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ILLINOIS BASIN[1]

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ABSTRACT

I. *Structural history.*—The Illinois basin is part of a larger basin which during Paleozoic time extended an unknown distance southward. The greater part of the relative uplift of the borders of the Illinois basin probably occurred at the close of the Paleozoic era (Appalachian revolution). Major and minor structures within the basin were formed at various times during the Paleozoic era; much deformation along the southern border of the basin was of post-Paleozoic age. The time of origin of the more important known structures in the basin is discussed.

II. *Exploration for oil.*—The history of oil exploration in Illinois is briefly reviewed with special attention to the great southeastern Illinois field which ranks sixth in total production to date in the United States. During most of the 32 years following discovery of this field there has been little systematic exploration for oil in Illinois, but this has been due in large measure to the belief that oil production is probable only around the rims and not in the central portions of large structural basins. Discovery of the Mt. Pleasant field in Michigan and numerous fields in West Texas and elsewhere has upset this belief, so that now many geologists and oil executives favor careful exploration for oil throughout the areas of large structural basins. Possible oil-producing formations in the Illinois basin and structural trends in the basin with relation to oil possibilities are discussed.

Since 1934 the central part of the basin has been explored scientifically by both geological and geophysical methods. The first discoveries following the recent activity have come in 1937; three new oil wells, all located on the basis of seismograph surveys, and two of which are in the deep basin area, appear to be the beginning of a new period of development.

For about a year and a half an intense leasing campaign has been in progress in the Illinois basin. This has been participated in by about ten major companies and by many smaller companies and individuals. Most of the major companies are depending principally upon seismograph surveys to guide their exploratory drilling. The Illinois basin area is now looked on by the industry as one of the country's most promising areas, and accordingly a report on the territory is appropriate in a program which seeks to cover current activity.

The writers' purpose in this paper is to present a brief summary of the geologic history of the Illinois basin with special reference to structure and to discuss the application of geological knowledge to exploration for oil in the territory.

[1] Presented before the Association at Los Angeles, March 19, 1937. Reprinted from the *Bulletin* of the American Association of Petroleum Geologists, Vol. 21, No. 6 (June, 1937), pp. 771-788.

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PART I—STRUCTURAL HISTORY

By J. MARVIN WELLER

Most of the State of Illinois lies within the great structural basin that is included between the Cincinnati arch on the east, the Wisconsin uplands on the north, and the Mississippi arch and the Ozark region on the west (Fig. 1). This basin includes adjacent parts of

