 | 2,443 |
| Dark gray laminated shale | 28 | 2,471 |
| Brown and gray limestone, partly crystalline, some shale, some chert | 22 | 2,493 |
| Dark gray laminated shale | 12 | 2,505 |
| Gray and brown limestone with chert and pyrite | 25 | 2,530 |
| Dark gray laminated shale | 24 | 2,554 |
| Dark gray laminated and plastic shale | 4 | 2,558 |
| Dark gray laminated shale | 8 | 2,566 |
| Gray and brown limestone; some chert | 31 | 2,597 |
| Gray laminated shale | 33 | 2,630 |

*Transition zone from Sunbury to Berea.

TUSCOLA OIL COMPANY No. 1—Continued

| | Thickness feet | Depth feet |
|---|-------------------|---------------|
| Gray and brown crystalline limestone; some chert..... | 15 | 2,645 |
| Gray shaly limestone..... | 11 | 2,656 |
| Dark gray laminated shale..... | 7 | 2,663 |
| Gray and brown limestone..... | 57 | 2,720 |
| Dark gray laminated shale..... | 132 | 2,852 |
| Dark gray plastic shale; some lamination..... | 9 | 2,861 |
| Dark gray laminated shale..... | 51 | 2,912 |
| Dark gray plastic shale; some plastic shale..... | 6 | 2,918 |
| Dark gray laminated shale..... | 71 | 2,989 |
| Dark gray plastic shale; some lamination..... | 16 | 3,005 |
| Dark gray laminated shale..... | 23 | 3,028 |
| Dundee Formation: | | |
| Grayish brown limestone with shale caving from the Traverse above..... | 4 | 3,032 |
| Mostly shale caving from the Traverse; some grayish brown limestone..... | 42 | 3,074 |
| *Grayish brown limestone; fossils..... | 102 | 3,176 |
| Grayish brown limestone with shale caving from Traverse above; water from 3,168 to 3,176..... | 18 | 3,194 |
| Grayish brown limestone..... | 20 | 3,214 |
| Light gray limestone with some samples of a nearly white powder, pulverized by the drill..... | 128 | 3,342 |
| Detroit River formation:** | | |
| Dark brown limestone; petroleum odor..... | 5 | 3,347 |
| Brown limestone; anhydrite..... | 2 | 3,349 |
| Brown limestone; petroleum odor, anhydrite..... | 51 | 3,400 |
| No record..... | 10 | 3,410 |
| Gray dolomitic limestone; anhydrite..... | 22 | 3,432 |
| No record..... | 6 | 3,438 |
| Light gray dolomite..... | 16 | 3,454 |

*Tests for gypsum gave positive results at the following points: 3,160, 3,198, 3,219, 3,258, 3,290, 3,347, 3,353, 3,355, 3,358, 3,364, 3,369, 3,371, 3,375.

**The division between the Dundee and the Detroit River Formation is not clear. Tests for gypsum reveal its presence well toward the top of the Dundee, but flakes of anhydrite are not conspicuous until the brown limestones are reached. These have been provisionally placed in the Detroit River formation on the basis of the presence of well crystallized anhydrite. The material from 3,438 to 3,454 is quite clearly Detroit River Formation.

MT. CLEMENS (MACOMB CO.)

ST. CLAIR OIL AND GAS CO., OTTO COULON NO. 1

Location: In the N. W. $\frac{1}{4}$ of S. W. $\frac{1}{4}$ of Sec. 4, T. 2 N., R. 13 E., on the Otto Coulon farm 500 ft. from north line and 1,000 ft. from west line (200 ft. south of lane and 150 ft. east of line fence between two barns.)
Elevation: Approximately 600 ft. above sea level.
Drilling commenced on Dec. 29, 1927, by Becker and McRae, contractors, of Halfway, Mich. Record compiled by R. B. Newcombe from log and samples.

| | Thickness feet | Depth feet |
|---|-------------------|---------------|
| Pleistocene: | | |
| Drift (No record)..... | 28 | 28 |
| Water sand..... | 2 | 30 |
| Hard pan..... | 108 | 138 |
| Devonian: | | |
| Antrim Formation: | | |
| Black shale (drills in large chips and contaminated with surface material)..... | 17 | 155 |
| Gray and black shale..... | 10 | 165 |
| Black shale and nodular chert..... | 15 | 180 |
| Black shale with pyrite..... | 35 | 215 |
| Light brown shale..... | 20 | 235 |
| Black bituminous shale (micaceous in part and showing abundant pyrite)..... | 55 | 290 |
| Dark gray to blue gray pyritiferous shale..... | 5 | 295 |
| Black shale (pyrite abundant)..... | 15 | 310 |
| Traverse Formation: | | |
| Buff dolomitic limestone..... | 5 | 315 |
| Blue gray to buff pyritiferous dolomitic limestone and shale (gas at 330 feet)..... | 15 | 330 |
| White to light buff limestone..... | 15 | 345 |
| Blue gray to buff limestone..... | 35 | 370 |
| Buff limestone..... | 10 | 380 |
| Gray to buff fossiliferous limestone..... | 20 | 400 |
| Bell Formation: | | |
| Soft gray calcareous shale..... | 95 | 495 |
| Hard gray fossiliferous shaly limestone..... | 5 | 500 |
| Soft gray calcareous shale..... | 55 | 555 |
| Dundee Formation: | | |
| Gray to buff fossiliferous limestone..... | 5 | 560 |
| Buff limestone (vari-shaded and fossiliferous)..... | 60 | 620 |
| Light buff limestone (oil at 625)..... | 10 | 630 |
| Buff limestone..... | 20 | 650 |
| Fine grained buff limestone (mineral water at 650)..... | 5 | 655 |
| Granular buff limestone..... | 10 | 665 |
| Fine grained light buff limestone..... | 5 | 670 |
| Buff limestone..... | 25 | 695 |
| Upper Monroe (Detroit): | | |
| Buff porous dolomitic limestone..... | 15 | 710 |
| Brown oily dolomite..... | 10 | 728 |
| Buff dolomite with some black shale..... | 15 | 735 |
| Light buff dolomite..... | 5 | 740 |
| Porous buff oily dolomite (iron stained)..... | 30 | 770 |
| White to light buff dolomite..... | 5 | 775 |
| Buff to gray dolomite with white and blue gray anhydrite..... | 15 | 790 |
| Buff dolomite and selenite..... | 15 | 805 |
| Buff porous granular dolomite (oil show at 823 ft.)..... | 20 | 825 |
| Buff fine grained dolomite..... | 5 | 830 |
| Buff dolomite (with pyrite and iron stained) (salt water at 1,835 ft.)..... | 5 | 835 |
| Fine grained buff dolomite (iron stained)..... | 45 | 880 |
| Buff to grayish buff fine grained dolomite..... | 25 | 905 |
| Blue gray dolomite and anhydrite..... | 10 | 915 |
| Buff dolomite..... | 15 | 930 |
| Brownish dolomite (granular and porous)..... | 45 | 975 |
| Cherty brown dolomite (granular and porous)..... | 35 | 1,010 |
| Brown sandy dolomite..... | 15 | 1,025 |
| Sylvania Formation: | | |
| White to yellowish iron stained sandstone with frosted well rounded grains..... | 25 | 1,050 |
| White sandstone (finer grained)..... | 10 | 1,060 |
| White sandstone (iron stained and showing dolomitic cemented streaks)..... | 15 | 1,075 |
| White sandstone (iron stained) (oil showing at 1,087 ft.)..... | 30 | 1,105 |
| Casing Record: 10 in—155 ft. | | |
| 8 $\frac{1}{4}$ in—622 ft. | | |
| 6 5-8 in—1032 ft. | | |

MINERAL RESOURCES OF MICHIGAN

TRENTON (WAYNE COUNTY).

WELL DRILLED IN 1927, BY W. E. ELLIS.

Location: In the N. E. $\frac{1}{4}$ of the N. E. $\frac{1}{4}$ of Section 35, T. 4 S., R. 10 E., Brownstown Twp., on the Miller Road, 2 miles southwest of Trenton, about 700 feet south of road.
 Elevation: About 585 feet above sea level.
 Record compiled by W. Osgood and R. B. Newcombe from samples furnished by J. F. Miller and driller's
 og. Spudded in April 11, 1927. Driller's name, Frank C. Cheers.

| | Thickness feet | Depth feet |
|---|-------------------|---------------|
| Pleistocene: | | |
| Surface deposits..... | 20 | 20 |
| Devonian: | | |
| Detroit River Formation: | | |
| Light buff dolomite..... | 70 | 90 |
| Gray dolomite..... | 15 | 105 |
| Light buff dolomite..... | 11 | 116 |
| Dark brown bituminous dolomite..... | 20 | 136 |
| Light buff dolomite..... | 44 | 180 |
| Sylvania Formation: | | |
| Gray sandstone cemented by dolomite..... | 10 | 190 |
| White sandstone (hole full of water at 215 feet)..... | 70 | 260 |
| Gray sandstone (dolomite cement)..... | 20 | 280 |
| White sandstone..... | 10 | 290 |
| Silurian: | | |
| Bass Island and Salina Formations (Undivided): | | |
| Gray cherty dolomite..... | 10 | 300 |
| Sandy dolomite..... | 10 | 310 |
| Gray to buff cherty dolomite (much chert from 310-360 feet)..... | 140 | 450 |
| Gray to buff dolomite..... | 90 | 540 |
| Gray dolomite..... | 10 | 550 |
| Buff dolomite..... | 10 | 560 |
| Gray dolomite with some gypsum..... | 20 | 580 |
| Light buff dolomite..... | 25 | 605 |
| Gray dolomite..... | 15 | 620 |
| Dark gray to black dolomite with some anhydrite..... | 110 | 730 |
| Brown dolomite..... | 20 | 750 |
| Dark gray dolomite (with anhydrite)..... | 30 | 780 |
| Buff dolomite..... | 10 | 790 |
| Gray dolomite..... | 30 | 820 |
| Buff dolomite..... | 20 | 840 |
| Gray and brown dolomite..... | 30 | 870 |
| Brown dolomite and anhydrite..... | 130 | 1,000 |
| Gray dolomite..... | 80 | 1,080 |
| Light gray dolomite and anhydrite..... | 30 | 1,110 |
| Light buff dolomite (water enough to drill with at 1195, more at 1,280 feet)..... | 30 | 1,140 |
| Brown dolomite..... | 110 | 1,250 |
| Gray and brown dolomite..... | 30 | 1,280 |
| Gray dolomite (six bailers of water)..... | 90 | 1,370 |
| Guelph Formation: | 20 | 1,390 |
| White or bluish white dolomite..... | 10 | 1,400 |
| Milky white crystalline dolomite..... | 10 | 1,410 |
| Light brown dolomite, iron stained..... | 20 | 1,430 |
| Pink dolomite, iron stained..... | 30 | 1,460 |
| Light blue dolomite..... | 30 | 1,490 |
| Blue to gray dolomite..... | 10 | 1,500 |
| Lockport Formation: | | |
| Light buff dolomite (lithographic)..... | 10 | 1,510 |
| Gray dolomite and greenish gray shale..... | 10 | 1,520 |
| Cataract Formation: | | |
| (Cabot Head Member): | | |
| Purple and green shale and dolomite..... | 20 | 1,540 |
| Soft greenish gray shale..... | 40 | 1,580 |
| Gray dolomite and purple shales (iron stained)..... | 10 | 1,590 |
| (Manitoulin Member): | | |
| Gray to buff dolomite (iron stained)..... | 10 | 1,600 |
| Gray to greenish gray shaly dolomite..... | 10 | 1,610 |
| Light gray to buff hard crystalline dolomite..... | 20 | 1,630 |
| Ordovician: | | |
| Cincinnatian Series: | | |
| Greenish gray to purple shale..... | 10 | 1,640 |
| Greenish gray shale..... | 10 | 1,650 |
| Light red shale..... | 10 | 1,660 |
| Greenish gray to purple shale..... | 30 | 1,690 |
| Soft red shale..... | 60 | 1,750 |
| Greenish gray to purple hard shale..... | 10 | 1,760 |
| Light red shale..... | 10 | 1,770 |
| Purple and green shale (purple predominating)..... | 10 | 1,780 |
| Purple and green shale (green predominating)..... | 10 | 1,790 |

PROGRESS STRUCTURAL CONTOUR MAP OF SOUTHEASTERN MICHIGAN

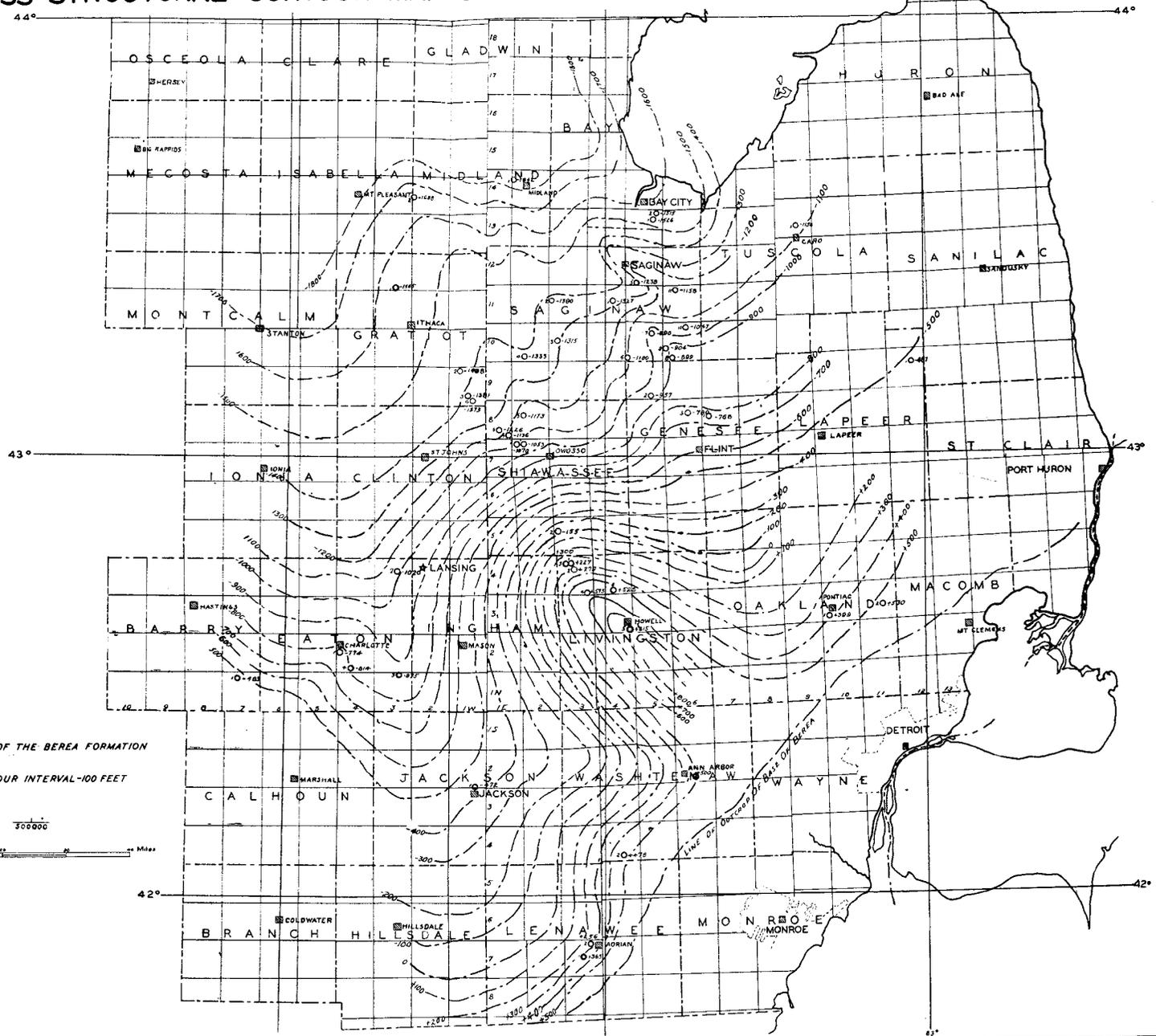


FIGURE 12.

Progress Structural Contour Map of Central and Southeastern Michigan Suggesting the Howell-Owosso Anticline.

WELL DRILLED IN 1927, BY W. E. ELLIS—Continued

| | Thickness feet | Depth feet |
|--|-------------------|---------------|
| Soft light gray shale..... | 10 | 1,800 |
| Gray shaly dolomite..... | 10 | 1,810 |
| Light to dark gray shale and shaly dolomite..... | 30 | 1,840 |
| Purple shale with some green..... | 20 | 1,860 |
| Greenish gray shale with some purple..... | 20 | 1,880 |
| Light greenish gray shale..... | 10 | 1,890 |
| Hard gray shale..... | 250 | 2,140 |
| Hard gray shale..... | 60 | 2,200 |
| Brownish gray shale (Utica?)..... | 40 | 2,240 |
| Brownish gray shale and dolomite (some pyrite)..... | 10 | 2,250 |
| Trenton Formation (Black River): | | |
| Buff dolomitic limestone and blue-gray shale..... | 30 | 2,280 |
| (Steel line measurement shows top of Trenton at 2,260 feet) | | |
| Brown limestone (some blue shale)..... | 20 | 2,300 |
| Light gray limestone..... | 10 | 2,310 |
| Buff and light gray limestone with some blue shale (fossils)..... | 36 | 2,346 |
| Show of oil and gas at 2,344. Oil at 2,342 to 2,352. After standing over night made about two quarts of oil. | | |
| Buff dolomite..... | 8 | 2,354 |
| White to buff cherty limestone..... | 16 | 2,370 |
| Light gray limestone..... | 20 | 2,390 |
| Dark gray to buff limestone..... | 30 | 2,420 |
| Light gray limestone..... | 10 | 2,430 |
| Buff to dark gray limestone (fossils)..... | 20 | 2,450 |
| Buff fossiliferous limestone and dark blue gray shale..... | 20 | 2,470 |
| Buff limestone..... | 50 | 2,520 |
| Dark gray shale (some buff limestone)..... | 20 | 2,540 |
| Buff limestone (fossils)..... | 40 | 2,580 |
| Dark gray limestone (some shale)..... | 60 | 2,640 |
| Light buff, fine grained, nearly lithographic limestone..... | 180 | 2,820 |

Casing Record: 10 in.—147 feet.
 8 1/4 in.—610 feet.
 6 5/8 in (20 pound)—1,798 feet.