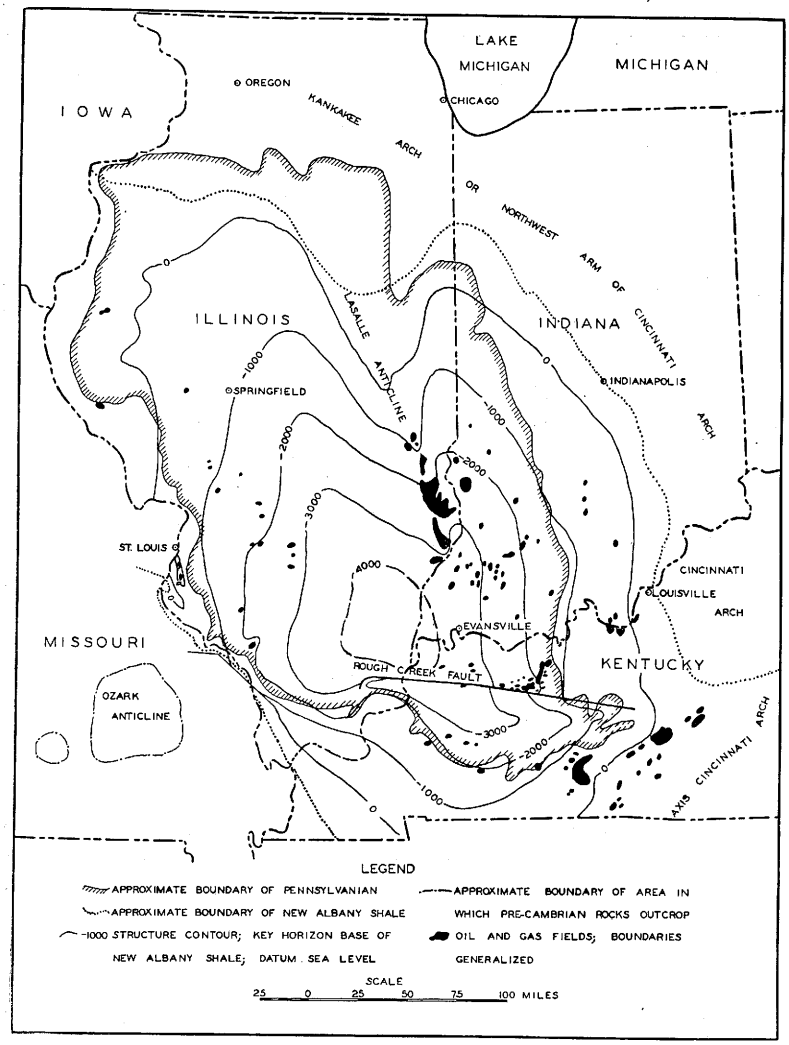

FIG. 1.—Map of Eastern Interior coal basin, showing principal tectonic features, oil and gas fields, and subsurface structure on base of New Albany shale. (From *Problems of Petroleum Geology, a Symposium*, American Association of Petroleum Geologists, Tulsa, Oklahoma, 1934, p. 559.)

southwestern Indiana and western Kentucky. Pennsylvanian rocks occur at the surface or immediately below the glacial drift throughout most of this area, but beneath them there exists a thick and fairly complete succession of the older Paleozoic systems (Fig. 3).

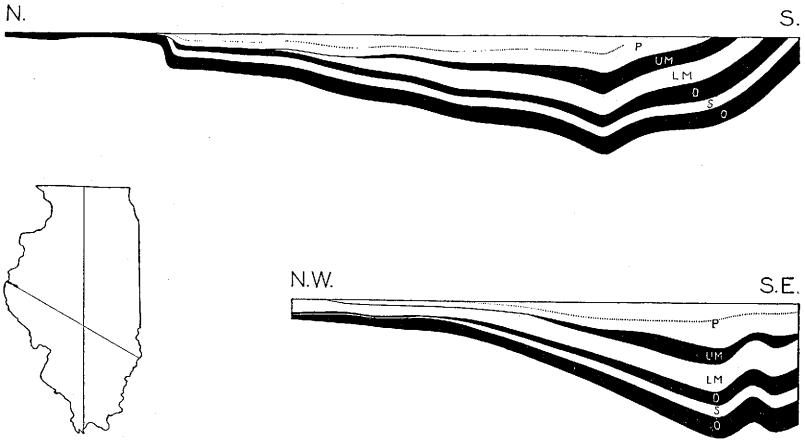

FIG. 2.—Cross sections of Illinois basin. P, Pennsylvanian (dotted line shows position of coal No. 6); UM, Upper Mississippian; LM, Lower Mississippian; D, Devonian; S, Silurian; O, Ordovician. (From "Geology and Oil Possibilities of the Illinois basin," *Illinois State Geol. Survey Illinois Petroleum No. 27*, July 11, 1936, p. 5.)

The Ozark region and the Wisconsin uplands are relatively stable areas which have not been subjected to notable depression or deeply buried by sediments since pre-Cambrian time. The Cincinnati arch is believed to have been in existence during the Ordovician period and may reflect conditions in the basement rocks dating back much farther. The monocline that bounds the Illinois basin on the south, however, is of much later origin and probably came into existence during the Appalachian uplift.

Well data indicate, so far as they are available, that practically all of the systems thicken notably inward and southward or southeastward in the basin (Fig. 2). This is particularly true of the Devonian system, which, with the exception of the ubiquitous New Albany shale and its equivalents, is poorly represented, or possibly absent locally, except in the southern part. If the results of the pre-Pennsylvanian unconformity are ignored for the moment, the thinnest and most incomplete post-St. Peter section occurs in western Illinois and northeastern Missouri on and adjacent to the Mississippi arch that connects the Ozark region with the Wisconsin uplands and separates the Illinois basin from the northeastern extension of the Mid-Continent (Western Interior) basin.