CENTRAL MICHIGAN

The central part of the Southern Peninsula comprises both a geographical and geological province. It is largely underlain beneath the drift cover with strata of Pennsylvanian and Mississippian age. With few exceptions, wells drilled in the area first encounter either the Coal Measures, the Michigan formation, or the Upper Marshall (Napoleon) Sandstone. Accordingly the records of wells drilled throughout this part of the State exhibit similar depths and the formations encountered show a comparative sequence.

The structural conditions existing in this area were vaguely suggested in early drilling and water well records aided to define a pronounced anticline of major size. Although the exact crest of this fold is by no means definite, it has been traced in a northwest direction for more than 80 miles. The width will probably vary from 4 to 10 miles, but these dimensions are by no means accurate. Fig. 12 shows the structure as contoured from present data on the top of the Berea sandstone. The trend is from a little north of Ann Arbor through Howell and Owosso and the fold might well be termed the Howell-Owosso Anticline. Various other suggestions of structure have been brought out in Central Michigan. Drilling was prompted from rather indefinite indications in Eaton and Genesee Counties, but the points of control were so few and scattered that the wells were not very favorably located. The numerous wells of the Dow Chemical Company in Midland and Isabella Counties afforded data for determining the presence of a fold in that vicinity. These favorable structures trending into the center of the Michigan Basin point to

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greater possibilities for that section of the State, and shallow prospecting together with deep drilling should bear out this contention.

The principal operators in Central Michigan have been the Sun Oil Company, the Pure Oil Company, and the partnership of Norris & Smith. The efforts of the Sun Oil Company and Norris & Smith have been largely confined to the area of the Howell-Owosso anticline. The Pure Oil Company has been a minor contender for this territory and

WELLS PENETRATING THE BEREA FORMATION IN EAST CENTRAL MICHIGAN

| | |
|---|--------------------------------------|
| Barry County | 3. Jason—Shumway. |
| 1. Assyria Well. | 4. Hoover et al.—Ross Robb No. 1. |
| Bay County | 5. Howell Municipal Well. |
| 1. North American Chem. Co. Well. | 6. Burkhart Well—Cohoctah Twp. |
| 2. North Bay City Well. | Midland County |
| Eaton County | 1. Saginaw Prospecting Co.—Hlavacek. |
| 1. Charlotte Well. | 2. Pure-Root No. 1. |
| 2. Delta Well—Hiscock Farm. | Oakland County |
| 3. Eaton Rapids Well. | 1. Pontiac Nat. Gas & Oil Well. |
| 4. Charlotte—Huber Well. | 2. D. M. Ferry Well. |
| Genesee County | Saginaw County |
| 1. Universal-Bruner. | 1. Snavelly-Holehan. |
| 2. Universal Bacon. | 2. Miller-Bailey. |
| 3. Bradley-McGinnis. | 3. McLaughlin-Craven. |
| Gratiot County | 4. Voorhees & Sovereign—Loackridge. |
| 1. Alma Sanatorium. | 5. Gardner-Schwannecke. |
| 2. Sun-Robinault No. 1. | 6. Dillard-Atkins. |
| 3. Sun-Anderson. | 7. Bacon-Cedar. |
| 4. Horrie Oil Co. No. 1. | 8. Wolohan-Courtney. |
| Jackson County | 9. E. & B. Sauve. |
| 1. Worthington & Cooley Mfg. Co. | 10. Ellis-Kobs. |
| Kalamazoo County | 11. Michigan Petroleum Co.—Rogner. |
| 1. Bostwick No. 1. | Shiawassee County |
| Lapeer County | 1. Sun—McGinnis No. 1. |
| 1. Gaines—Burnside. | 2. Sun—Gallagher & Scullen. |
| 2. | 3. Voorhees & Sovereign—Wade No. 1. |
| Lenawee County | 4. Fordney-Mathews. |
| 1. Madison Oil and Gas Co. No. 1 (1905) | 5. Treat-Chapman Bros. |
| 2. Adrian Gas Company. | 6. Welch-Voorhees-Curtis. |
| Livingston County | Tuscola County |
| 1. Norris & Smith—Jno. Finlan No. 1. | 1. Tuscola Oil Company—Taylor. |
| 2. Norris & Smith—L. E. Raymer. | Washtenaw County |
| | 1. U. of M. Campus Well. |
| | 2. Manchester Well. |

has concentrated on the Midland-Isabella County area. These concerns have all drilled test wells and are actively developing the districts in which they are interested.

The firm of Norris and Smith is made up of J. T. Norris, Pittsburg, Pa., and C. A. Smith, Jr., of Chester, West Va., and their Michigan office is located at Owosso. The Pure Oil Co. maintains a Saginaw office with Wm. F. Wiechers in charge and W. A. Thomas, Geologist. The Sun Oil Company keeps their field office at Saginaw. George Myers is Supt., Sam. Burman, Field Supt., and Ralph Melhorn is resident Geologist at Owosso.

Several other concerns hold acreage blocks of considerable size and have drilled deep tests on their properties. Among these are the Saginaw Prospecting Company, the Universal Oil Company of Flint and Detroit, and the Wittmer Oil and Gas Company of Pittsburg. Various single individuals, drilling contractors, and local syndicates have also been interested in the oil development of Central Michigan and have contributed to its progress.

EATON COUNTY.

The scattered deep holes that had been drilled in Eaton and Barry Counties gave a semblance of a structural high running up through Eaton County. The Wittmer Oil and Gas Properties Company recognized the possibilities of this territory and leased a block of land on which they decided to make a test. R. R. Brant contracted for drilling the well, which was located on the Huber Bros. property in the NE $\frac{1}{4}$ of the SE $\frac{1}{4}$ of Section 28, 1200 feet east of the west line and 600 feet south of the north line. Drilling operations were commenced in the summer of 1927 and the well was plugged and abandoned on March 12, 1928. The Marshall occurred at 490 feet, the Berea at 1704 feet, the Traverse at 1955 feet, and the Dundee at 2075 feet. The hole was continued to a total depth of 2644 feet in the Monroe formation. A rainbow of oil was present in the top part of the Dundee limestone and water filled the hole for 800 feet at a depth of about 2130 feet. Water was encountered in the top of the Detroit River formation at 2325 feet, and also at various intervals deeper in the Monroe Series. A very oily dolomite occurred at 2632 feet and gas came up through the column of water in the hole. After packing the water off at 18 feet from the bottom and swabbing dry, the gas showing disappeared. Drilling was suspended because of the small size of hole.

Samples of the Monroe formation brine were collected for analysis and the water was found to have several unusual chemical constituents. Among these were the salts of Potassium and Calcium, and a small quantity of Iodine and Bromine radicals. A copy of the analysis indicates the proportions of various substances contained in the brine.

| Chemical Analysis | Parts Per Million |
|--------------------------------------|-------------------|
| Sodium | 35,750 |
| Potassium | 15,300 |
| Lithium | 4 |
| Solids, total | 243,940 |
| Solids, dissolved | 243,737 |
| Solids, dissolved | 203 |
| SiO ₂ (Silica) | 94 |
| Fe | 80 |
| Ca | 30,300 |
| Mg | 6,220 |
| Cl | 146,750 |
| SO ₄ | 14.8 |
| HCO ₃ (Bicarbonate) | 22.0 |
| CO ₃ (Carbonate) | None |
| Iodine p. p. b | 67 |
| Bromine | 201.5 |

GENESEE COUNTY.

Drilling in Genesee County was prompted because the general structural trend, as outlined from tests around Saginaw, seemed to be in that general direction. The Universal Oil Company of Detroit and Flint was organized for development and testing in various parts of the county. Contracts were made with C. P. Brant of Saginaw for three wells which were to be put down in the vicinity of Mt. Morris. Other Saginaw operators at once became interested in the territory and numerous interests took up leases in the immediate vicinity. A group of Catholic Priests organized the Genesee Development Company, which was capitalized

with 2,500 shares no par stock. The officers of the company included Rev. Fr. Valerian S. Szymanski, Rev. Fr. Stanley J. Sikorski of Saginaw, and Rev. Fr. Joseph A. Lewandowski of Bay City. One well was drilled for this concern by Wm. Bradley and Son of Saginaw.

Several water wells afforded additional data by having penetrated the Marshall formation. These wells were located in the general area north of Flint, and they not only gave important information, but they clearly demonstrated the possibilities of shallow testing for structure in northern Genesee County.

The dry holes drilled during 1927 apparently give sufficient structural control to show that none of the deep tests were in the most favorable location. It would appear that the two deep wells near Mt. Morris were situated in the syncline, and that potential territory will exist farther north and east of this town. Such suggestions are based on only scattered points of information and locations for wildcatting should be checked carefully by shallow well data. The risk would then be sufficiently limited to warrant the investment of larger sums of capital in deep well drilling.

GENESEE TOWNSHIP

The Universal Oil Company drilled its first well on the Bruner farm in the SW $\frac{1}{4}$ of the SE $\frac{1}{4}$ of Section 8, 250 feet north of the road and east of the cemetery. C. P. Brant commenced to spud in on this well on May 3, 1927, and operations were carried on throughout the summer. The Marshall was found at 320 feet, the Berea at 1528 feet, the Traverse at 1970 feet, and the Dundee at 2430 feet. Water flowed over the casing at 50 feet in the Berea and a large flow of water with some gas was found in the "Saginaw Sand." Salt water was tapped at 140 feet in the Dundee and drilling was continued to 2751 feet in the Monroe formation. The well was finally abandoned as a dry hole.

Caster Bros. of Saginaw drilled a water well for the Pere Marquette Railway. The location was 1 mile north of McGrew Station near Flint. A log was furnished by Wm. E. Caster in which the top of the Marshall formation was apparently encountered at 330 feet. The total depth of the well was 396 feet and a good supply of water was obtained.

FLUSHING TOWNSHIP

A shallow well was drilled by Caster Bros. in September, 1927, for the new Water Works plant at Fushing, Michigan. The location was in about the center of Section 26, approximately 1 mile east and $\frac{1}{4}$ mile north of the Flint River bridge. The record as compiled from a drillers' log and a few samples showed the Marshall to occur at 415 feet. The water obtained was quite salty.

MONTROSE TOWNSHIP

The Universal Oil Company put down their second deep well on the S. Bacon farm (Industrial Bank of Flint) which was about 3 miles southeast of the village of Montrose. The location was in the SE $\frac{1}{4}$ of the SE $\frac{1}{4}$ of Section 35, 175 feet west of the south property line. The Marshall sandstone occurred at 445 feet and the Berea grit was found at 1650 feet. No important showings of oil or gas were present and the well was plugged and abandoned at a total depth of 1776 feet.

MT. MORRIS TOWNSHIP

A well was drilled $2\frac{1}{2}$ miles west of Mt. Morris by Wm. Bradley & Son for the Genesee Development Company of Bay City. The location on the Mrs. M. McGinnis farm was in the northeast corner of the NW $\frac{1}{4}$ of the NW $\frac{1}{4}$ of Section 10. Drilling was carried to a total depth of 2560 feet with no significant indications of oil or gas. The Berea was found at 1530 feet, a stray sand was present at 1977 feet, the top of the Traverse occurred at 2038 feet, and the Dundee was found at 2460 feet. Water was tapped in the Traverse formation at 2038 feet. The well was plugged and abandoned on Feb. 25, 1928.

GRATIOT COUNTY.

A great deal of excitement was created in Gratiot County by the discovery of a large flow of gas in a shallow formation near Ashley. The sustained pressure and the excellent manner in which the flow kept up demonstrated the staying qualities of the well. Many believed that this gas was an indication of deeper production because of the supposed location on the general trend of the Howell-Owosso Anticline. Resulting from this belief drilling operations began in earnest, and five more wells were put down during the remainder of 1927. Three of these were deep tests and the other two were shallow offsets to the gas well. The results were mostly unfavorable until the Horrie Oil Company brought in their producer during the first part of 1928. Operations were resumed and three wells were started as offsets to this location. The county promises to be a center of development again during 1928 and new discoveries should result. At the present time one well is being carried on down to the Dundee in the hopes of finding deeper production.

ELBA TOWNSHIP

The Sun Oil Company's shallow gas well was located in Elba township in the NE $\frac{1}{4}$ of the NW $\frac{1}{4}$ of Section 16 and 150 feet south of the road. The gas was found at 490 feet and the sand was drilled to a total depth of 507 feet. According to position this sand should be the Parma formation of Pennsylvanian age, but this is not definitely established. When first gauged the open flow was 1,750,000 cu. ft. per 24 hours and the closed in rock pressure was 217 pounds. This is reported to be holding up remarkably well after a year's time.

V. M. Voorhees and others drilled an offset on the A. M. Darry farm in the SW $\frac{1}{4}$ of the NW $\frac{1}{4}$ of Section 15. The location was 300 feet east of the road and in the center of the farm north and south. No production was obtained and the well was abandoned.

On July 1, 1927, C. P. Brant and F. P. Hallick commenced a well which was located across the track on the east side of the village of Ashley. The boring was in SW $\frac{1}{4}$ of the NE $\frac{1}{4}$ of Section 7 on the Trask property. The so called Parma was found from 485 to 495 feet without any production of gas. Drilling was continued for some distance below this depth with no signs and the well was plugged and abandoned in late September, 1927.

The Sun Oil Company put down a test about a mile and three-quarters northwest of the gasser in the NW $\frac{1}{4}$ of the SE $\frac{1}{4}$ of Section 5 on the Robinault property. Water was encountered in this hole in the Parma at a depth of 485 feet. The Marshall occurred at 800 feet, the Berea at

2108 feet and the Traverse at 2493 feet. No significant shows were found in either the "Berea" or the "Saginaw Sand." Drilling was continued and a good showing found at 2597 feet to 2627 feet was shot with 40 quarts of nitroglycerin on August 20, 1927. Attempts were made to operate with a small production resulting, but the casing was ultimately pulled and abandoned.

An attempt was made by the Sun Oil Company to find an extension of the shallow gas pocket by drilling a well about 2200 feet to the southwest of the gasser. This location was on the Peter Anderson farm in the SW $\frac{1}{4}$ of the NE $\frac{1}{4}$ of Section 16, and fuel for drilling was supplied from the gas well. No production was found in the shallow sand and drilling was continued to total depth of 2578 feet. The Marshall occurred at 710 feet, the Berea at 2039 feet, and the Traverse at 2453 feet. A strong flow of brine was tapped in the Marshall at 748 feet, but no production of oil or gas was found. The well was plugged and abandoned.

In the fall of 1927 the Horrie Oil Company commenced to drill on the Charles B. Horrie farm in the SE $\frac{1}{4}$ of the NE $\frac{1}{4}$ of Section 22. The organization consisted of Chas. B. Horrie, Thos. Ryan, and Dale D. Horrie of Flannigan, Ill., who were doing business under the name of the Horrie Oil Company. The location was 300 feet from the south property line and 300 feet from the north-south road. The Marshall was found at 730 feet, the Berea at 2033 feet, and the Traverse at 2436 feet. Oil and gas were encountered in the "Saginaw Sand" at the top of the Traverse from 2436 to 2438 feet. Sufficient gas was present to cause the oil to flow upon slight agitation. On December 23, 1927, there were 75 barrels of oil in the tank and 800 feet of fluid in the hole. The well was tubed during the latter part of January and the daily average up to that time by swabbing was 16 $\frac{7}{8}$ barrels. In April, 1928, the pumping reports showed from 20 to 30 barrels per day.

Three additional wells were commenced during the spring of 1928 with hopes of finding adjacent production to the Horrie well. These locations were Charles B. Horrie No. 2 located 300 feet north of south and 300 feet west of east; the Wayco Producing Company, Frank M. Ireland in the SW $\frac{1}{4}$ of the NW $\frac{1}{4}$ of Section 23, 300 feet from the North and 300 feet from the west; and the Sun Oil Company, S. S. Menter in the NE $\frac{1}{4}$ of the NE $\frac{1}{4}$ of Section 22, 300 feet from the south and 300 feet from the east.

LIVINGSTON COUNTY.

According to present data, the Howell-Owosso Anticline extends across Livingston County from the southeast corner to the northwest corner and water well information seems to indicate that the high point of the fold exists somewhere in this County. Early shows of oil and gas in water wells first directed interest to this part of the State. Later the accurate records kept by Frank Chapman, a water well driller from Fowlerville, Michigan, added further evidence. Since the discovery of the Saginaw Oil Field, four wells have been put down in the county in the search for oil and gas. A great portion of the territory supposed to be located on the anticline is under lease by the Sun Oil Company, Norris & Smith, and the Pure Oil Company. Co-operative shallow testing for structure in this area is being projected for the coming season.

CONWAY TOWNSHIP

Norris & Smith made plans to drill three wells during 1927 in Conway township. J. L. Hoover of Saginaw was given the contract for the projects and the first location was made on the L. E. Raymer farm in the SW $\frac{1}{4}$ of the SE $\frac{1}{4}$ of Section 16. The well was situated 250 feet east of the line fence and 250 feet south of the second 40 acres. The top of the Berea grit was found at 636 feet and drilling was finished at 777 feet. A small showing of oil in the Berea was shot with nitroglycerin but no production resulted. The well was plugged and abandoned.

The second test was made by Norris & Smith on the John Finlan farm in the SW $\frac{1}{4}$ of the SW $\frac{1}{4}$ of Section 9 and the location was 250 feet from the south line and 250 feet from the east line. Fresh water occurred at 130 feet and brine at 355 feet. A gas sand was tapped at from 418 to 421 feet with about 30,000 cubic feet estimated flow, but water which came in below drowned it out. The Berea was encountered at 673 feet and a show of oil and a small amount of gas was struck at 10 feet in the formation. Water was found in the bottom of the Berea and the well was plugged at a total depth of 696 feet.

J. L. Hoover and others, including Norris & Smith and some Fowler-ville parties, drilled the third well on the Ross Robb farm. This location was in the SE $\frac{1}{4}$ of the SE $\frac{1}{4}$ of Section 26, 300 feet from the east property line and 300 feet from the south property line. The Berea sandstone occurred at the shallow depth of 317 feet and salt water was present in the bottom of the first sand streak. The Traverse formation occurred at 640 feet and the Dundee limestone at 750 feet. Salt water was found at 715 feet but the water at 790 feet in the Dundee was of the fresh variety. A nice showing of oil and small amount of water existed at 1155 feet and black water with some oil in the bottom came in at 1200 feet. According to the most recent reports drilling operations were still under way at 1370 feet.

IOSCO TOWNSHIP

Norris & Montgomery of Pittsburg, Pa., drilled on the J. M. Bradley farm, close to the center of Section 21, T. 2 N.—R. 3 E., Iosco township. O. J. Carr of Jewett, Ohio, was contractor for the project in which drilling commenced on Sept. 23, 1926, and ended on October 15, 1926. The total depth of the well was 625 feet where operations were stopped in the Coldwater formation. The Upper Marshall (Napoleon) sandstone was found at 111 feet and was the only identifiable marker encountered.

MIDLAND COUNTY.

A great deal of drilling carried on by the Dow Chemical Company gave some evidence of oil and gas. One well in the western part of Greendale township flowed a considerable amount of oil on several occasions. From their activities in the Saginaw field, the Saginaw Prospecting Company became very much interested in this general vicinity. Later the Pure Oil Company obtained data from the Dow Chemical Company wells which enabled them to carry on a structural study of the region. Being favorably impressed, they leased a large block of acreage west of Midland and put down a deep test well during the fall of 1927 and the winter of 1927-28. Results have been to focus attention on this locality and it will no doubt be the scene of much future testing and development.

The Saginaw Prospecting Company drilled in the NE $\frac{1}{4}$ of the SW $\frac{1}{4}$ of Section 29, T. 14 N., R. 2. E., Midland township on the Chas. Hlavacek property. The well was commenced on October 18, 1926, by Regan & Goll, Drilling Contractors, of Saginaw, and Lancaster, Ohio, and the rig had to be moved 185 feet because of collapsing drive pipe. The Upper Marshall (Napoleon) formation was found at 1175 feet and it carried water. The Berea occurred at 2442 feet and consisted of 131 feet of soft gray sandstone which was broken and dry. The top of the Traverse was found at 2960 feet and the "Saginaw Sand" was hard, brown, and dry. Water was encountered at 132 and 152 feet in the Dundee formation, the top of which occurred at 3587 feet, and the well was continued to a total depth of 3739 feet. Drilling operations were suspended on January 30, 1927, after which plugging and abandonment followed.

The Pure Oil Company commenced their test in Greendale township early in September, 1927. The well was located on the Laura Root property in the NE $\frac{1}{4}$ of the SE $\frac{1}{4}$ of Section 18, 300 feet from the north line and 300 feet from the east line. H. W. Arbaugh contracted for the drilling which was carried on with a Star portable drilling machine.

At 1127 to 1148 feet black oil was encountered which raised in the hole between 400 and 500 feet. The gravity of this crude was about 26 degrees Be. After trying to pump this oil for several days with little success, the tubing and rods were removed and drilling was resumed. A hole full of water was obtained at 1154 feet and the Marshall brine horizon was tapped at 1172 feet. At 1390 feet there was 800 feet of water in the hole and a show of oil appeared. The Berea sandstone which occurred at 2401.5 feet, was very shaly and broken and contained no oil and gas. The top of the Traverse was found at 2902 feet and significant amounts of oil occurred in this formation from 2902 to 2926, 2981 to 2984, 3009 to 3020, and 3082 to 3090. Gas was present at 3081 feet and water which soon became exhausted came in from 3068 feet to 3079 feet. The top of the Dundee was reached at 3500 $\frac{1}{2}$ feet according to steel line measurement, and oil and gas was found at 3433 feet. After drilling to 3534 feet the oil was turned into the tank and the flow was about 30 barrels during the first 24 hours. The amount of gas was estimated from 40,000 to 70,000 cubic feet. Additional tanks were moved in, a standard rig was erected over the hole, and reports for the first three months of production showed an average of about 28 barrels daily. The oil was of 42 Degrees Be. gravity and exceptionally high grade. A pipe line has now been completed to the nearest railroad point and plans are being made to drill the well in deeper.

SHIAWASSEE COUNTY.

The Sun Oil Company and Norris and Smith decided to put down a number of "wildcat" holes in Shiawassee County in an effort to test out more exactly the nature of the high of the Howell-Owosso Anticline. Two wells were initially planned in Owosso and Fairfield townships, and future prospecting was to follow from these findings. Although these tests were drilled in the name of the Sun Oil Company, the expenses of operation were shared by Norris and Smith who held contiguous acreage. Other drilling resulted from this start and before the year of 1927 was over, seven wells had been completed in Shiawassee County.

ANTRIM TOWNSHIP

The Sun Oil Company drilled in the southern part of Shiawassee County near the town of Morrice. The well was located on the Gallagher & Scullen farm in the SE $\frac{1}{4}$ of the SW $\frac{1}{4}$, Section 18, 460 feet south of the north property line, 125 feet west of the east property line, and 200 feet north of the south line of the section. The Upper Marshall (Napoleon) was absent and the Berea was found at 1033 feet. A show of oil was present from 1105 to 1110 feet and oil and gas from 1152 to 1168 feet. Sufficient oil to operate was not available and the well was drilled to the Traverse which was found at 1435 feet. This formation was also dry and the well was plugged and abandoned at a total depth of 1462 feet.

FAIRFIELD TOWNSHIP

J. W. Fordney of Saginaw drilled in the NE $\frac{1}{4}$ of the SE $\frac{1}{4}$ of Section 36 on the 40 acre farm belonging to Roy Mathews. The contracting parties for drilling were Crowley and Carr and the well was commenced in the summer of 1927. The location was about a mile and a half northwest of the Sun Oil Company McGinnis well, 285 feet west of the road, and 420 feet south of the north property line. The top of the Marshall was found at 650 feet, the Berea at 1908 feet, and the Traverse at 2314 feet. There was 5 feet of Berea and 3 feet of "Saginaw Sand." The well was drilled to 2380 feet where the hold filled within 100 feet of the top with a heavy brine. This resulted in its plugging and abandonment.

A well was commenced about November 1st, 1927, by James A. Welch of Flint and V. M. Voorhees of Saginaw on the Daniel D. Curtis farm, SE $\frac{1}{4}$ of SE $\frac{1}{4}$, Section 27, near the village of Carland. The location was 150 feet from the north farm line, 150 feet from the east farm line, and across the road from a cemetery. The Marshall occurred at 697, the Berea at 1971, and the Traverse at 2384 feet. About 47 feet of broken "Berea Sand" and 8 feet of "Saginaw Sand" were present. No production was found and a hole full of water caused abandonment of the project at 2450 feet.

OWOSSO TOWNSHIP

The first well put down by the Sun Oil Company in Shiawassee County was located on the H. C. McGinnis estate in the SW $\frac{1}{4}$ of the SW $\frac{1}{4}$ of Section 5, T. 7 N., R. 2 E., Owosso township. Drilling was commenced early in the spring of 1927 and was carried on through the first part of the summer. The Marshall occurred at 525 feet, the Berea at 1798 feet, and the top of Traverse at 2201 feet. The Berea was only represented by 3 feet of actual sandstone and the top limestone (Saginaw Sand) of the Traverse formation was also only 3 feet thick. Oil was found in the top of the Traverse and 35 barrels of crude was bailed from the well during the first 24 hours. For some time the well bailed 10 barrels daily, and after being put on the pump the production was about 9 barrels daily. Output increased during the second week to between 15 and 18 barrels daily, but this fell off rapidly. The decrease of flow into the well prompted drilling deeper and water was encountered at 2298 feet. Hopes were given up of making the well a sustained producer and it was plugged and abandoned.

V. M. Voorhees, a Saginaw contractor, and W. J. Sovereign of Bay City drilled on the Pat Wade farm in the SW $\frac{1}{4}$ of the SE $\frac{1}{4}$ of Section 6, which was located about $\frac{1}{2}$ mile west of the McGinnis well. The Mar-

shall was reported at 580 feet, the Berea at 1815 feet, and the Traverse at 2211 feet. No production was obtained and the well was plugged and abandoned as a dry hole.

In the winter of 1927-28, Norris & Smith drilled an offset southeast of the McGinnis well. This location was on the Joe Jurica farm in the NE¹/₄ of the NW¹/₄ of Section 8 and was 200 feet from the north property line and 200 feet from the west property line. The Berea horizon was found at 1804¹/₂ feet and the top of the Traverse formation was found at 2211 feet. These measurements were made with a steel line. The 3 feet of "Saginaw Sand" encountered contained no significant showing of oil and the well was carried to the total depth of 2248 feet. Plugging and abandonment followed immediately.

RUSH TOWNSHIP

The E. M. Treat Oil and Gas Company of Pittsburg, Pa., drilled in the fall of 1927 on the Chapman Bros. farm about 3 miles west of Henderson. The location was in the SE¹/₄ of the SW¹/₄ of Section 17, 300 feet west of east property line and along the Henderson drain. The top of the Marshall formation was encountered at 620 feet, the Berea at 1908 feet, and the Traverse at 2328 feet. A show of oil was found at 2340 feet, but the tapping of water in the next few feet caused the plugging and abandonment of the hole.

EATON COUNTY

| Location. | Sec. | T.-R. | Township. | Farm. | Company. | Elev. | Drift. | Marshall. | Berea. | Traverse. | Dundee. |
|-----------|------|---------|-----------|-------------|-----------------------|-------|--------|-----------|------------------|-----------|---------|
| N.E./S.E. | 28 | 2N.-4W. | Eaton | C. E. Huber | Wittmer Oil & Gas Co. | 890 | 99 | 490 | (1,440) 1,704 | 1,955 | 2,075 |

GENESEE COUNTY

| Location. | Sec. | T.-R. | Township. | Farm. | Company. | Elev. | Drift. | Marshall. | Berea. | Traverse. | Dundee. |
|-----------|------|---------|------------|-------------------|-------------------------|-------|--------|-----------|--------|-----------|---------|
| SW/SE | 8 | 8N.-7E. | Genesee | Bruner | Universal Oil | 760 | 142 | 320 | 1,528 | 1,970 | 2,430 |
| NW/SE | 19 | 8N.-7E. | Genesee | P. M. R. R. | P. M. R. R. | 732 | 177 | 330 | | | |
| SE/SE | 26 | 8N.-5E. | Flushing | Water works plant | Flushing Water Works | 730 | 60 | 415 | | | |
| S.E./S.E. | 35 | 8N.-5E. | Montrose | S. Bacon | (Universal) C. P. Brant | 693 | 140 | 445 | 1,650 | | |
| N.W./N.W. | 10 | 8N.-6E. | Mc. Morris | M. McGinnis | Genesee Development Co. | 750 | 135 | | 1,530 | 2,023 | 2,460 |

GRATIOT COUNTY

| Location. | Sec. | T.-R. | Township. | Farm. | Company. | Elev. | Drift. | Marshall. | Berea. | Traverse. | Dundee. |
|-----------|------|---------|-----------|-----------------------|---------------------|-------|--------|------------------------------------|--------|-----------|---------|
| N.E./N.E. | 22 | 9N.-1W. | Elba | S. S. Menter | Sun Oil Co. | | | 745 | 2,035 | | |
| S.W./N.W. | 23 | 9N.-1W. | Elba | F. M. Ireland | Wayco Prod. Co. | | | Gas at 490 (Parma) ² | | 2,433 | |
| N.E./N.W. | 16 | 9N.-1W. | Elba | A. M. Darry | Sun Oil Co. | 658 | 148 | 800 | 2,108 | | |
| S.W./N.W. | 15 | 9N.-1W. | Elba | Robinault | Voorhees | 670 | | 710 | 2,039 | 2,493 | |
| N.W./S.E. | 5 | 9N.-1W. | Elba | P. Anderson | Sun Oil Co. | 658 | 126 | Parma ² | | 2,453 | |
| S.W./N.E. | 7 | 9N.-1W. | Elba | Trask | C. P. Brant, et al. | | 160 | 485 | | | |
| S.E./N.E. | 22 | 9N.-1W. | Elba | Chas. B. Horrie No. 1 | Horrie Oil Co. | 660 | 139 | 730 | 2,033 | 2,436 | |
| S.E./N.E. | 22 | 9N.-1W. | Elba | Chas. B. Horrie No. 2 | Horrie Oil Co. | | | | | | |

LIVINGSTON COUNTY

| Location. | Sec. | T.-R. | Township. | Farm. | Company. | Elev. | Drift. | Marshall. | Berea. | Traverse. | Dundee. |
|-----------|------|---------|-----------|---------------|----------------------|-------|--------|-----------|--------|-----------|---------|
| Center | 21 | 2N.-3E. | Iosco | J. M. Bradley | Norris-Montgomery | 920 | 75 | 111 | | | |
| S.W./S.W. | 9 | 4N.-3E. | Conway | John Finlan | Norris & Smith | 900 | 108 | | 673 | | |
| S.W./S.E. | 16 | 4N.-3E. | Conway | J. E. Raymer | Norris & Smith | 915 | 99 | | 636 | | |
| S.E./S.E. | 26 | 4N.-3E. | Conway | Ross Robb | J. L. Hoover, et al. | 890 | 94 | | 317 | 640 | |

MIDLAND COUNTY

| Location. | Sec. | T.-R. | Township. | Farm. | Company. | Elev. | Drift. | Marshall. | Berea. | Traverse. | Dundee. |
|-----------|------|----------|-----------|-------------|-------------------------|-------|--------|-----------|--------|-----------|-------------------|
| N.E./S.W. | 29 | 14N.-2E. | Midland | C. Hlavacek | Saginaw Prospecting Co. | 600 | 264 | 1175 | 2442 | 2960 | T.D. 3739 3587 |
| N.E./S.E. | 18 | 14N.-2W. | Greendale | L. Root | Pure Oil | 713 | 268 | 1127 | 2401 | 2902 | 3501 |

SHIAWASSEE COUNTY

| Location. | Sec. | T.-R. | Township. | Farm. | Company. | Elev. | Drift. | Marshall. | Berea. | Traverse. | Dundee. |
|-----------|------|---------|-----------|---------------------|----------------------|-------|--------|-----------|--------|-----------|---------|
| S.E./S.W. | 18 | 5N.-2E. | Antrim | Gallagher & Souller | Sun Oil Co. | 875 | 175 | | 1,030 | 1,435 | |
| S.E./S.E. | 27 | 8N.-1E. | Fairfield | D. D. Curtis | Welch & Voorhees | 745 | 127 | 697 | 1,971 | 2,384 | |
| N.E./S.E. | 36 | 7N.-2E. | Fairfield | Roy Matthews | J. W. Fordney | 742 | 115 | 650 | 1,908 | 2,314 | |
| S.W./S.W. | 5 | 7N.-2E. | Owosso | H. C. McGinnis | Sun Oil Co. | 745 | 95 | 525 | 1,798 | 2,201 | |
| N.E./N.W. | 8 | 7N.-2E. | Owosso | Jos. Jurica | Norris & Smith | 734 | 105 | | 1,804 | 2,211 | |
| S.W./S.E. | 6 | 7N.-2E. | Owosso | Pat Wade | Voorhees & Sovereign | 745 | 96 | 580 | 1,815 | 2,211 | |
| S.E./S.W. | 17 | 8N.-2E. | Rush | Chapman Bros. | E. M. Treat | 755 | 97 | 620 | 1,908 | 2,328 | |

TYPICAL WELL RECORDS
FROM
CENTRAL MICHIGAN

CHARLOTTE (EATON COUNTY)
WITTMER CO.—HUBER NO. 1

Location: On C. E. Huber farm just south of center of N. E. ¼ of S. E. ¼ section 28, T. 2 N., R. 4 W. Eaton Township.
Elevation: 900 feet.
Drilled for oil in 1927 by Wittmer Oil & Gas Company, Pittsburgh, Penna. Record from log and samples furnished by company.

| | Thickness feet | Depth feet |
|--|----------------|------------|
| Pleistocene: | | |
| Soil | 1 | 1 |
| Gravel | 40 | 41 |
| Sand and gravel | 35 | 76 |
| Quicksand | 23 | 99 |
| 99 feet 10 inch drive pipe. | | |
| Pennsylvanian: | | |
| Saginaw Formation: | | |
| Sandstone | 46 | 145 |
| Sand and slate | 4 | 149 |
| Sand rock | 12 | 161 |
| (Hole caving) | | |
| Sandy shale | 200 | 361 |
| Parma Formation: | | |
| Sand rock | 104 | 465 |
| Mississippian: | | |
| Michigan Formation: | | |
| Sandy slate | 10 | 475 |
| Blue slate | 5 | 480 |
| Sandy slate | 10 | 490 |
| Upper Marshall Formation: | | |
| Sandstone | 50 | 540 |
| Lower Marshall Formation: | | |
| Blue sandy slate | 30 | 570 |
| Black slate | 10 | 580 |
| Sandy slate | 35 | 615 |
| Sandstone | 25 | 640 |
| Blue slate | 10 | 650 |
| Black slate | 20 | 670 |
| Sandstone | 25 | 695 |
| Coldwater Formation: | | |
| Blue slate | 100 | 795 |
| (Set 719 feet of 8 inch casing) | | |
| Lime | 2 | 797 |
| Dark shale | 643 | 1,440 |
| Berea (Richmondville?) Formation: | | |
| Sand, broken sand and slate | 14 | 1,454 |
| Slate | 6 | 1,460 |
| Sand | 23 | 1,483 |
| (First 6 feet soft) | | |
| Blue slate | 207 | 1,690 |
| Shell | 4 | 1,694 |
| Blue slate | 10 | 1,704 |
| Berea Horizon: | | |
| Red rock | 12 | 1,716 |
| Bedford Formation: | | |
| Blue slate | 4 | 1,720 |
| Hard shell | 4 | 1,724 |
| Blue slate | 6 | 1,730 |
| Antrim Formation: | | |
| Black slate | 15 | 1,745 |
| White slate | 15 | 1,760 |
| Black slate (rainbow of oil in black slate) | 130 | 1,890 |
| Black lime (concretion?) | 3 | 1,893 |
| Black slate | 62 | 1,955 |
| Traverse Formation: | | |
| Dark lime (Saginaw sand at top) | 35 | 1,990 |
| Black slate | 10 | 2,000 |
| Dark lime | 55 | 2,055 |
| Black slate | 20 | 2,075 |
| Dundee Formation: | | |
| Light lime (rainbow of oil) | 40 | 2,115 |
| Salt sand | 43 | 2,158 |
| (Water filled hole 800 feet second screw in) | | |
| Light lime (flaky) at | | 2,158 |