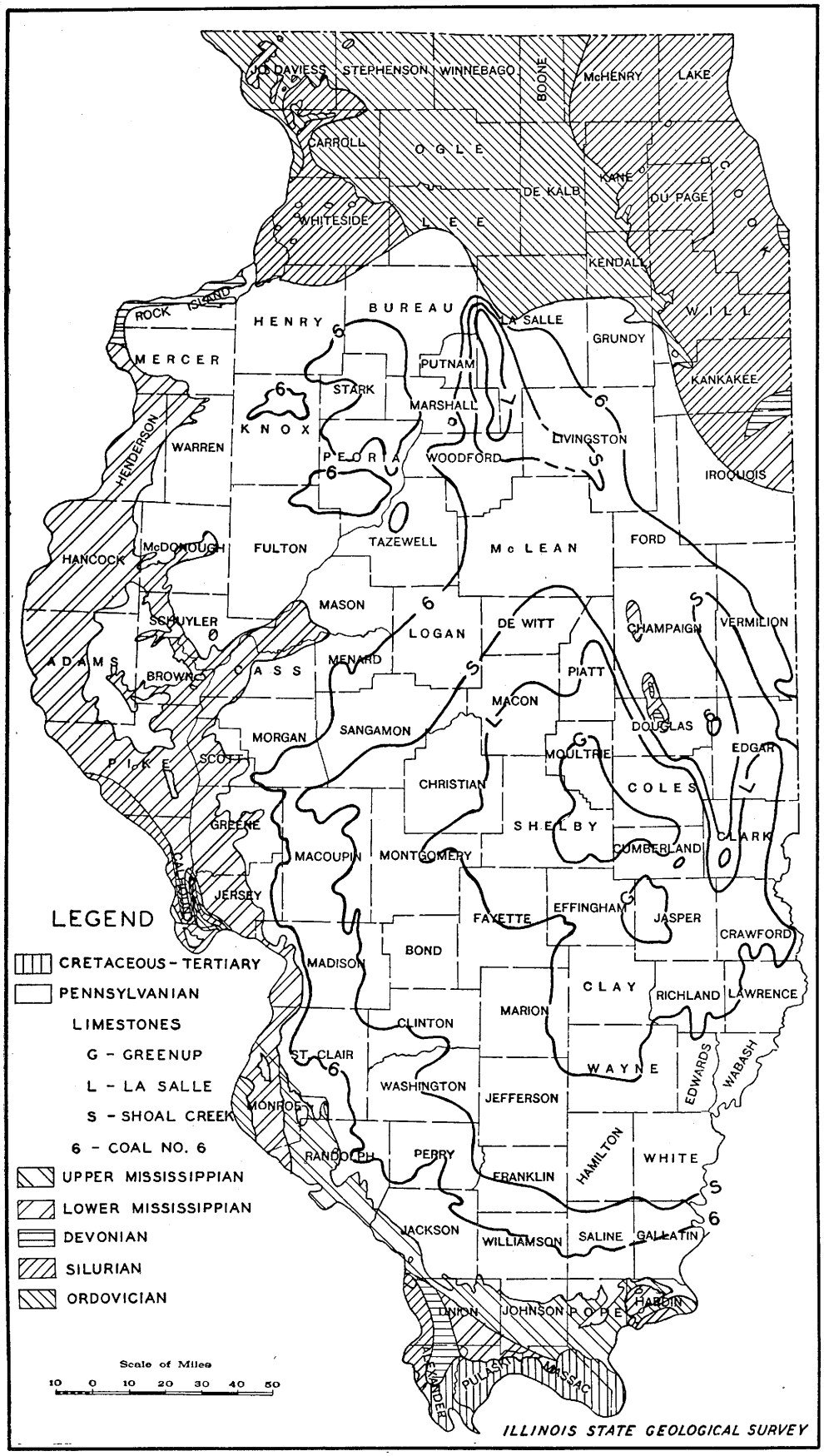

FIG. 3.—Areal geology of Illinois (modified after Fig. 14, p. 128, *Illinois State Geol. Survey Bulletin 61*, "Rock Wool").

The southward thickening of all of the Paleozoic systems above the Cambrian (which has not been penetrated in wells) continues to the extreme southern limit of the Illinois basin, where the Paleozoic beds pass beneath the younger sediments of the Mississippi embayment. This fact, together with the known age of the uplift which bounds the basin on the south, is proof that the Illinois basin as it exists today is only the northern part of a larger basin which during Paleozoic time extended an unknown distance toward the south along the present course of the Mississippi valley. It is probable that during Paleozoic time the Illinois basin communicated freely with the Arkansas valley trough, although marine connections were established frequently and for long periods of time across the Cincinnati arch toward the east and across the Mississippi arch and even the Ozark region toward the west. It is probable that the greatest amount of uplift of all the borders of the Illinois basin (or the greatest depression of the basin itself) that occurred at any single time was accomplished at the end of the Paleozoic era. In other words, the major part of the gross structure of the Eastern Interior United States, although previously determined and long in existence on a smaller scale, dates from the Appalachian revolution.

The earlier structural history of the Illinois basin is not well known. Numerous unconformities occur between the formations, but except where they obviously represent important erosional intervals, their significance is not apparent. The oldest known erosional unconformity occurs at the base of the St. Peter sandstone in north-central Illinois, but this horizon has not been penetrated by the drill elsewhere in the state except along the western border. It appears to record, however, uplift of the Kankakee arch (west branch of Cincinnati arch) in Ordovician time.

Considerable relief was developed by erosion of the Maquoketa shale in northern Illinois at the close of the Ordovician, but this erosion, so far as is known, was unrelated to structure.

During Lower and Middle Devonian times a structural basin extended across southern Illinois into southwestern Missouri, while, probably contemporaneously, a domal uplift occurred in western Illinois and northeastern Missouri. A great thickness of sediments accumulated in the basin, whereas the dome was eroded through the Silurian and Maquoketa into the Galena formation. The Upper Devonian sediments cover the Middle Devonian in the south and overlap with variable thickness an uneven erosion surface in central and western Illinois. The Colmar oil field is a minor structure on the northeast flank of the dome, where local sedimentary conditions produced a concentration of Upper Devonian sand.

Later erosional intervals and related structural movements are best exhibited upon the flanks of the Ozarks. In Ste. Genevieve County, Missouri, post-Middle Devonian faulting occurred, followed by peneplanation and overlap by Mississippian formations. This system of faults probably extends beneath these beds into southwestern Illinois, but has not been accurately located. Disturbances of similar age are unknown elsewhere in the basin.

Overlap of New Albany (so-called Chattanooga) shale of Upper Devonian or Lower Mississippian age onto Ordovician limestones occurs well up on the Cincinnati arch in southern Kentucky and somewhat similar overlap of Bushberg sandstone (basal Kinderhook) occurs in northeastern Missouri.

Conspicuous overlap of the Fern Glen (basal Osage) onto Maquoketa shale occurs in Monroe County, Illinois, and similar but less extensive erosion preceded deposition of the Sedalia (= Fern Glen) limestone farther north in the Mississippi valley. Although the total absence of Silurian, Devonian, and Lower Mississippian from outcrops in Monroe County may be the result of more than one period of erosion, it at least suggests that the Valmeyer and probably also the Waterloo anticlines were in existence before the beginning of middle Mississippian time.

The existence of a basal conglomerate in the Ste. Genevieve formation containing silicified Middle Devonian fossils in Ste. Genevieve County, Missouri, records uplift and erosion of the Ozarks after St. Louis time. In the Ohio valley, however, the Ste. Genevieve appears to succeed the St. Louis with perfect conformity.

A widespread unconformity separating the Ste. Genevieve limestone from the overlying Chester series is recognized in outcrops around the margins of the basin. Erosion at this horizon, however, was relatively unimportant except in Monroe County, where the Ste. Genevieve is overlapped and the Chester locally rests on the St. Louis limestone. Apparently renewed folding of the Valmeyer and Waterloo anticlines, followed by erosion, occurred at this time. In the same area the Lower Chester beds exhibit definite overlap relations with the Renault formation, extending beyond the limits of the basal Aux Vases sandstone to rest upon the Middle Mississippian limestones. Possibly the porosity of the McClosky "sand" (limestone) of Lawrence County is related to this unconformity.

By far the most important unconformity of the Illinois basin occurs beneath the Pennsylvanian (Fig. 2). From south to north the Pennsylvanian overlaps a stratigraphic section 3,000 feet thick from the top of the Chester to the St. Peter sandstone. For the most part

this unconformity is known to possess little local relief, although in Edmonson County, Kentucky, a channel 300 feet deep was eroded in Chester strata. In Monroe County, Illinois, Chester hills of moderate height are surrounded by Pennsylvanian beds and locally are exposed as inliers, and similar hills of St. Louis limestone and Warsaw formation occur in Fulton County. What may be basal Pennsylvanian strata preserved in sink holes are known in Calhoun and Pike counties. Thick deposits of glacial drift which form the surface throughout most of Illinois, however, make the recognition of such features difficult except in especially favorably situated localities.

Although the absence of Silurian, Devonian, and Mississippian strata beneath the Pennsylvanian in northern Illinois may be the result of more than one erosional interval, and most of the Devonian and the Chester may never have been deposited in this area, still it is certain that extensive erosion did occur in late Mississippian or early Pennsylvanian time, because remnants of Upper Devonian shale are preserved in crevices in the Silurian dolomite of the Chicago region and because cherts of Osage age have been recognized in glacial gravel deposits of northern Illinois, demonstrating that these strata were originally present farther north, well beyond their present boundaries.