WITTMER CO.—HUBER No. 1—Continued

| | Thickness feet | Depth feet |
|---|-------------------|---------------|
| Flaky light gray to buff limestone | 80 | 2,238 |
| Gray limestone (shade darker and some buff streaks) | 48 | 2,286 |
| Buff limestone (darker at top) | 54 | 2,340 |
| Light brown fine grained oily limestone (water in the top) | 5 | 2,345 |
| Monroe Formation: | | |
| Light buff sugary limestone | 10 | 2,355 |
| Brown oily dolomitic limestone | 6 | 2,361 |
| Light gray to buff dolomite | 14 | 2,375 |
| Brown oily dolomite | 10 | 2,385 |
| Buff dolomite | 11 | 2,396 |
| Brown dolomite | | |
| Buff dolomite | 9 | 2,405 |
| Light brownish buff dolomite | 15 | 2,420 |
| Gray dolomite | 5 | 2,425 |
| Buff dolomite and bluish anhydrite | 74 | 2,499 |
| Fine grained buff dolomite (water) | 6 | 2,505 |
| Flaky and chalky buff dolomite | 5 | 2,510 |
| Buff sandy dolomite (smell of oil in drilling) | 7 | 2,517 |
| Fine grained buff dolomite becoming lighter toward the bottom (water) | 33 | 2,550 |
| Dark gray dolomite | 4 | 2,554 |
| Bluish gray dolomite and anhydrite | 6 | 2,560 |
| Brownish fine grained dolomite | 4 | 2,564 |
| White to light buff dolomite | 22 | 2,586 |
| Brownish dolomite | 20 | 2,606 |
| Very fine grained light buff limestone | 4 | 2,610 |
| Light gray to buff dolomite | 31 | 2,641 |

MT. MORRIS WELL (GENESEE COUNTY)

BRUNER NO. 1

Location: Near N. W. corner of S. W. $\frac{1}{4}$ of S. E. $\frac{1}{4}$ of section 8, T. 8 N., R. 7 E., Genesee Township, on and one-half miles S. E. of Mt. Morris, on Bruner farm, 250 feet north of road and near cemetery.
Elevation: About 760 feet above sea level.
Record by R. A. Smith from samples. Drilled by Universal Oil Company in 1927 for oil. C. P. Brant, contractor.

| | Thickness feet | Depth feet |
|---|-------------------|---------------|
| Pleistocene: | | |
| Yellow sandy clay | 8 | 8 |
| Fine gray sand | 72 | 80 |
| Blue clay | 32 | 112 |
| Gravel, water bearing | 8 | 120 |
| Sand | 22 | 142 |
| Pennsylvanian: | | |
| Saginaw Formation: | | |
| Fine gray sandstone | 65 | 207 |
| Coarse white sandstone (Parma?) | 13 | 220 |
| Mississippian: | | |
| Michigan Formation: | | |
| Greenish gray shale | 20 | 240 |
| Dark gray shale | 50 | 290 |
| Gray sandstone | 4 | 294 |
| Dark gray shale | 26 | 320 |
| Upper Marshall or Napoleon Formation: | | |
| Gray sandstone | 85 | 405 |
| Gray to medium grained sandstone, shaly | 93 | 498 |
| Blue shale | 27 | 525 |
| Very fine grained gray sandstone | 20 | 545 |
| Blue shale | 85 | 630 |
| Very fine grained gray sandstone, shaly | 32 | 662 |
| Gray shale | 18 | 680 |
| Red sandy shale | 10 | 690 |
| Light gray shale | 105 | 795 |
| Dark red sandy shale | 30 | 825 |
| Gray shale, reddish in places | 625 | 1,450 |
| Gray shale | 20 | 1,470 |
| Reddish shale | 10 | 1,480 |
| Gray shale | 23 | 1,503 |
| Sunbury Formation: | | |
| Black shale | 25 | 1,528 |

BRUNER No. 1—Continued

| | Thickness feet | Depth feet |
|--|-------------------|---------------|
| Berea Formation: | | |
| Sandstone | 22 | 1,550 |
| Fine yellowish white sandstone | 30 | 1,580 |
| Very fine argillaceous sandstone and dark sandy shale | 75 | 1,655 |
| Dark yellowish gray sandstone, muddy | 15 | 1,670 |
| Bedford Formation: | | |
| White or light gray shale | 90 | 1,760 |
| Devonian: | | |
| Antrim Formation: | | |
| Black shale | 46 | 1,806 |
| Brown shale | 109 | 1,915 |
| Brown shale and limestone (concretions?) | 15 | 1,930 |
| Brown shale | 40 | 1,970 |
| Traverse Formation: | | |
| Brown bituminous limestone | 3 | 1,973 |
| Dark buff bituminous and crystalline limestone | 7 | 1,980 |
| Dark buff limestone | 10 | 1,990 |
| Blue shale | 22 | 2,012 |
| Buff gray cherty limestone | 13 | 2,025 |
| Granular limestone, very rusty | 10 | 2,035 |
| Brown bituminous limestone, rusty | 25 | 2,060 |
| Shaly bituminous limestone, rusty | 2 | 2,062 |
| Black bituminous limestone, rusty | 18 | 2,080 |
| Gray limestone, argillaceous | 5 | 2,085 |
| Hard granular limestone, badly rusted | 2 | 2,087 |
| Bell Formation?: | | |
| Blue shale | at | 2,200 |
| No samples | 230 | 2,430 |
| Dundee Formation: | | |
| Buff to gray limestone | 170 | 2,600 |
| Monroe Formation: | | |
| No samples but probably gray brown and buff limestone and dolomite, argillaceous bituminous and sandy with anhydrite and sulphur | | 2,751 |

NOTE: Water came over casing in the Berea at 50 ft. in the formation. (Big flow of water and some gas in Saginaw sand Traverse). Salt water found 140 feet in the Dundee

ASHLEY (GRATIOT COUNTY)

ANDERSON NO. 1

Location: S. W. $\frac{1}{4}$ of N. E. $\frac{1}{4}$ of Section 16, T. 9 N., R. 1 W., on Peter J. Anderson farm, 700 feet north of south farm line and 2,200 feet southwest of the shallow gas well.
Elevation: 658 feet above sea level.
Drilled in 1927 by Sun Oil Company, Toledo. Record compiled by R. B. Newcomb from driller's log

| | Thickness feet | Depth feet |
|--|-------------------|---------------|
| Pleistocene: | | |
| Drift, soil, sand and gravel | 126 | 126 |
| Pennsylvanian: | | |
| Saginaw Formation: | | |
| Shale | 54 | 180 |
| White sand, fresh water flow at 200 feet | 150 | 330 |
| Black slate | 40 | 370 |
| Parma Formation: | | |
| Sand | 54 | 424 |
| Mississippian: | | |
| Michigan Formation: | | |
| Blue slate | 76 | 500 |
| Broken formation | 30 | 530 |
| Blue slate | 180 | 710 |
| Napoleon (Upper Marshall) Formation: | | |
| Sandstone (salt brine flow at 748 feet) | 116 | 826 |
| Lower Marshall Formation: | | |
| Red rock | 209 | 1,035 |
| Blue slate | 55 | 1,090 |
| Blue slate (?) | 85 | 1,175 |
| Red rock | 8 | 1,183 |

ANDERSON No. 1—Continued

| | Thickness feet | Depth feet |
|--------------------------------------|-------------------|---------------|
| Coldwater Formation: | | |
| Blue slate..... | 197 | 1,380 |
| Lime..... | 40 | 1,420 |
| Blue slate..... | 580 | 2,000 |
| Red rock..... | 7 | 2,007 |
| Sunbury Formation: | | |
| Black shale..... | 32½ | 2,039½ |
| Berea Formation: | | |
| Sandstone..... | 12½ | 2,052 |
| Devonian: | | |
| Bedford Formation: | | |
| Broken slate..... | 48 | 2,100 |
| Antrim Formation: | | |
| Brown shale..... | 100 | 2,200 |
| Black shale..... | 253 | 2,453 |
| Traverse Formation ("Saginaw Sand"): | | |
| Limestone, dry..... | 11 | 2,464 |
| Blue slate..... | 32 | 2,496 |
| Hard limestone..... | 82 | 2,578 |
| Casing record: | | |
| 10 inch drive pipe..... | 126 feet | |
| 8¼ inch casing..... | 451 feet | |
| 6 5-8 inch casing..... | 1,090 feet | |

LAKE ODESSA (IONIA COUNTY)

ARTIC DAIRY PRODUCTS COMPANY WELL

Location: At the Artic Dairy Products Company plant, village of Lake Odessa, T. 5 N., R. 7 W.
Elevation:
Record compiled by R. B. Newcombe from log and set of samples furnished by Wm. E. Caster, contractor of Saginaw. Drilled in 1927.

| | Thickness feet | Depth feet |
|--|-------------------|---------------|
| Pleistocene: | | |
| Glacial drift material..... | 245 | 245 |
| Mississippian: | | |
| Michigan Formation: | | |
| Soft light gray shale..... | 20 | 265 |
| Gray shale..... | 17 | 282 |
| Hard dark gray shale..... | 18 | 300 |
| Gray sandy shale..... | 3 | 303 |
| Pink gypsum..... | 2 | 305 |
| Hard black shale and red gypsiferous shale..... | 5 | 310 |
| Dark gray very soft shale..... | 7 | 317 |
| Light gray soft shale..... | 13 | 330 |
| Dark gray shale..... | 13 | 343 |
| Light gray shale (slightly sandy)..... | 20 | 363 |
| Dark gray shale..... | 60 | 423 |
| Flinty white to buff limestone and anhydrite (considerable pyrite)..... | 6 | 429 |
| Light yellowish sandstone..... | 10 | 439 |
| Buff sandy limestone..... | 12 | 451 |
| Upper Marshall (Napoleon) Formation: | | |
| White to greenish gray sandstone (grains regular and some pink and brown color)..... | 63 | 514 |
| Lower Marshall Formation: | | |
| Gray shale (slightly sandy)..... | 30 | 544 |
| Calcareous gray sandstone..... | 35 | 579 |
| Very sandy gray shale..... | 16 | 595 |
| Sandy gray shale..... | 35 | 630 |
| Sandy gray shale..... | 10 | 640 |
| Fine grained brownish gray sandstone..... | 28 | 668 |
| Greenish gray micaceous shale..... | 14 | 682 |
| Brown shale (no sample)..... | 6 | 688 |
| Coldwater Formation: | | |
| (All samples are light gray) | | |
| Light gray sandy shale..... | 5 | 693 |
| Darker gray sandy shale..... | 5 | 698 |
| Greenish sandy shale..... | 12 | 710 |
| Light gray sandy shale..... | 30 | 740 |
| Fine light gray sandy shale..... | 10 | 750 |
| Fine darker gray sandy shale..... | 5 | 755 |

SOUTH MT. PLEASANT (ISABELLA COUNTY)

W. F. BRAUN WELL

Location: W. ½ of the N. W. ¼ of Section 27, T. 14 N., R. 4 W., Union Township, on Riley farm.
Elevation: About 800 feet above sea level.
Driller's record of 3,082 feet. Record supplemented by samples below this point.

| | Thickness feet | Depth feet |
|---|-------------------|---------------|
| Pleistocene: | | |
| Sandy loam..... | 2 | 2 |
| Quicksand and water..... | 16 | 18 |
| Clay..... | 32 | 50 |
| Sand and Water..... | 8 | 58 |
| Clay..... | 2 | 60 |
| Sandy clay..... | 15 | 75 |
| Quicksand vein, good water..... | 1 | 76 |
| Sandy clay..... | 13 | 89 |
| Quicksand..... | 1 | 90 |
| Sandy clay..... | 10 | 100 |
| Quicksand..... | 10 | 110 |
| Gravel..... | 15 | 125 |
| Gravel and quicksand..... | 47 | 172 |
| Blue fire clay..... | 45 | 217 |
| Gravel..... | 5 | 222 |
| Blue "fire clay"..... | 60 | 282 |
| Red "sand rock" (boulder?)..... | 10 | 292 |
| "Fire clay" blue..... | 10 | 302 |
| Red sand rock (boulder?)..... | 27 | 329 |
| "Fire clay" pinkish color..... | 41 | 370 |
| Quicksand and water..... | 10 | 380 |
| "Red fire clay"..... | 10 | 390 |
| Gravelly sand..... | 10 | 400 |
| Pennsylvanian: | | |
| Saginaw Formation: | | |
| Limestone..... | 5 | 405 |
| Red sand rock, hard..... | 40 | 445 |
| Fresh soft water..... | 5 | 450 |
| Sand rock, red..... | 3 | 453 |
| Black slate (shale)..... | 10 | 463 |
| Gray sand rock..... | 10 | 473 |
| Black fire clay..... | 4 | 477 |
| Gray sand rock..... | 31 | 508 |
| Black shale..... | 25 | 533 |
| Gray shaly limestone..... | 10 | 543 |
| Black shale..... | 124 | 667 |
| Pure white sand, fresh water..... | 55 | 722 |
| Red shale..... | 30 | 752 |
| White soapstone..... | 24 | 776 |
| Gray limestone..... | 26 | 802 |
| White shales..... | 9 | 811 |
| Parma Formation: | | |
| Pure gray salt sand, much brine..... | 124 | 935 |
| Mississippian: | | |
| Bayport Formation: | | |
| Limestone, gray, very hard..... | 45 | 980 |
| Mixed limestone, pebbly and sandy..... | 38 | 1,018 |
| Michigan Formation: | | |
| Salt blue (shale?)..... | 3 | 1,021 |
| Mixed limestone..... | 6 | 1,027 |
| Blue shale..... | 11 | 1,038 |
| Mixed rock, blue shale and limestone..... | 32 | 1,070 |
| Mixed rock, gypsum and clay..... | 35 | 1,105 |
| Gray limestone..... | 10 | 1,115 |
| Blue shale..... | 35 | 1,150 |
| Black shale..... | 10 | 1,160 |
| Gray limestone..... | 10 | 1,170 |
| White limestone..... | 24 | 1,194 |
| Blue shale..... | 6 | 1,200 |
| White limestone..... | 15 | 1,215 |
| Blue shale..... | 25 | 1,240 |
| Gray limestone, very hard..... | 25 | 1,265 |
| Mixed limestone of rock and shale..... | 35 | 1,300 |
| Gray limestone..... | 10 | 1,310 |
| Blue shale..... | 10 | 1,320 |
| Limestone, very hard..... | 10 | 1,330 |
| Blue shale..... | 10 | 1,340 |
| Fine gray sand (top of Upper Marshall)..... | 60 | 1,400 |
| Gray limestones..... | 38 | 1,438 |
| Napoleon (Upper Marshall) Formation: | | |
| Salt, sand, gas, sand top; much salt water..... | 69 | 1,507 |
| Lower Marshall Formation: | | |
| Red rock sand..... | 75 | 1,582 |

W. F. BRAUN WELL—Continued

| | Thickness feet | Depth feet |
|--|-------------------|---------------|
| Coldwater Formation: | | |
| Blue shale..... | 716 | 2,298 |
| Gray shell (Carbonate Nodule?)..... | 2 | 2,300 |
| Blue shale..... | 15 | 2,315 |
| Gray shell (Carbonate Nodule?)..... | 3 | 2,318 |
| Blue shale..... | 232 | 2,550 |
| Sunbury Formation: | | |
| Brown shale..... | 18 | 2,568 |
| Limestone..... | 4 | 2,572 |
| Brown shale..... | 6 | 2,578 |
| Berea Formation: | | |
| Black sand and shale, showing oil and gas; oil of sp. grav. of 47° at 2,590 feet.... | 20 | 2,598 |
| Mississippian?: | | |
| Bedford Formation: | | |
| White shale..... | 18 | 2,616 |
| Devonian: | | |
| Antrim Formation: | | |
| Brown shale..... | 40 | 2,656 |
| Black shale..... | 20 | 2,676 |
| Black sand and shale, small show of oil..... | 6 | 2,682 |
| Black shale..... | 233 | 2,915 |
| Black sand, mixed with black shale; mineral ore showing silver (?) and iron ore..... | 13 | 2,928 |
| Black shale..... | 54 | 2,982 |
| Black sand, mixed with black shale, showing mineral ore, silver (?) and iron..... | 13 | 2,995 |
| Black shale mixed with limestone..... | 15 | 3,010 |
| Black shale..... | 72 | 3,082 |
| Traverse Formation: | | |
| Salt and pepper limestone. Very little chert. Some particles of black shale from above at 3,082..... | 2 | 3,084 |
| Light grayish buff limestone..... | 2 | 3,086 |
| Buff gray limestone, slightly cherty..... | 2 | 3,088 |
| Grayish buff limestone, pyritic, a little chert..... | 5 | 3,093 |
| Gray limestone..... | 6 | 3,099 |
| Dark buff gray limestone..... | 6 | 3,105 |
| White and dark gray limestone, pyritic. Some dark gray shale; calcite crystals..... | 6 | 3,111 |
| White crystalline limestone and very calcareous shale; some pyrite..... | 17 | 3,127 |
| Very calcareous blue shale..... | 16 | 3,143 |
| Light gray to dark gray limestone; calcite fragments..... | 7 | 3,150 |
| Light gray limestone and dark gray shale..... | 7 | 3,157 |
| White to light gray limestone..... | 13 | 3,170 |
| Yellowish gray limestone..... | 18 | 3,188 |
| Very cherty white limestone..... | 6 | 3,194 |
| Very cherty fossiliferous (coral, Acervularia?) limestone, blue and black shale..... | 6 | 3,200 |
| Very cherty fossiliferous (coral) light gray limestone, some blue shale..... | 6 | 3,206 |
| Very cherty light gray limestone, pyritic with some blue shale..... | 2 | 3,208 |
| Very fine white cherty limestone..... | 2 | 3,210 |
| Cherty white crystalline limestone..... | 2 | 3,212 |
| Yellowish white and very cherty limestone..... | 6 | 3,218 |
| White to light gray cherty limestone..... | 12 | 3,230 |
| Very cherty white fossiliferous limestone..... | 4 | 3,234 |
| Fine grained cherty white limestone..... | 6 | 3,240 |
| Buff gray limestone, some dark shale..... | 20 | 3,260 |
| White to light gray cherty limestone, very hard..... | 16 | 3,276 |
| Light gray limestone..... | 20 | 3,296 |
| White limestone..... | 4 | 3,300 |
| Light gray with some black limestone and dark gray shale..... | 6 | 3,306 |
| Light and dark limestone ("salt and pepper"); some gray shale..... | 6 | 3,312 |
| Dark gray limestone..... | | |
| Traverse Formation: | | |
| Gray limestone..... | 25 | 3,337 |
| Salt and pepper limestone..... | 13 | 3,350 |
| Buff and white limestone mixed with some shale..... | 25 | 3,375 |
| Buff gray limestone..... | 9 | 3,384 |
| Light limestone and dark to black shaly limestone..... | 4 | 3,388 |
| Gray limestone mixed with some light limestone..... | 12 | 3,400 |
| White and gray limestone..... | 15 | 3,415 |
| Buff gray limestone mixed with some dark..... | 12 | 3,427 |
| Hard white to light gray limestone..... | 3 | 3,430 |
| White limestone mixed with gray..... | 42 | 3,472 |
| Salt and pepper limestone..... | 8 | 3,480 |
| Gray shale mixed with limestone at 3,480..... | | |
| Calcareous gray shale..... | 24 | 3,504 |
| Very calcareous light gray shale..... | 2 | 3,506 |
| Calcareous bluish gray shale..... | 10 | 3,516 |
| Dark bluish gray shale mixed with light gray limestone..... | 6 | 3,522 |
| Dark bluish gray shale..... | 11 | 3,533 |
| Calcareous gray shale and limestone..... | 25 | 3,558 |
| Calcareous and fossiliferous gray shale..... | 22 | 3,580 |
| Very dark gray, cherty and fossiliferous limestone and dark calcareous shale..... | 8 | 3,588 |
| Cherty limestone mixed with shale..... | 10 | 3,598 |

W. F. BRAUN WELL—Continued

| | Thickness feet | Depth feet |
|--|-------------------|---------------|
| Bluish shaly limestone; some chert very hard..... | 22 | 3,620 |
| Dark buff gray limestone and black shale..... | 47 | 3,667 |
| Dundee Formation: | | |
| Very hard buff to dark gray limestone; cherty and very pyritous..... | 8 | 3,675 |
| Very hard dark buff pyritous limestone..... | 5 | 3,690 |

So strong a flow of water was struck at 3,675 feet that drilling was stopped at 3,870 feet. Temperature at bottom 104° F. Temperature gradient apparently one degree in about 67 feet.