Important folding likewise occurred at the close of the Mississippian period. All of the borders of the Illinois basin were upraised. Folding occurred along the Cincinnati arch, and Chester strata which originally spanned this structure in Kentucky were completely removed so that outliers of the Pennsylvanian are now found on strata at least as old as the St. Louis limestone. Wisconsin and northern Illinois were upraised and, as already mentioned, erosion cut deeply into the Ordovician. The Ozark region was also lifted; its Mississippian cover, which consisted at least of the Osage formations (and possibly also older beds) was completely stripped off so that Pennsylvanian outliers now rest upon Ordovician strata. In this same region pronounced karst topography was either developed or an old karst surface was re-exposed and accentuated and Pennsylvanian sediments and coals were deposited in sink holes in which they are preserved to the present time. Pennsylvanian clays and sands are likewise present in solution channels and caverns in the Silurian formations in northwestern and northeastern Illinois and in Mississippian limestones in Missouri and western Illinois.

Within the basin preëxisting structures such as the Valmeyer and Waterloo anticlines were accentuated (Fig. 4). In addition other structures not known to have been previously in existence were produced. The most important of these is the La Salle anticline (Fig. 4),

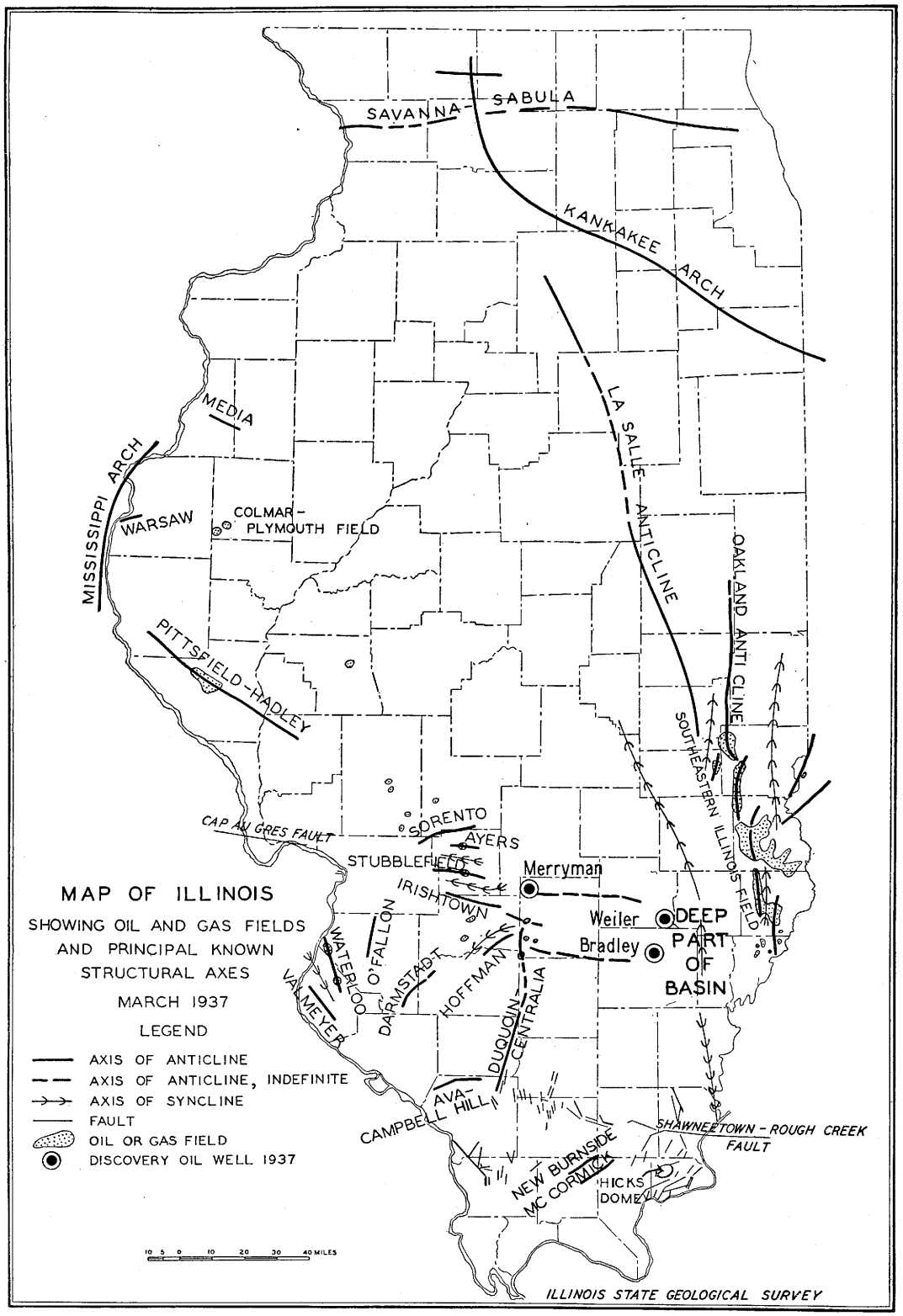

FIG. 4.—Map of Illinois showing oil and gas fields, principal known structural axes, and discovery oil wells, January–March, 1937