CONWAY TOWNSHIP (LIVINGSTON COUNTY)

NORRIS & SMITH JOHN FINLAN WELL No. 1

Location: S. W. ¼ of S. W. ¼ of Section 9, T. 4 N., R. 3 E., on the John Finlan farm, 250 feet from south line and 250 feet from east line.

Elevation: 900 feet above sea level.

Drilled in 1927 by J. Hoover. Record compiled from driller's log by R. B. Newcombe.

| | Thickness feet | Depth feet |
|---|-------------------|---------------|
| Pleistocene: | | |
| Drift..... | 108 | 108 |
| Mississippian: | | |
| Coldwater Formation: | | |
| Shale..... | 12 | 120 |
| Sandstone (fresh water)..... | 10 | 130 |
| Blue gray shale..... | 225 | 355 |
| Sandstone (brine)..... | 15 | 370 |
| Shale..... | 48 | 418 |
| Sandstone (30,000 cu. ft. gas, 3 ft. with no water—then brine)..... | 15 | 433 |
| Sandy shale..... | 225 | 658 |
| Sunbury Formation: | | |
| Black shale..... | 15 | 673 |
| Berea Formation: | | |
| Sandstone (show of oil and smell of gas 10 feet in. Water in bottom of Berea....) | 20 | 693 |
| Blue shale..... | 3 | 696 |

MIDLAND (MIDLAND COUNTY)

SAGINAW PROSPECTING CO. WELL

Location: On farm of Chas. Hlavacek, in N. E. ¼ of S. W. ¼ of Section 29, T. 14 N., R. 2 E.

Elevation: 600 feet above sea level.

Record from log submitted by Regan and Goll, Drilling Contractors.

| | Thickness feet | Depth feet |
|-------------------------------------|-------------------|---------------|
| Pleistocene: | | |
| Surface formations..... | 264 | 264 |
| Pennsylvanian: | | |
| Saginaw Formation: | | |
| Black slate, soft..... | 46 | 310 |
| Blue slate, soft..... | 60 | 370 |
| White sand, soft (mild brine)..... | 185 | 555 |
| Blue slate, soft..... | 26 | 581 |
| Black slate, soft..... | 25 | 606 |
| Blue slate, soft..... | 164 | 770 |
| Black slate, soft..... | 10 | 780 |
| Blue slate, soft..... | 40 | 820 |
| Gray lime, hard..... | 10 | 830 |
| Blue slate, soft..... | 30 | 860 |
| Parma Formation: | | |
| White sand, soft..... | 35 | 895 |
| Blue slate, soft..... | 10 | 905 |
| Gray sand, hard (water, salty)..... | 36 | 941 |

SAGINAW PROSPECTING CO. WELL—Continued

| | Thickness feet | Depth feet |
|---------------------------------------|-------------------|---------------|
| Mississippian: | | |
| Michigan Formation: | | |
| Blue slate, soft..... | 5 | 946 |
| Black lime, hard..... | 14 | 960 |
| Blue slate, soft..... | 55 | 1,015 |
| Gray lime, hard..... | 23 | 1,038 |
| Blue slate, soft..... | 44 | 1,082 |
| Gray lime, hard..... | 12 | 1,094 |
| Blue slate, soft..... | 24 | 1,118 |
| Lime shells, gray, hard..... | 57 | 1,175 |
| Upper Marshall Formation: | | |
| White sand, hard (carried water)..... | 26 | 1,201 |
| Red rock, soft..... | 50 | 1,251 |
| White sand, hard (2nd Marshall)..... | 30 | 1,281 |
| Lower Marshall: | | |
| Red rock, soft..... | 105 | 1,386 |
| Brown shale, soft..... | 14 | 1,400 |
| Red rock, hard..... | 14 | 1,414 |
| Brown shale, hard..... | 21 | 1,435 |
| Red rock, soft..... | 15 | 1,450 |
| White slate, soft..... | 47 | 1,497 |
| Red rock, soft..... | 15 | 1,512 |
| White slate, soft..... | 78 | 1,590 |
| Red rock, soft..... | 50 | 1,640 |
| Coldwater Formation: | | |
| Blue slate, soft..... | 208 | 1,848 |
| Gray sand, broken (hard)..... | 58 | 1,906 |
| White slate, soft..... | 508 | 2,414 |
| Gray broken slate and lime..... | 3 | 2,417 |
| Sunbury Formation: | | |
| Brown slate, soft..... | 25 | 2,442 |
| Berea Formation: | | |
| Gray sand, soft (broken dry)..... | 131 | 2,573 |
| Devonian: | | |
| Antrim Formation: | | |
| Black slate, soft..... | 301 | 2,874 |
| White broken sand, hard..... | 10 | 2,884 |
| Brown shale, soft..... | 76 | 2,960 |
| Traverse Formation: | | |
| "Saginaw sand" brown, hard (dry)..... | 26 | 2,986 |
| Blue slate, soft..... | 71 | 3,057 |
| Brown sandy lime, hard..... | 255 | 3,312 |
| Black slate, soft..... | 23 | 3,335 |
| Brown lime, hard..... | 25 | 3,360 |
| Bell Formation: | | |
| Gray slate, soft..... | 227 | 3,587 |
| Dundee Formation: | | |
| Brown lime, hard (water 132-152)..... | 152 | 3,739 |

Casing Record:

14 inch drive pipe..... 264 feet, 8 inches
 10 inch casing..... 1111 feet, all pulled out
 8 1/4 inch casing..... 1308 feet, all pulled out
 Hole reduced to 6 5-8 inches at 2690 feet

Plugging Record:

Dundee sand filled with mud and iron ball dropped on shoulder at 2,690 feet and 200 to 300 feet of mud put on top of iron ball, then iron ball dropped on shoulder of 10 inch hole at 1,308 feet and Marshall filled with mud; then iron ball dropped on seat of 10 inch casing or 14 inch hole at 1,111 feet and 200-300 feet of mud placed on top of this. The 264 feet, 8 inches of 14 inch O. D. Drive pipe not pulled.
 Started spudding Oct. 18, 1926, but had to move rig at 185 feet on account of drive pipe going bad. Completed drilling Jan. 30, 1927.

OWOSSO TOWNSHIP (SHIAWASSEE COUNTY)
SUN OIL COMPANY WELL (McGINNIS NO. 1)

Location: S. W. 1/4 of S. W. Section 5, T. 7 N., R. 2 E. on H. C. McGinnis estate. Farm is 220 acres and well is located 175 feet N. of South line and 250 feet W. of East line.
 Elevation: 740 feet (approximately) above sea level.
 Well drilled in 1927 by Sun Oil Company and Norris and Smith. Record compiled by R. B. Newcombe from samples submitted.

| | Thickness feet | Depth feet |
|---|-------------------|---------------|
| Pleistocene: | | |
| No record..... | 85 | 95 |
| Pennsylvanian: | | |
| Saginaw Formation: | | |
| Gray shale..... | 85 | 180 |
| Light and gray shale..... | 30 | 210 |
| Fine grained gray sandstone and shale..... | 10 | 220 |
| White fine grained micaceous sandstone (some iron stained and shale fragments)..... | 25 | 245 |
| Parma Formation: | | |
| Clear to milky white sandstone (medium grained to coarse) (Iron stained)..... | 140 | 385 |
| Coarse grained milky white conglomeratic sandstone (some shale, pyrite, pink and green grains)..... | 50 | 435 |
| Medium grained white sandstone with pyrite..... | 10 | 445 |
| Coarse grained hard white pyritic sandstone..... | 5 | 450 |
| Mississippian: | | |
| Bayport Formation: | | |
| Dark gray limestone with white and red sandstone..... | 5 | 455 |
| Dark gray shaly limestone (pyritiferous)..... | 5 | 460 |
| Michigan Formation: | | |
| Gray calcareous shale..... | 5 | 465 |
| Gray micaceous shale and sandy shale..... | 50 | 515 |
| Hard pyritic gray sandstone and calcareous shale..... | 10 | 525 |
| Napoleon (Upper Marshall) Formation: | | |
| Fine grained gray sandstone (pink and pyritic greenish grains)..... | 15 | 540 |
| Medium to fine grained white sandstone..... | 35 | 575 |
| Coarse to medium grained white sandstone..... | 33 | 608 |
| Lower Marshall: | | |
| Bluish gray, fine grained sandy shale..... | 2 | 610 |
| Micaceous and pyritic light greenish gray fine grained sandstone..... | 10 | 620 |
| Coarse grained cream colored sandstone (some light green grains)..... | 5 | 625 |
| Medium grained greenish gray sandstone..... | 45 | 670 |
| Coarse to fine grained gray sandstone..... | 50 | 720 |
| Very fine grained gray micaceous sandstone (drills in small chunks)..... | 60 | 780 |
| Gray to dark gray shaly micaceous sandstone..... | 40 | 820 |
| Red, grayish red, and gray micaceous shaly, sandstone..... | 125 | 945 |
| Light gray micaceous shale..... | 140 | 1,085 |
| Gray to reddish gray micaceous sandy shale..... | 15 | 1,100 |
| Light to dark gray micaceous shale..... | 10 | 1,110 |
| Mixed light red and gray shale..... | 10 | 1,120 |
| Red shale..... | 15 | 1,135 |
| Coldwater Formation: | | |
| Gray micaceous shale..... | 95 | 1,230 |
| Hard blue gray shale..... | 170 | 1,400 |
| No record..... | 15 | 1,415 |
| Gray shale and brownish sandstone..... | 20 | 1,435 |
| Gray micaceous sandy shale..... | 15 | 1,450 |
| Hard gray shale..... | 15 | 1,465 |
| Light and dark gray micaceous shale..... | 65 | 1,530 |
| Hard bluish gray shale..... | 70 | 1,600 |
| Fine grained gray sandstone (Richmondville horizon?)..... | 10 | 1,610 |
| Micaceous blue gray shale..... | 130 | 1,740 |
| Hard gray and red shale..... | 25 | 1,765 |
| No record..... | 13 | 1,778 |
| Sunbury Formation: | | |
| Black shale..... | 20 | 1,798 |
| Berea Formation: | | |
| Fine grained gray sandstone..... | 3 | 1,801 |
| Devonian: | | |
| Bedford Formation: | | |
| Hard gray shale..... | 9 | 1,810 |
| Light gray shale..... | 8 | 1,818 |
| Light and dark gray micaceous shale..... | 89 | 1,907 |
| Antrim Formation: | | |
| Black and brownish shale with pyrite..... | 223 | 2,130 |
| Gray shale..... | 15 | 2,145 |
| Black shale..... | 53 | 2,198 |
| Traverse Formation: | | |
| Hard buff limestone (drillings fine)..... | 3 | 2,201 |
| Gray shale and limestone (some pyrite)..... | 5 | 2,206 |
| Gray to buff limestone (iron stained)..... | 37 | 2,243 |

SOUTHWESTERN MICHIGAN

The area comprising Southwestern Michigan includes Branch, St. Joseph, Cass, Berrien, Van Buren, Kalamazoo, and Allegan Counties. This district is almost entirely underlain by the Coldwater and Antrim Shales, and since the Berea Grit is almost entirely absent as such, the first possible oil and gas pay formations to be encountered are the Devonian limestones. One structure has been outlined in a broad way which extends northeastward from the vicinity of South Bend, Indiana, towards Cassopolis, Michigan. The wells which give control points to determine this anticline are widely scattered and are discussed in detail by Smith*. He states that the fold seems to be related to the Kankakee uplift and therefore may have a much greater northeastward extension toward Jackson than indicated by present drillings. The structure of the region as contoured from present data is shown in Fig. 13.

Recent explorations in this part of Michigan have been confined to Van Buren and Kalamazoo Counties. The Wert Oil and Gas Company was organized to operate in the vicinity of Decatur, Van Buren County, and capital stock amounted to 50,000 dollars. Most of the officers of the concern reside in East Chicago and South Bend, Indiana, and they include James W. Regan, Pres., Max Weinstein, E. S. Dickey, I. L. Tannenbaum, Vice Presidents, and R. G. Estill, Sec'y and Treas. In Kalamazoo County the operations were carried on by Messrs. H. W. Kinney, Watts, Hughes and the Saginaw Homebuilders. Their efforts were concentrated in area located northwest of Battle Creek in the vicinity of Gull Lake. Further drilling was carried on in the city of South Haven by hotel operators who were desirous of establishing bath house connections and were seeking a mineral water supply. More recently the Vermont Petroleum Company of Rutland, Vermont, has become interested in the Decatur territory.

WELLS PENETRATING RED COLDWATER HORIZON IN SOUTHWESTERN MICHIGAN.

Mason County

1. Pere Marquette Lumber Company Well.
2. Anchor Salt Company Well No. 4.
3. Logan Oil Company—W. K. Young No. 1.

Newaygo County

1. Wensel Oil Company—F. W. Squiers No. 1.

Muskegon County

1. Central Paper Co. Well.
2. Ryerson Hills Well.
3. Bull-Dog, O. and G. Giles No. 1.
4. Dixie Oil Company—Reeths No. 1.
5. Bankers' Trust—Torrent No. 1.
6. Kuntz-Hulse-Langeshulte No. 1.

Kent County

1. Grand Rapids Artesian Well.

Ottawa County

1. Ottawa Development Co.—Stone No. 1.
2. Ottawa Development Co.—Vrieling No. 1.

Barry County

1. Assyria Well.

Allegan County

1. Gerber Well.
2. Northern O. & G. Co.—Well No. 1—Thomas.
3. Northern O. & G. Co.—Well No. 2.
4. Allegan Gas, Oil and Mining Co. Well.

Van Buren County

1. Wert O. & G. Co.—Vought No. 1.
2. Janis Hotel—South Haven.

*Smith, R. A., The Occurrence of Oil & Gas in Michigan, Pub. 14, Mich. Geol. & Biol. Survey p. 175.

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1. Wert
2. Janis

*Smith,
Survey p. 17:

Kalamazoo County

1. Augusta Well.
2. Kalamazoo Nat. Gas Co. Well.

Berrien County

1. Benton Harbor Nat. Gas & Oil Co. Well.

Cass County

1. Dowagiac Well.

St. Joseph County

1. Constantine Well.
2. White Pigeon Well.

KALAMAZOO COUNTY.

ROSS TOWNSHIP

The Saginaw Homebuilders Company and others drilled on the F. Bostwick farm in the NE¹/₄ of the NE¹/₄ of Section 14, 250 feet south of the north line and 250 feet west of the east line. The well was commenced on May 24, 1927, by A. S. Cochran, contractor of North Olmstead, Ohio, and was completed on July 30th, 1927. According to the record and samples furnished by Mr. Cochran, the Berea red horizon was penetrated at 1225 feet, the Traverse at 1602 feet, and the Dundee at 1680 feet. The well was finished in the Dundee formation at a total depth of 1800 feet. A show of oil was recorded at 285 feet, but no production was found. The well was located by John Kellogg of Battle Creek, by means of a peach limb device. The drilling machine and casing were allowed to stand until fall when plugging and abandonment was finished on November 19, 1927.

VAN BUREN COUNTY.

The Wert Oil and Gas Company which was incorporated at Paw Paw commenced drilling operations in the spring of 1927. The name of the company "Wert" was a composition of the first letters of the names of the officers. A. D. Vought of Decatur was instrumental in securing a number of leases and the first well was located on his farm to the south of town. Further activity was started in the county by C. R. Tuttle who claimed to be able to locate productive territory by means of soil tests. Great things were claimed for his powers and numerous property owners paid \$25.00 apiece for the testing of their land. Later he was taken into custody for fraud, but he was bailed out and started building a rig in the vicinity of Lawrence, Michigan.

DECATUR TOWNSHIP

The first well on the A. D. Vought farm was in the SE¹/₄ of the NE¹/₄ of Section 32, 160 feet north of an old mint still and 25 feet west of Red Run Creek. The contract for drilling was made with R. H. Kersey of South Bend, Indiana, and J. R. Baker was driller on the well. An artesian flow of water was tapped in the drift at a depth of 200 feet. The column of water coming out of the 10-inch pipe was 6¹/₂ feet high and the quantity emitting was estimated at 10,000 gallons per minute.