which detaches itself from the Kankakee arch in Lee County and plunges east of south to the Wabash River a short distance below Vincennes. Another conspicuous structure that appears to have originated at this time is the Cap-au-Gres fault (Fig. 4) which, in Illinois at least, is mainly a sharp, very steeply dipping monocline modified by subordinate small *en échelon* faults. Probably the Pittsfield-Hadley anticline in Pike County also was formed at the close of the Mississippian period, although the absence of overlapping Pennsylvanian beds on the crest of the structure renders this dating somewhat uncertain. Faulting on a small scale occurred in Union County, Illinois, and in Grayson County, Kentucky.

It is possible that other known folded structures which exist farther within the borders of the basin were initiated, or, if previously in existence, were accentuated at this time, but subsurface data are for the most part too incomplete to make this interpretation positive.

After the epoch of disturbance which produced these uplifts, smaller folds, and displacements, erosion reduced their summits in some degree and weathering locally rendered limestones porous, as on the La Salle anticline in Clark County and near Jacksonville in Morgan County.

Deepening of the basin and accentuation of the smaller structures continued in varying degree throughout the Pennsylvanian period. The Pennsylvanian system shows greater variation of thickness of sediment from place to place within the basin than the other systems. This is particularly true of the beds which underlie coal No. 2 although it also holds to a lesser degree for strata above this coal, to the top of the system as it is developed in the Illinois basin. For example, a section 700 or more feet thick in southern Illinois and western Kentucky is reduced to a few feet in the vicinity of St. Louis and northward along the Mississippi valley and on the La Salle anticline in the upper Illinois valley. This thinning does not represent overlap to any great extent, but is mainly the result of thinning and wedging out of individual members and of transition from thick layers of clastic to thin deposits of much finer materials. Similar although probably less marked thinning, mainly of the Lower Pennsylvanian section, also occurred upon the flanks of structures within the basin, as for example along the La Salle anticline, although subsurface data are too meager to reveal details.

Differential subsidence within the basin appears to have produced at least one new structural axis, the DuQuoin anticline (Fig. 4). This structure is not a continuous anticline but is more accurately described as a steep monocline broken by subordinate faults and termi-

nating above in a broad terrace which is locally domed. It separates an area of thin Pennsylvanian sediments on the west from an area with a much thicker section of equivalent beds on the east. It was uplifted more or less gradually and continuously throughout Lower and Middle Pennsylvanian time.

The last important structural readjustment of the Illinois basin occurred, as already stated, at the close of the Paleozoic era or possibly early in the Mesozoic. The youngest Pennsylvanian beds present in the basin were involved in this disturbance and the region was subsequently peneplaned and overlapped from the south by late Cretaceous sediments of the Mississippi Embayment. Subsequently the embayment area, including the southern tip of Illinois and the western tip of Kentucky, was depressed, but this movement does not seem to have involved any portion of the Illinois basin except its extreme southwestern margin.

The most conspicuous result of the post-Pennsylvanian disturbance was the separation of the Illinois basin from its original southward continuation, which was accomplished by the development of a northeastward dipping monocline in part complexly faulted. In the Illinois-western Kentucky fluorspar district, which includes Hardin and Pope counties, Illinois, and Crittenden, Livingston, and adjacent counties in Kentucky, faulting is dominantly of the normal type, with displacements attaining a maximum of about 2,000 feet. In Illinois the major faults extend northeast-southwest, but in Kentucky their direction gradually swings around to nearly east and west. They appear to radiate outward in these directions from a focus beneath the embayment deposits of western Kentucky. Numerous cross faults extend in all directions between the major displacements to produce an extremely complex mosaic pattern. The statement that these faults are of the normal type, does not, however, describe them adequately. Slickensides demonstrate that movements possessed important horizontal components and displacement along some faults appears to have taken place at different angles at different times. It is even probable that complete reversal of movement occurred at some places. The New Madrid earthquake almost certainly resulted from a minor disturbance in this area and every year mild tremors are reported that appear to originate here.

North of the fluorspar district and extending in an east-west direction is a complex series of ramifying faults known as the Rough Creek fault zone (Fig. 1) in western Kentucky. It decreases in importance toward the east, but appears to cross the Cincinnati arch and connect with the Irvine-Paint Creek disturbance of eastern Kentucky

and the Warfield and Chestnut Ridge anticlines of West Virginia and Pennsylvania. Toward the west, it crosses the Ohio River at Shawneetown and continues as the Shawneetown fault or faults, crosses Gallatin County, swings southward and plays out or passes into some of the previously mentioned northeast-southwest faults of Pope County.

The Rough Creek fault zone has evidently been produced by compressional forces acting from the south. This is demonstrated by the steep dips and folds that occur along this zone and the presence in it, as in Webster County, Kentucky, of areas of crumpled Chester sediments surrounded on all sides by fairly high Pennsylvanian beds. The deepest part of the western Kentucky coal field was probably produced by these same compressive forces much as foredeeps are developed adjacent to some young and rising continental coasts.

In Union County, Illinois, is the beginning of another system of faults which develops parallel to the strike on the rapidly steepening monocline and extends northwestward, crossing the Mississippi River into Missouri near Grand Tower. These faults likewise have resulted from compression, which in this case came from the southwest. Upthrow is toward the southwest and is associated with steeply dipping, vertical and even locally overturned beds.

In the fluorspar district of Illinois and Kentucky and in western Ste. Genevieve County, Missouri, also in the southern Illinois coal-mining district, are numerous small intrusions of basic igneous rock. In the fluorspar district, dikes are most common, but sills and plugs also occur and there is one locality that appears to mark an explosion vent. Hicks dome (Fig. 4), which is the outstanding structural feature of Hardin County, is believed to have been produced by an intrusion possibly of a laccolithic type. In Missouri,[4] dikes are uncommon and most of the intrusions are small plugs. There are also numerous small structures that appear to be explosion vents that were never filled by magma but into which fragments of overlying rocks fell. They are present in a Cambrian terrain and are marked by erratic boulders, including fossiliferous Middle Devonian limestone, which at present occurs in place only down-stream 20 miles away, with which are associated fragments of biotite.

Preëxisting structures were also accentuated by the post-Pennsylvanian disturbances. These include the Valmeyer and Waterloo anticlines, the Cap-au-Gres fault, and the La Salle anticline from La Salle to Clark counties. Some of the minor features of the latter structure were also accentuated at this time, for example the Martinsville dome,

[4] George W. Rust, "Preliminary Notes on Explosive Volcanism in Southeastern Missouri," *Jour. Geol.*, Vol. XLV, No. 1 (1937), pp. 48–75.

which is outlined by comparatively steep dips and concentric outcrops of the exposed Pennsylvanian beds.

In addition there are localities within the Illinois basin where the surface structure in Pennsylvanian beds suggests more important structure in underlying formations such as those recently described in Clay and Marion counties.[5]

PART II—EXPLORATION FOR OIL

By ALFRED H. BELL

The history of exploration for oil in Illinois may be divided into three periods: (1) prior to 1905, the year production began in the Southeastern Illinois field, (2) 1905–1934, the year in which the recent activity in the deep-basin area began, and (3) 1934 to the present. During the first of these periods there was only small commercial production of oil, beginning with the discovery of the Litchfield pool in 1886.

The second period began with the discovery of the Southeastern Illinois field, one of the nation's major oil fields, which reached a production peak a few years later of nearly 100,000 barrels per day and which has produced to date more than 415 million barrels of oil from 92,000 acres. The 5-year period, 1906–1910, was marked by intensive drilling, including many scattered wildcat wells. Subsequently interest shifted to new major fields in the Mid-Continent and exploratory drilling in Illinois tapered off, reaching a low point in 1934 when only 26 wells were drilled in the whole state.

The second period saw the development of numerous oil and gas fields around the margins of the basin, for example the Sandoval field (Marion County) in 1908, the Carlyle field (Clinton County) in 1911, the Colmar-Plymouth field (McDonough and Hancock counties) in 1914, and the Dupo field (St. Clair County) in 1928. However, an area of 10,000 square miles in the central portion of the basin remained undrilled except for scattered wildcats (Fig. 5).

Under the prevalent theory of oil migration this whole area was considered unfavorable. Detailed structural conditions were practically unknown. With the discovery of the Mount Pleasant field in 1928 in the very center of the Michigan basin, it became evident that the central portion of the Illinois basin could not be dismissed from consideration as a possible source of oil. If favorable local structures

[5] J. M. Weller and A. H. Bell, "Geology and Oil and Gas Possibilities of Parts of Marion and Clay Counties, with Discussion of the Central Portion of the Illinois Basin," *Illinois State Geol. Survey Rept. Investigations No. 40* (1936).