On account of these water difficulties, a new Star drilling machine was purchased by the company and the location for No. 2 well on the Vought property followed. This well was in the NE¹/₄ of the SE¹/₄ of Section 32, 1200 feet south of No. 1, 25 feet east of Red Run Creek, and 150 feet from the road. Drilling was continued to a depth of 266 feet, where financial adjustments caused temporary abandonment.

The flowing water finally subsided sufficiently in No. 1 well to go on with drilling and the red shale horizon of the Berea was found at 400 feet. The top of the Traverse occurred at 920 feet and the Dundee was at 955 feet. A pay streak was struck at 962 feet and the bottom of the hole when drilling ceased was at 971 feet. After striking the pay formation the oil arose in the casing to a height of 140 feet. Before shooting with nitroglycerin there was between 300 and 400 feet of fluid in the hole. The formation was shot with 60 quarts but after cleaning out the well did not seem to fill up with oil so fast as when the pay was first struck five days previously. The decision was made to continue with No. 2 well in hopes that production from both holes might be pumped by the same power.

Bed rock in No. 2 Vought was encountered at 290 feet and the heavy flow of water from the drift was not found. The Traverse occurred at 951 feet and the Dundee at 976 feet. A pay was found in hard limestone at 969 feet and in softer rock at 1023 feet. The hole was continued to a total depth of 1140 feet and after tapping water at 1125 feet and 1140 feet the well was plugged. Abandonment followed on November 21, 1927.

The No. 1 well on the Vought farm had been allowed to stand for 42 days. Tubing and rods were installed and pumping resulted in 25 barrels of oil during the first day. After standing for five days without any appreciable amount of oil coming into the hole, the tubing and rods were removed in preparation for drilling deeper. At about 1000 feet salt water was tapped. The hole filled up 200 feet at once and after standing for some time this amount increased to 700 feet. The well was again pumped at irregular intervals and it made some gas and oil along with the water. In March, 1928, pumping was continued quite regularly for about 4 weeks. At the present time the well is not being operated.

The rig from the No. 2 Vought location was moved to the Burget High farm during the winter of 1927, but actual drilling did not begin until in the spring of 1928. The well which is being put down by the Decatur Lease Holding Company is in the SW $\frac{1}{4}$ of the NW $\frac{1}{4}$ of Section 33, and about 1000 feet east of the No. 1 Vought. The farm measurements are 650 feet from the north line and 654 feet from the east line. According to last reports the well was drilling at a depth of 370 feet.

The Vermont Petroleum Development Company of Rutland, Vermont, made their first location in the E $\frac{1}{2}$ of the SW $\frac{1}{4}$ of Section 31. The well is on the Anton Fier farm, 1586 feet from the south line and 1100 feet from the west line, and west of the tests made in 1927 by the Wert Oil & Gas Company. Drilling operations have just been commenced on this hole.

HAMILTON TOWNSHIP

A wood derrick was built by C. R. Tuttle, et al, on the Fred Steele farm in the SW $\frac{1}{4}$ of SW $\frac{1}{4}$ of Section 3. On August 8, 1927, a concrete foundation had been built and the rig was completed but up to the present time no tools have been moved to the location.

SOUTH HAVEN TOWNSHIP

A deep well was drilled by F. M. Gray, Jr., Inc., of Milwaukee, Wisconsin, for the Janis Hotel in South Haven. The Janis Hotel of which Messrs. D. A. Klein and A. J. Sofield are owners is located at the corner of Michigan Ave. and Center Streets, and the well is directly back of the

hotel building. The top of the Traverse was found at 1040 feet and the Monroe formation was at 1220 feet. The total depth was 1716 feet and an abundant supply of sulphuretted water was found for bath house purposes. No significant showings of oil or gas were reported.

Calvin Knight, a drilling contractor from Indiana, put down a well for Irving Cohen, proprietor of the Edgemere Beach Hotel in the north part of South Haven. The location was in the SE $\frac{1}{4}$ of the NW $\frac{1}{4}$ of Section 3, back of a house across the road and to the northeast of the hotel. Drilling was carried on during the summer of 1927. The Dundee occurred at 1172 feet, the Monroe at 1220 feet, and total depth was reported at 1400 feet. When visited during July, 1927, there was a plug in the pipe and the well was not being pumped.

KALAMAZOO COUNTY

| Location. | Sec. | T.-R. | Township. | Farm. | Company. | Elev. | Drift. | Marshall. | Berea. | Traverse. | Dundee. | Monroe. |
|------------|------|---------|-----------|-------------|-----------------------|-------|--------|-----------|--------|-----------|---------|---------|
| N.E., N.E. | 14 | 1S.-9W. | Ross | F. Bostwick | Saginaw Home Builders | 945 | 190 | | 1,225 | 1,602 | 1,680 | |

VAN BUREN COUNTY

| Location. | Sec. | T.-R. | Township. | Farm. | Company. | Elev. | Drift. | Marshall. | Berea. | Traverse. | Dundee. | Monroe. |
|------------|------|----------|-------------|--------------------|--------------------------------|-------|--------|-----------|--------|-----------|---------|---------|
| S.E., N.E. | 32 | 4S.-14W. | Decatur | A. D. Vought No. 1 | West Oil & Gas Co. | 744 | 282 | | 400 | 920 | 955 | |
| N.E., S.E. | 32 | 4S.-14W. | Decatur | A. D. Vought No. 2 | West Oil & Gas Co. | 759 | 290 | | | 951 | *976 | |
| S.E., N.W. | 3 | 1S.-17W. | South Haven | Edgers Beach Hotel | Wing Cohen | 692 | | | | | | |
| N.E., N.E. | 10 | 1S.-17W. | South Haven | Janis Hotel | Klein & Schaid | 621 | 130 | | | 1,040 | 1,172 | 1,220 |
| S.W., N.W. | 33 | 4S.-14W. | Decatur | Burget High. | Venatur Lease Holding Co. | | | | | | | 1,225 |
| E., S.W. | 31 | 4S.-14W. | Decatur | Anton Farm | Vermont Pet. Dev. D. Co., Inc. | | | | | | | |
| S.W., S.W. | 3 | 4S.-15W. | Hamilton | Fred Steet | C. K. Tuttle, et al. | | | | | | | |

* (Water-1,125-1,140)

TYPICAL WELL RECORDS
FROM
SOUTHWESTERN MICHIGAN

AUGUSTA (KALAMAZOO COUNTY).
BATTLE CREEK WELL.

Location: N. E. ¼ of N. E. ¼ section 14, T. 1 S., R. 9 W. Located 250 ft. south of north line and 250 ft. west of east line.
Elevation: 945 feet above sea level.
Well No. 1 drilled on the F. Bostwick farm by the Saginaw Homebuilders Company in 1927. Record compiled from samples by R. B. Newcombe and log of contractor, A. S. Cochran, 22010 Loraine Road, North Olmstead, Ohio.

| | Thickness feet | Depth feet |
|--|----------------|------------|
| Pleistocene: | | |
| Drift..... | 190 | 190 |
| Mississippian: | | |
| Marshall Formation: | | |
| Sandstone..... | 10 | 200 |
| Coldwater Formation: | | |
| Blue shale..... | 85 | 285 |
| Sandstone (show of oil)..... | 10 | 295 |
| Blue shale..... | 930 | 1,225 |
| Berea or Bedford? | | |
| Red shale..... | 11 | 1,236 |
| Devonian: | | |
| Antrim Formation (Probably Bedford at the top): | | |
| No record..... | 184 | 1,420 |
| Bluish gray soft to hard shale..... | 110 | 1,530 |
| Black shale..... | 72 | 1,602 |
| Traverse Formation: | | |
| Light to dark gray limestone and calcareous shale..... | 68 | 1,670 |
| Dark gray limestone with pyrite..... | 10 | 1,680 |
| Dundee Formation: | | |
| Gray to buff limestone..... | 25 | 1,705 |
| Buff limestone..... | 30 | 1,735 |
| Blue gray to buff limestone..... | 25 | 1,760 |
| Light buff crystalline limestone..... | 5 | 1,765 |
| No record..... | 20 | 1,785 |
| Dark gray to buff limestone (iron stained)..... | 15 | 1,800 |

Show oil at 287 ft.
Water at 1,725 ft.
Casing Record: 10-inch drive pipe 195 ft 6 in.
3½-inch casing 317 ft.
6 5-8 inch casing 980 ft.
Well commenced May 24, 1927. Completed July 30, 1927.

DECATUR (VAN BUREN COUNTY).

VOUGHT NO. 1.

Location: In the S. E. $\frac{1}{4}$ of the N. E. $\frac{1}{4}$ of Section 32, T. 4 S, R. 14 W., on the A. D. Vought 104 acre farm. 160 feet north of mint still and 25 feet west of Red Run.
Elevation: 744 feet above sea level (approximate). Drilled in 1927 by the West Oil and Gas Co., Ind. Harbor, Ind. R. H. Kersey, South Bend, Ind., Contractor, and J. R. Baker, driller.
Record compiled from log and partial set of samples by R. B. Newcombe.

| | Thickness feet | Depth feet |
|---|-------------------|---------------|
| Pleistocene: | | |
| Drift Material: | | |
| Muck..... | 9 | 9 |
| Gravel (water)..... | 18 | 27 |
| Gray clay (very sticky)..... | 113 | 140 |
| Red clay..... | 20 | 160 |
| Fine gravel (water)..... | 40 | 200 |
| Flowed 6½ feet high out of 10 inch pipe at rate of 10,000 gal. per min. | | |
| Brown quicksand..... | 75 | 275 |
| Coarse muddy gravel..... | 7 | 282 |
| Mississippian: | | |
| Coldwater Formation: | | |
| Blue gray shale..... | 18 | 300 |
| Gravel (?) with water..... | 1½ | 301½ |
| Blue shale..... | 98 | 400 |
| Berea or Bedford Formation: | | |
| Red shale..... | 7 | 407 |
| Bedford Formation(?) | | |
| Soft light gray shale..... | 98 | 505 |
| Hard gritty blue shale..... | 5 | 510 |
| Soft gray shale..... | 190 | 700 |
| Blue gray shale..... | 20 | 720 |
| Greenish gray shale..... | 30 | 750 |
| Devonian: | | |
| Antrim Formation: | | |
| Light brown shale (some gray)..... | 90 | 840 |
| Black shale..... | 70 | 910 |
| Sandy pyritiferous shale (brown to gray)..... | 10 | 920 |
| Traverse Formation: | | |
| Brownish-gray limestone (some pyrite)..... | 13 | 933 |
| Gray calcareous shale..... | 22 | 955 |
| Dundee Formation: | | |
| Cream colored crystalline limestone (some pyrite and gray calcareous shale)..... | 7 | 962 |
| (Fire clay break and pay reported at 962 ft.) (Gray to buff crystalline limestone) (Fossils)..... | 2 | 964 |

Pipe Record: 10 inch drive pipe—317 feet.
8¼ inch casing—707 feet.

SOUTH HAVEN (VAN BUREN COUNTY)

JANIS HOTEL WELL.

Location: At the rear of the Janis Hotel on Michigan Avenue and west of Pheonix Street.
Elevation: 621 feet above sea level (approximately).
Drilled in 1927 by F. M. Gray, Jr., Inc., of Milwaukee, Wis., for D. A. Klein and A. J. Sofield, owners of the Janis Hotel. Log compiled by R. A. Smith from samples submitted by F. M. Gray, Jr., Inc., and re-checked by R. B. Newcombe.

| | Thickness feet | Depth feet |
|--|-------------------|---------------|
| Pleistocene: | | |
| Fine sand with large pebbles..... | 20 | 20 |
| Gray pebbly clay..... | 20 | 40 |
| Fine yellow gray sand..... | 10 | 50 |
| Light gray fine grained clay..... | 20 | 70 |
| Gray pebbly clay..... | 10 | 80 |
| Gravel..... | 20 | 100 |
| Gray pebbly clay..... | 20 | 120 |
| Mississippian: | | |
| Coldwater Formation: | | |
| Gray shale..... | 280 | 400 |
| Hard sandy red shale..... | 40 | 440 |
| Greenish gray shale..... | 260 | 700 |
| Devonian: | | |
| Bedford and Antrim Formations (Undivided): | | |
| Greenish gray and dark gray shale, laminated..... | 200 | 900 |
| Dark gray and black bituminous shale..... | 100 | 1,000 |
| Gray calcareous shale..... | 40 | 1,040 |
| Traverse and Dundee Formations (Undivided): | | |
| White to light buff limestone..... | 50 | 1,090 |
| (Violent effervescence with cold dilute acid) | | |
| Light to dark gray bituminous limestone, shaly..... | 60 | 1,150 |
| Dundee Formation: | | |
| Brown to buff limestone..... | 75 | 1,225 |
| Silurian (in part): | | |
| Monroe Formation (Detroit River and Bass Island Series (undivided): | | |
| White dolomite with anhydrite (anhydrite apparently abundant at several horizons from 1,225 ft. down)..... | 25 | 1,250 |
| Dark brown to buff dolomite..... | 40 | 1,290 |
| Light buff to buff dolomite..... | 80 | 1,370 |
| White to bluish gray dolomite..... | 20 | 1,390 |
| Buff to brown dolomite..... | 10 | 1,400 |
| Dolomite and anhydrite..... | 10 | 1,410 |
| Light gray dolomite..... | 10 | 1,420 |
| Light buff dolomite..... | 10 | 1,430 |
| Very light buff dolomite..... | 20 | 1,450 |
| Light buff and gray dolomite..... | 10 | 1,460 |
| Bass Island Series (?): | | |
| Shaly dolomite and gray shale..... | 50 | 1,510 |
| Gray and buff dolomite..... | 10 | 1,520 |
| White and gray dolomite..... | 10 | 1,530 |
| Light buff dolomite..... | 20 | 1,550 |
| Gray shaly dolomite..... | 10 | 1,560 |
| Buff dolomite..... | 20 | 1,580 |
| Gray shaly dolomite..... | 20 | 1,600 |
| Light buff dolomite..... | 20 | 1,620 |
| Gray shale..... | 10 | 1,630 |
| Buff dolomite..... | 10 | 1,640 |
| Gray shale and shaly dolomite..... | 10 | 1,650 |
| Gray to buff dolomite..... | 10 | 1,660 |
| Buff dolomite..... | 26 | 1,686 |
| Gray dolomite, shaly..... | 5 | 1,692 |
| Buff dolomite..... | 10 | 1,712 |
| Light brown dolomite..... | 4 | 1,716 |

NOTE: City datum on level of Lake Michigan at South Haven is approximately 580 feet above sea level

WESTERN MICHIGAN

Ever since numerous shows of oil were found in the salt wells at Ludington and Manistee, Western Michigan has always been a center of attraction for petroleum development. Early deep drilling by several lumber companies at Muskegon failed to find sizeable beds of rock salt, but oil was present at different horizons in all of these wells. Production of oil from Allegan County in 1912 furnished definite proof of the presence of commercial quantities of petroliferous substances in the western part of the state.

As a result of interest stimulated by the Saginaw Oil Field, several projects for "wildcatting" and development of oil and gas possibilities were started in Muskegon, Newaygo, and Mason Counties. The Muskegon Oil Corporation was formed at Muskegon, the Logan Oil Company was organized at Ludington and Reed City, and local parties banded together in northwestern Newaygo County for the purpose of leasing land and drilling wells. Operations did not get under way on any of these attempts until the summer of 1927, but their results were far reaching. By the spring of 1928 a definite oil and gas field with steady production had been established near Muskegon, and the results of the Mason County test were decidedly promising.

After the discovery of the Muskegon Oil Field, prospecting spread out into adjoining areas. Immediate drilling was carried on near Robinson, Ottawa County, by the Ottawa Development Company and several other local syndicates were formed in the northern part of the country. Leasing activity spread out into Kent and Oceana Counties, where locations have just been made for the commencing of wells. Muskegon became a center of operations in 1928 and threatened the position previously held by Saginaw.

A deep well was started by Ruggles and Rademaker at their salt plant in Manistee. The plans were to make it as thorough a test as possible in order to test all of the potential possibilities for salt, brine, oil and gas. At the present time this is the deepest well in the State of Michigan and drilling is still in progress.

MUSKEGON COUNTY.

The Muskegon Oil Corporation was organized in July, 1926, for development in Muskegon County with Stanley D. Daniloff, president and treasurer; Charles E. Myler, vice president, and Willard G. Turner, Jr., secretary. Well No. 1 was drilled by this company in the summer of 1927 on the Bert Haze Kemp property in Section 28, T. 10 N., R. 16 W., corner of Eastgate Avenue and the old Grand Rapids Road, in the eastern part of Muskegon. A total depth of 2360 feet was reached by this well without obtaining production, although it is certain that some oil was drowned out with salt water encountered. The top of the Traverse limestone was found at a depth of 1755 feet and several brine bearing horizons occurred at 1770, 1840, 1938, and 2215 feet. Apparently the well was finished in the Upper Monroe formation, but no samples were obtained below 2115 feet. Although the drilling of this well was somewhat prompted by geological evidence, the exact location was made by a Mr. Reber, who had been given credit for the discovery of the Saginaw Field.

MUSKEGON TOWNSHIP

HISTORY OF DEVELOPMENT—

Following out the suggestions made years ago by Dr. A. C. Lane, and restated by R. A. Smith, in Publication 14, that there was a rise in the

rocks to the north of Muskegon Lake, the location was made for the No. 2 well of the Muskegon Oil Corporation. This location was made by H. D. Crider, Geologist for the Dixie Oil Company, on the Charles Reeths farm in the northwest $\frac{1}{4}$ of the northwest $\frac{1}{4}$ of Section 9, T. 10 N., R. 16 W., Muskegon township. Although Dr. Lane had referred specifically to Secs. 15 and 16 in Laketon township as a likely place to drill, the Crider location was much in keeping with this idea.

On December 8th, 1927, gas was encountered in this well at 1640 feet, and the quantity increased for 18 feet to an open flow of 494,000 cubic feet per day. Previously gas had been found at 580 feet in a sandy phase of the Coldwater shale and at 1180 feet some oil which was very likely in the Bedford formation close to the Berea horizon. Oil was first observed on December 12th when there was a hundred feet, or between six and eight barrels in the hole. The well filled slowly until on December 14th between 600 and 800 feet of oil was in the $8\frac{1}{4}$ inch casing. Drilling into the soft limestone formation one foot farther caused the oil to flow. Estimates of this initial flow were from 300 to 500 barrels per day, but the former figure is probably more nearly correct. On December 21st the well was still flowing under head of about 200 barrels per day, and upon drilling in between 2 and 3 feet farther the flow increased to 330 barrels. In the days following decline was relatively slow, but upon January 21st the production had reached about 90 barrels per day. Later the pipes became plugged with paraffin and pressure was created which blew off the control head and the improperly anchored pipe dropped 30 or more feet to the bottom of the hole. This caused the flow to stop for a period of about 14 hours, after which the production came back, but the well did not show its previous life after this accident. In April the output had dwindled from 20 to 50 barrels daily and preparations were made to pull the pipe, clean out the paraffin and drill deeper into the pay formation.

SCOPE OF FIELD.

The discovery of oil and gas in the Reeths well under conditions which gave promise of flush production attracted many operators to the Muskegon field. Under the terms of a previous agreement the Dixie Oil Company took over 200 acres in the adjacent proven area. Local real estate men and operators from the Saginaw field scoured the immediate vicinity for leases, and numerous deals resulted. Frank L. Maire and Chas. H. Caswell doing business as the Lima Oil Corporation took over a large block of close in land in Muskegon township and laid plans for their first well. The Johnson Oil Refining Company, the Bulldog Oil and Gas Company, and the partnership of Bowers & O'Keefe were all preparing to drill tests within a mile and one-half of the discovery well.

Another result of the intensive development was reorganization of the Muskegon Oil Corporation on a more pretentious scale. A land holding company which was called the Muskegon Development Company was formed and the quantity of land under lease was increased immediately to about 50,000 acres. Three operating companies were then organized which were known as the Citizens Petroleum Company, the Lakeshore Petroleum Company, and the Joliet-Morris Development Company. The total authorized capitalization of these four concerns was \$250,000, about half of which was represented in working capital and the remainder in leases. The most of this stock was sold in Joliet, Chicago and Morris, Ill., although several blocks were disposed of in Muskegon proper.

| Name of Company | Muskegon Oil Corporation | Muskegon Development Company | Citizens Petroleum Company | Lakeshore Petroleum Company | Joliet-Morris Development Company |
|----------------------------|--------------------------|------------------------------|----------------------------|-----------------------------|-----------------------------------|
| Authorized Capital..... | \$100,000.00 | \$50,000.00 | \$100,000.00 | \$100,000.00 | \$100,000.00 |
| Kind of Stock..... | \$100 Par Common | \$100 Par Common | \$100 Par Common | \$100 Par Common | \$100 Par Common |
| Subscribed..... | \$51,000.00 | \$7,000.00 | \$50,000.00 | \$39,100.00 | \$65,000.00 |
| Paid In..... | \$5,875.00 | 3,000.00 | 50,000.00 | 21,400.00 | 30,000.00 |
| Place of Operation..... | Muskegon, Mich. | Joliet, Ill. | Muskegon, Mich. | Joliet, Ill. | Muskegon, Mich. |
| Officers: | | | | | |
| President..... | Stanley Daniloff | Charles E. Myler | Leo M. Herkert | Willard I. Foster | Oscar Weinbrod |
| First Vice-President..... | Leo M. Herkert | W. I. Foster | Chas. Brusator | Chester W. Bacon | H. B. Smith |
| Second Vice-President..... | Chas. E. Myler | Julius Herkert | David L. Apsol | Walter Heintz | R. D. Richards |
| Secretary..... | Willard G. Turner, Jr. | Leo M. Herkert | Edward J. Bysma | Robert F. Kelly | E. C. Shields |
| Treasurer..... | Stanley Daniloff | Leo M. Herkert | Henry E. Vollmer | Oliver A. Campeau | |

Preparations were now made for an extensive drilling campaign and the second location followed.

The new well was on the Fred Figge farm about 600 feet west of the Reeths location, 700 feet south of the north property line and 330 feet east of the west property line. The top of the Traverse occurred at 1633 feet and the first gas was found at 1646 feet. Oil first started coming into the hole at 1662 feet and the well commenced spraying oil at 2 o'clock on Feb. 20th, 1928. Production for the first 24 hours amounted to 178 barrels and after two months the output had only declined to between 90 and 110 barrels daily.

The Johnson Oil Refining Company of Chicago, Ill., made preparations to drill about 1½ miles northeast of the Reeths well, on the Grace B. Cehak farm in the SW¼ of the NW¼ of Section 3, 300 feet from the south property line and 300 feet from the west property line. Hagan & Hagan of Saginaw contracted for drilling the well, which was commenced on the 6th of February, 1928. The top of the Traverse formation was found at 1715 feet and brine which was tapped at 1795 feet filled the hole for 600 feet. Operations were completed on March 3, 1928, and plugging and abandonment followed on March 8, 1928.

The Citizens Petroleum Company drilled their first well on the A. & O. Becker farm in the NE¼ of the SW¼ of Section 4, 330 feet from the south line and 330 feet from the east line. The Gray Drilling Company of Milwaukee, Wis., were contractors. An equivalent horizon to the Berea was reported at 1223 feet and the top of the Traverse formation was encountered at 1640 feet. Pay streaks occurred from 1731-1734 feet, 1905-1910 feet, and 1925-1935 feet. About 1 barrel of oil was found in the hole on March 26th but drilling was continued. Water was reported from 1950-1975 feet and the well was completed at a total depth of 2038 feet. The dolomitic character of the rock seemed to indicate that the Upper Monroe formation had been penetrated. The well was plugged and abandoned on April 4, 1928.

The Lima Oil Corporation (Maire-Caswell) started to drill on the Margaret Figge property on Feb. 18, 1928, and V. M. Voorhees of Saginaw was contractor for the well. This location was southeast of the discovery well on the Muskegon River flats in the SE¼ of the NW¼ of Section 9, 250 feet from the north farm line and 250 feet from the west farm line. Gas was found at 535 feet in a limestone phase of the Cold-water formation and a show of oil was present at 1140 feet in what was thought to be the Berea horizon. The top of the Traverse occurred at 1581 feet and the first gas started to come in at 1592 feet. This gas increased at 1594 feet and when a depth of 1610 feet was reached a marked increase took place to about 1 million cubic feet. At 1611 feet a porous, honeycombed, coral limestone was struck which netted an open flow measurement of 4,552,860 cubic feet of gas on March 15, 1928. The gas kept increasing and two days later it gauged over 4,900,000 cubic feet. The rock pressure, although not accurately determined, amounted to about 640 pounds per square inch.

Preparations had not been made for handling a well of this size and the gas was allowed to go into the air through a length of 6% inch pipe until a gate valve and proper fixtures could be obtained for closing in the flow. This was by far the largest gas well ever obtained in Michigan. After the well had been closed in for some time preparations were made

to case off this flow and drill deeper. A string of 5 3/16 inch casing was landed at 1610 feet and further drilling brought 1,200,000 additional gas and a spray of oil which amounted to several barrels over night. At 1626 feet the total amount of gas was about 6 million cubic feet and when the well was finally shut in at 1640 feet the flow capacity had reached 8 1/2 million cubic feet.

C. M. Bowers of Detroit, Michigan, and W. W. O'Keefe of Plymouth, Ind., also drilled a test well to the northeast of immediate production. This location was on the Chas. W. Smith farm in the NE 1/4 of the SW 1/4 of Section 3, 300 feet from the south line and 300 feet from the west line. Prather & Son of Saginaw contracted for the well. Some gas was reported from 700 to 720 feet and a sandy horizon equivalent to the Berea appeared at 1315 feet. The top of the Traverse limestone occurred at 1710 feet and blue lick sulphur water came in the hole at about 1775 feet. Drilling was continued to a total depth of 1800 feet and plugging followed on March 26, 1928.

The Wolverine Mineral Development Company with J. B. Reed as contractor prepared to drill on the Geo. H. Shoup property in the NW 1/4 of the NW 1/4 of Section 8, 250 feet north from M-20 highway and 200 feet west of the Cihak property. The top of the Traverse was penetrated at about 1650 feet and the first show of gas appeared at 1661 feet and from 1675 to 1679 feet the formation was soft and oil was present in the last 2 feet. The well was drilled to about 1700 feet and was given a 160-quart shot of nitroglycerin on May 4, 1928. Production, after first shot, was about 25 barrels daily, and on May 10th the well was making 7 barrels per day by pumping.

R. L. Hill and a syndicate composed of Glenn M. Porter, J. Arthur Dratz, and several other Muskegon parties drilled on John C. Marquart property at the fork of the roads where U. S. 31 and M-20 intersect. The location was in the SW 1/4 of the SE 1/4 of Section 7, 300 feet from the north property line and 300 feet from the west property line. The well was commenced by V. M. Voorhees, contractor, on March 5, 1928, and a show of oil was found in a fine grained (Berea?) sandstone at 1164 feet. The top of the Traverse occurred at 1603 feet and a show of oil was present at 1662 feet. No water was found but drilling was discontinued at 1701 feet and the well was plugged and abandoned on March 23, 1928.

The Johnson Oil Refining Company drilled their second well on the Harley Smith farm in the SE 1/4 of the SE 1/4 of Section 5, 250 feet from the south line and 250 feet from the east line. C. P. Brant of Indianapolis, Indiana, contracted for the drilling and a good show of oil was obtained in a broken sandy shale (Berea?) from 1198 to 1205 feet. The Traverse was found at 1634 feet and gas occurred at 1672 feet. An oil pay was tapped between 1678 and 1682 feet and further gas and oil came in at 1702 feet. Drilling was continued to 1710 feet and on April 4th the well was shot with 150 quarts of nitroglycerin between 1675 and 1710 feet. The hole filled 1200 feet with oil and about 40 barrels were swabbed the first day. After being put on the pump, current records of production show the well to be doing between 10 and 15 barrels daily.

The Dixie Oil Company with Hagan & Hagan as contractors drilled their first well on the Chas. Reeths farm in the SW 1/4 of the NW 1/4 of Section 9, 330 feet from the north line and 250 feet from the east line.

Shows of oil and gas were present all the way down, with gas at 280 feet, gas at 535 feet, and several bailers of oil at 635 feet. The top of the Traverse formation occurred at 1577 feet and the first gas was tapped at 1597 feet. This gas kept increasing with depth until at 1605 feet the porous, honeycombed limestone was struck. The open flow was gauged at about 4,500,000 cubic feet. Oil was encountered at 1613 feet which sprayed 30 barrels into the tanks during the first day that the well blew open. The Maire-Caswell Company got out an injunction to restrain drilling into the oil, on the grounds that the gas should be mudded or cased off to prevent intermixture and a wet gas condition. The Dixie Oil Company contended that the oil and gas were inseparable, in the same formation, and that no wastage was involved by continued operation. Drilling was carried on to a total depth of 1638 feet, where the well was closed in to await developments for a gas market. The injunction was finally withdrawn.

The Joliet-Morris Company put down a well on the John B. Nichols farm in the SE 1/4 of the NW 1/4 of Section 8, 330 feet from the north line and 330 feet from the east line. F. M. Gray, Jr., Inc., of Milwaukee, contracted for drilling and an accurate log was kept. A four foot sandstone horizon was recorded at 1171 feet which was in a somewhat equivalent position to the Berea. The top of the Traverse limestone occurred at 1574 feet and was with a little oil was found down to 1639 feet. From 1653 to 1661 feet the big pay of gas and oil was struck which amounted to 500 barrels initial daily production. This proved to be the largest well in the field to date and started a frenzied campaign of offset wells to the east, south and southeast.

The second well of the Dixie Oil Company was put down by Edward Stewart, contractor of Bremen, Ohio. The location was on the Dixie lease of the Fred Figge farm in the SW 1/4 of the NW 1/4 of Section 9, 330 feet from the north line and 330 feet from the west line. A show of oil and gas appeared at 684 feet, the Berea equivalent was reported at 1155 feet and the top of the Traverse was found at 1588 feet. The first gas was tapped at 1617 feet, oil at 1623 feet, and oil commenced to flow between the depths of 1628 and 1632 feet. The hole was drilled to a total depth of 1636 feet and production for the first 24 hours was about 400 barrels. The output soon dropped to 200 barrels daily, and for the first part of May it fluctuated between 110 and 120 barrels.

The Lakeshore Petroleum Company drilled on the Jas. Dow property in the SW 1/4 of the SE 1/4 of Section 5, 250 feet from the north line, 250 feet from the west line, and west of M-20 highway. The Berea was reported at 1202 feet and some gas was found in a broken hard sandy shale from 1202 to 1217 feet. The Traverse occurred at 1661 feet with shows of oil from 1700 to 1712 feet and 1716 to 1722 feet. The well was shot on April 4th with 60 quarts of nitroglycerin from 1700 to 1739 feet, but results were not favorable and plugging followed on April 7th, 1928.

The Muskegon Development Company started their first drilling on the Herman Hartman farm in the NE 1/4 of the NW 1/4 of Section 9. The location was an offset north of the Maire-Caswell gasser, 250 feet from the south line, 250 feet from the west line, and Hoffman & Sweeney were the contractors. Some gas occurred at 560 feet and the top of the Traverse as measured with a steel line was at 1560 feet. The first gas

started coming from 1585 to 1597½ feet and both gas and oil were found from 1597½ to 1637 feet, where the well was finished. The first oil occurred at 1620 feet and it started to flow at the rate of 22 barrels per hour at 1625 feet. Production for the first 24 hours amounted to 360 barrels, but early in May the output had declined to about 100 barrels daily.

The first well on the H. C. Heinz property was drilled by the Muskegon Oil Corp. in the NE¼ of the NE¼ of Section 8, 250 feet from the north line and 231 feet from the east line. Drilling was done by the Gray Drilling Company with the same outfit that put down the discovery well. The sand with a show of oil that had been determined as Berea by drillers in the field was found from 1200 to 1204 feet. The top of the Traverse limestone was struck at 1644 feet, with gas occurring at 1670 feet and oil at 1681 feet. The oil and gas kept increasing to a depth of 1696 feet, and the bottom of the hole was at 1700 feet. Sufficient gas was not available to flow the oil steadily and the well produced about 10 barrels during the first night. Attempts at "bleeding" the shell were successful, and after the well was shot the output increased to about 50 barrels daily.

A. S. Cochran and others of Cleveland, Ohio, put down a well on the A. R. Taggart property near the Johnson Oil Refining Smith No. 1. The location was on a small tract in the E½ of the SE¼ of the SE¼ of Section 5, 50 feet from the south line and 50 feet from the west line. Formation conditions were similar to those in the Smith No. 1 well and drilling was continued to a total depth of 1700 feet. After being shot with nitroglycerin on April 16, 1928, the output by pumping amounted to between 10 and 20 barrels per day.

The Bankers Trust Company of Muskegon with J. B. Reed as contractor drilled on the John Torrent estate in the NE¼ of the NW¼ of Section 17, 500 feet from the north line and 300 feet from the east line. This location, which was farthest south of any in the field, was just east of the P. M. Ry. embankment and southwest of the south center line of Section 8, near the forks of Cedar Creek. A show of oil was reported at 1024-1039 feet in the supposed Berea horizon, and the top of the Traverse was found at 1605 feet. Some oil and gas was tapped at 1678 feet and the well was drilled to a total depth of 1714 feet. A shot of nitroglycerin caused very little effect so that plugging and abandonment followed on May 9, 1928.

The Muskegon Oil Corporation also drilled on the John Torrent estate in the SW¼ of the SE¼ of Section 8, 250 feet from the north line and 250 feet from the east line. The Traverse limestone occurred at 1602 feet and shows of oil and gas were present from 1612 to 1624 feet and from 1696 to 1700 feet. Drilling was continued to a total depth of 1720 feet and the well was shot on April 30th with 100 quarts of nitroglycerin from 1612 to 1624 feet and from 1662 to 1700 feet. Forty-eight hours after the shot 8 barrels of oil were taken from the hole and it is reported that the well is a very small producer.

A well was put down by the Muskegon Oil Corporation on the Albert Heinz farm in the NE¼ of the NE¼ of Section 8, 250 feet from the south line and 175 feet from the east line. The top of the Traverse limestone was found at 1620 feet and gas was first struck at 1656 feet. Oil occurred from 1660 to 1669 feet and drilling was continued to a total depth of 1682 feet. The initial production was 1½ million cubic feet of gas and about 300 barrels of oil.

The well farthest west in the field was drilled by the Bulldog Oil and Gas Company on the Chas. Giles farm in the SE¼ of the SE¼ of Section 6, 150 feet from the south line and 150 feet from the east line. This test was the first drilled with a rotary outfit in Michigan and was watched with considerable interest. Drilling was in charge of Edward M. Self and C. Wilbur White of Chicago was president of the company. The top of the Traverse was found at 1577 feet and a show of oil and gas was present from 1632 to 1637 feet. The well was drilled to a total depth of 1690 feet and was shot on two different occasions. The first charge consisted of 60 quarts put in from 1627 to 1645 feet on April 30th and the second consisted of 140 quarts from 1635 to 1645 feet on May 4th, 1928. Results of shooting were only 2 barrels of oil and about 5,000 cubic feet of gas and plugging followed immediately.

Several other major companies hold acreage in the vicinity of the field but have not commenced any active operations. These include the Ohio Oil Company, the Pure Oil Company, and the Sun Oil Company. On May 18th there had been 25 completions in Muskegon Twp., which included 8 dry holes, 2 shut in gas wells, and 15 producing oil wells. Of the 15 producers, 10 are making gas which amounts to from 200,000 to 1,000,000 cubic feet daily, which is more than sufficient to flow the oil. The other five are pumpers and they bring the average production per well to about 75 barrels per day.

New wells are constantly being drilled and although the pool is limited to the north, west and southwest, many inside locations still remain. Operations to the southeast have been somewhat delayed because of the difficulty of moving in equipment. Possibilities exhibit themselves in this direction for future extension of the field. At the present time there are 21 rigs in the immediate area and several new projects are under way. A summary of wells in the Muskegon field up to May 15, 1928, is included in the following list:

WELLS IN MUSKEGON OIL FIELD (TO MAY 15, 1928)

| Company | Order of Completion | Farm | Date Completed | Bbls. Initial Production |
|--|---------------------|-----------------------------|----------------|--------------------------|
| Bankers Trust Co. | 18 | John C. Torrent | 4-18-28 | Dry |
| Bowers-O'Keefe | 7 | Chas. W. Smith | 3-15-28 | Dry |
| Bradley, Wm., Trustee | | Alex Layman | Drilling | |
| Bulldog Oil & Gas Co. | 21 | Chas. Giles | 5-2-28 | Dry |
| Citizens Petroleum Co. | 5 | A. & O. Becker | 3-13-28 | Dry |
| Cochran, A. S., et al. | 17 | Albert Heinz, No. 1 | Drilling | 15 |
| Cochran & Press | | A. R. Taggart | 4-12-28 | |
| Dixie Oil Co. | 11 | Augusta Steiner | Drilling | 4½ M. |
| | | Chas. Reeths, No. 1 | 3-25-28 | 30 bbls. |
| | 13 | Fred Figge, No. 1 | 4-1-28 | 400 |
| | | Fred Figge B, No. 1 (No. 2) | 4-26-28 | B. S.-60 |
| | | A. and O. Becker | Drilling | A. S.-150 |
| | | Fred Figge, No. 3 | Drilling | |
| Hill, R. L., et al. | 3 | John C. Marquart | 3-22-28 | Dry |
| Joliet Morris Development Co. | 12 | John B. Nichols | 3-30-28 | 500 |
| | | Garrett Kooi | 5-11-28 | 80 A. S. |
| | | John Ehler | Drilling | |
| Johnson Oil Refining Co. | 10 | Harley Smith | 3-24-28 | A. S.-40 |
| | 4 | Grace B. Cehak | 3-3-28 | Dry |
| Lakeshore Petroleum Co. | | Joseph DeVries | Drilling | |
| | 14 | James Dow | 4-2-28 | Dry |
| Lakeshore & Citizens Petroleum Co. | | Tom Kooi | Drilling | |
| Lima Oil Corporation (Maire-Caswell Co.) | 6 | Margaret Figge | 3-14-28 | 6 M. |
| Muskegon Development Co. | 15 | H. Hartman | 4-5-28 | 360 |
| Muskegon Oil Corp. | 1 | Bert Haze Kemp | 10-1-27 | Dry |
| | 2 | Chas. Reeths, No. 1 | 11-22-27 | 330 |
| | 3 | Fred Figge, No. 1 | 2-20-28 | 178 |
| | 20 | Albert Heinz, No. 1 | 5-1-28 | 360 |
| | 16 | H. C. Heinz, No. 1 | 4-5-28 | 50 |
| | 19 | John Torrent Est. | 4-28-28 | B. S.-10 |
| | | Herman Heinz | Drilling | |
| Porter, Glenn M., Trustee | | Geo. Workman | Drilling | |
| Reed Oil Co. | | A. Heinz | Drilling | |
| Wa-jes-el Oil Co. | | Peck & Anderson | Drilling | |
| Wolverine Mineral Development Co. | 8 | Geo. H. Shoup | 3-17-28 | A. S.-25 |

PRODUCTION.

The oil from the Reeths well is of paraffin base and various field tests have shown it to be from 33.5 degrees to 37 degrees Baume gravity. It is dark in color and lower in gasoline content than any of the Saginaw crudes. In January a price of \$1.30 per barrel was quoted for it by the Standard of Indiana refinery at Whiting, Ind. The first tank cars of oil were shipped from Muskegon on Dec. 17, 1927, and showed a refinery gravity test of 37.2 degrees. Be. The crude is of paraffin base and has been given the same rating as Mid-Continent. Later in May the price was increased to \$1.35 per barrel at the well. A sample tested showed the following result:

| | |
|------------------------|----------------|
| A. P. I. Gravity | 36½—37 degrees |
| Sulphur Content | .336 |
| S. R. Gasoline content | 34—35% |
| Kerosene Content | 14% |

The remainder crackable residuum.

The market for the output of the field has been furnished by the Standard Oil Company of Indiana. Part of the oil has been shipped to Whiting, Indiana, but the most of it is used in the smaller new refinery at Zilwaukee, Michigan, near Saginaw. A 4 inch pipe line has been installed from the wells in the district to the loading racks on a nearby spur of the Pere Marquette Railway. Recently the company leased from

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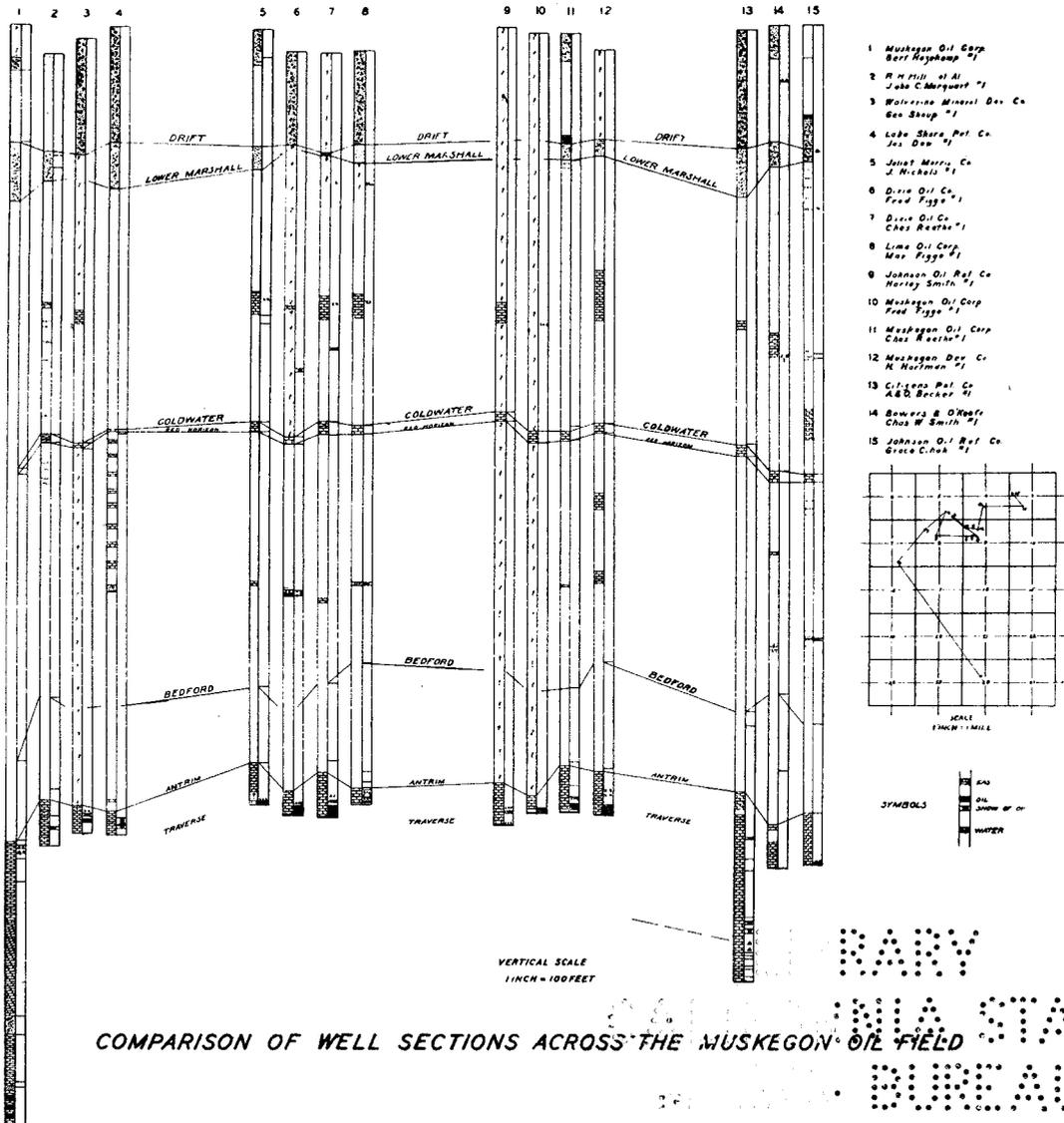


FIGURE 14.

Comparison of Well Sections across the Muskegon Oil Field.

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| Company |
|------------------------------|
| Bankers Trust Co. |
| Bowers-O'Keefe. |
| Bradley, Wm., Trustee. . |
| Bulldog Oil & Gas Co. . . |
| Citizens Petroleum Co. . . |
| Cochran, A. S., et al. . . . |
| Cochran & Press. |
| Dixie Oil Co. |
| Hill, R. L., et al. |
| Joliet Morris Developme |
| Johnson Oil Refining Co. |
| Lakeshore Petroleum Co |
| Lakeshore & Citizens Pe |
| Lima Oil Corporation. . . |
| (Maire-Caswell Co.) |
| Muskegon Development |
| Muskegon Oil Corp. |
| Porter, Glenn M., Trus |
| Reed Oil Co. |
| Wa-je-sel Oil Co. |
| Wolverine Mineral Dev |

PRODUCTION.

The oil from have shown it is dark in color crudes. In Ja the Standard c of oil were shi finery gravity and has been g price was incr showed the foll

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The market ard Oil Comp ing, Indiana, Zilwaukee, M stalled from t of the Pere

Charles Myler an acre of ground which adjoins the North Muskegon siding junction where the loading cars are now located. Upon this small tract it is proposed to erect two 2,500 barrel storage tanks as soon as the daily production warrants such precautions.

The decline of the wells has not gone on far enough to make any speculations concerning their future productivity. After the first day they drop off about one-half and during the first month the decrease in output for the larger wells averages from 2½ to 3 barrels per day. The Reeths well made about 3,500 barrels of oil during the first month after it came in. On March 2, 1928, the output of Muskegon Field had reached 1000 barrels daily and by June 1st, this figure had been increased to almost 2000 barrels by flush producers.

The Muskegon Oil Corporation and its associated companies contribute the greater part of the field's production. At the present time the Dixie Oil Company is the second largest operator from the standpoint of current output. Numerous other concerns are finding producing wells and are entering actively into the development of the field.

Gas has been found in larger quantities than anywhere else in Michigan. Up to the present no commercial use has been made of this commodity except for flowing the oil and for fuel in drilling on adjacent properties. The two largest gassers in the field are closed in with a potential supply of between 10,000,000 and 12,000,000 cubic feet. Negotiations are under way with the Muskegon Traction and Lighting Company to use the gas. The heating value of this fuel amounts to 980 B. T. U. and the the public utility firm proposes the adoption of a proportionate mixer to utilize at least a part of the natural gas coming from the wells. As yet arrangements have not been consummated between the city officials and the present producers of artificial gas for terms in the utilization of this new supply.

GEOLOGICAL CONDITIONS.

Although drilling in the early days at Muskegon had given general information concerning the rocks to a depth of 2627 feet, an accurate set of samples had never been kept. When the Mukegon Oil Corporation drilled their first test on the Hazekemp property, a complete record from drill cuttings was preserved. Since the development of the field has progressed other complete and detailed records have become available. Figure 14 shows a comparison of well sections across the Muskegon Oil Field and demonstrates geological conditions in thickness variation and relation of oil, gas and water. The heaviest flow of water comes immediately below the drift, but some of the wells low on structure report water at about 600 feet. Gas or oil in small quantities usually occurs in a sandy limestone at depths from 540 to 580 feet. A horizon at about 1200 feet also shows oil and gas in nearly all the wells favorably located on structure. The principal production comes from depths ranging from 1620 to 1680 feet.

The first rock to be encountered is the Lower Marshall formation where a flow of water is tapped. At Saginaw the equivalent beds occur between depths of 1000 and 1100 feet. The Coldwater Formation which is next penetrated shows several calcareous phases, one of which contains frequent pays between 600 and 700 feet. The interval from this shaly limestone to the red limestone is about 260 feet. This red horizon is the best marker in the field and has been found in all the wells.

The identity of this red bed is thought to be equivalent to red shale that occurs very close above the Sunbury black shale in the Saginaw District. In the samples from several wells at Muskegon, microscopic carbonaceous streaks and pyrite are found in the gray shale immediately below the red limestone.

The greenish gray shales of the Bedford Formation replace the Berea on the western side of the State. They contain occasional sandy zones or "shells" and one of these has been logged as "Berea" by drillers. This frequently contains oil and gas and occurs at an interval of about 340 ft. below the top of the "red marker."

Below the Bedford formation occurs the Devonian Antrim black shale. This rock is full of pyrite and sporangites and becomes more calcareous toward the bottom. It is logged as "coffee" shale by drillers because of the striking resemblance of drill cuttings to ground coffee. The color of sand pumpings is a chocolate brown.

The top of the Traverse Formation is a transition zone and is difficult to establish in well records. In the field the drillers usually call the Traverse the first buff limestone, and it is the usual casing point before drilling into the pay. From well samples the actual top of the Traverse is shown to be approximately 70 feet above this place. The interval between the top of the red marker and the Traverse has been remarkably constant at about 730 feet.

The most important pay strata in the Muskegon Field up to the present time have been in the upper part of the Traverse limestone. The rock is a gray to buff porous limestone which is honeycombed in some places and shows a corraline structure. Gas starts coming from 10 to 20 feet below the top and the first oil is usually tapped from 30 to 40 feet in the Traverse limestone. No water has been found close below this pay on structure.

Since no sharp break occurs between the Traverse and Dundee limestones in the western part of the State it is difficult to differentiate between them with any degree of accuracy. Both of these formations thin decidedly and probably only represent together only about 300 feet of strata in the Muskegon area. Further difficulty is encountered in determining the break between the Dundee and Monroe formations. The only present basis for determination of Monroe age from well cuttings is dolomitic character, and this is by no means definite criteria. Future drilling to greater depth may modify these conclusions as to the thickness limits of the Traverse and Dundee.

The first idea of structure near Muskegon was developed by Dr. A. C. Lane and was restated by R. A. Smith in Publication 14. The contention was that a rise in the rocks occurred to the north across Muskegon Lake, and this was substantiated by the findings in the Reeths well. These results showed a northward rise of about 40 feet to the mile. Since the regional dip according to the well data proved to be southeast, evidently some type of pronounced structure was represented. Later drilling partly defined the structure.

Dry holes to the northeast and north outlined the pool in those directions and showed a sharp northeast dip. Failures to the south and southwest also limited development in those directions. Indications now are that the fold is a closed anticline with a northwest-southeast trend. Points of control are lacking to the southeast and the exact size and

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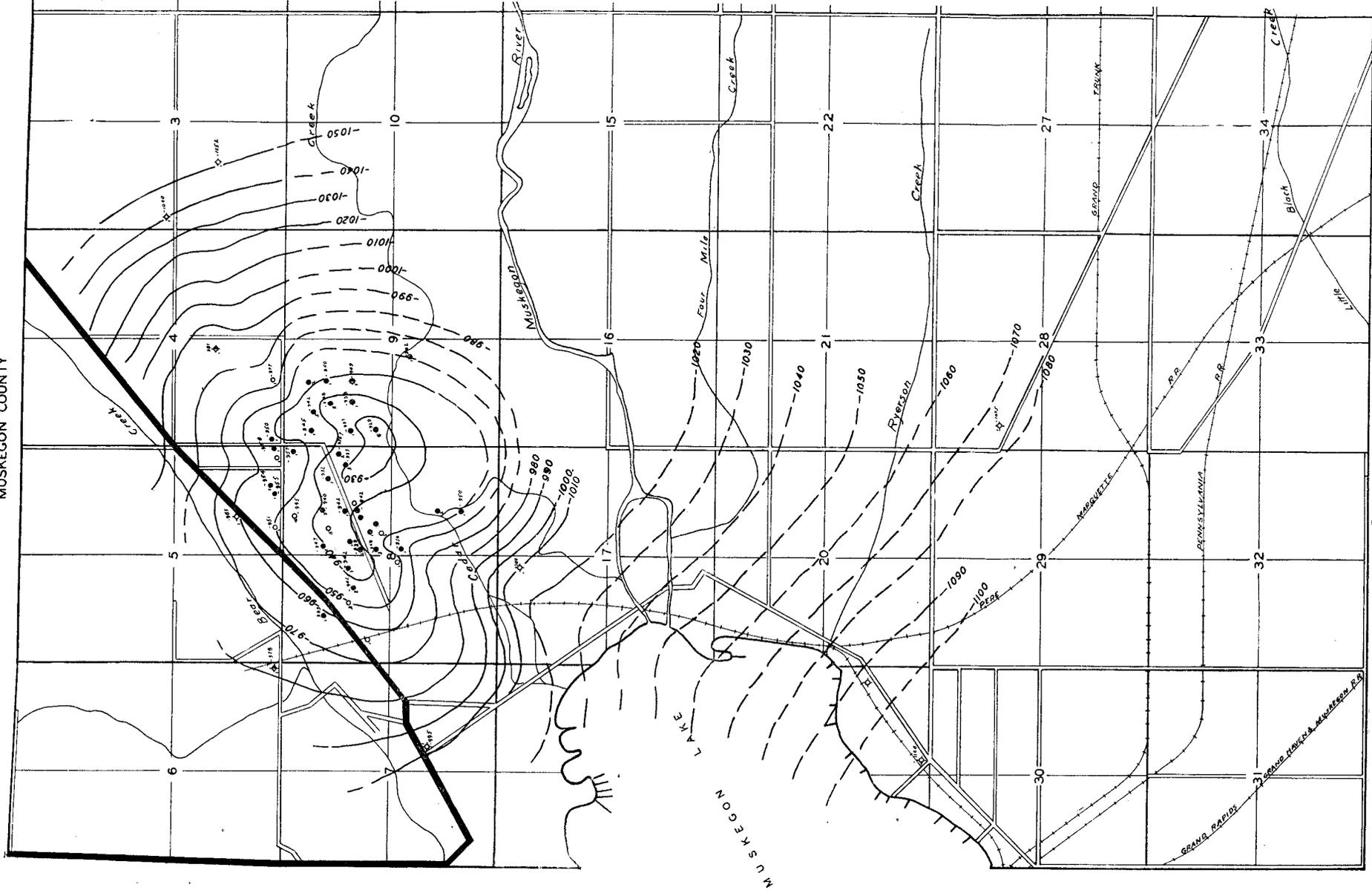
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STRUCTURAL CONTOUR MAP OF THE MUSKEGON ANTICLINE

MUSKEGON COUNTY



SCALE $\frac{1}{4}$ IN. = 1 MILE
DATUM-MEAN SEA LEVEL CONTOUR INTERVAL -10 FEET
CONTOURS DRAWN ON THE TOP OF THE TRAVERSE FORMATION

FIGURE 16.

Progress Structural Contour Map of the Muskegon Anticline.
Drawn on the Top of the Traverse Formation.