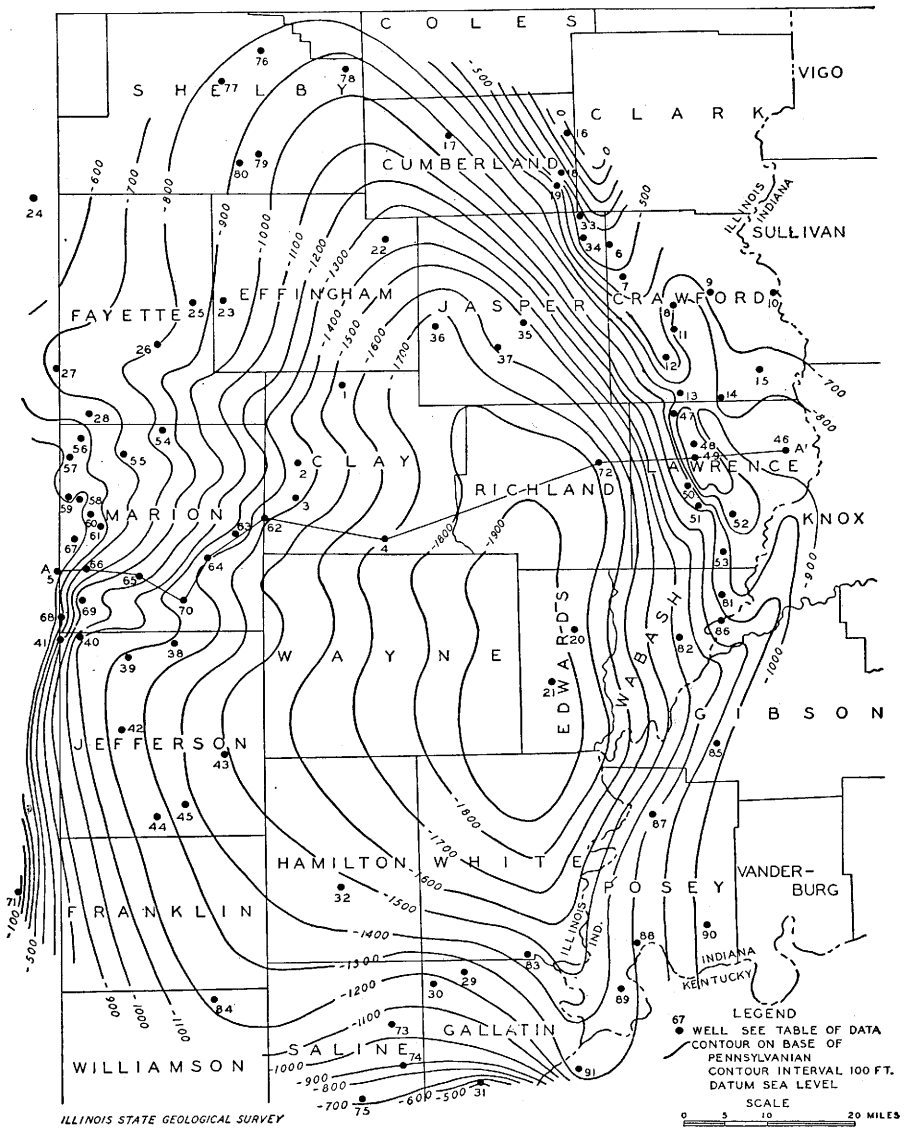

FIG. 5.—Central portion of the Illinois basin; subsurface contour map on the base of the Pennsylvanian system, a surface of unconformity. (Fig. 2, *Illinois Geological Survey Report of Investigations No. 40*, 1936.)

exist in this territory, some of them should prove productive.[6] The important question then became how to find the areas of favorable structure. Most of Illinois is covered by glacial drift of such thickness that the bed rock and its structure is largely obscured. There appeared to be an excellent opportunity for the use of geophysical methods of exploration, such as the seismograph.

State-wide studies of Pennsylvanian stratigraphy by J. M. Weller, H. R. Wanless and others during a period of 10 years revealed that correlations of outcropping strata could be made in some areas with sufficient assurance to make possible the mapping of structure. Elevations of the outcrops in such an area were determined in the summer of 1935 and the results of this work were published March 1, 1936.[7]

During 1934, detailed studies of surface geology in the basin were begun by the Carter Oil Company, initiating the present period of activity by oil companies. Several large blocks of acreage were leased by that company in the fall of 1935, after two seasons of field work. At the same time the Pure Oil Company began seismograph work in the deepest part of the basin, and the Texas Company and the Shell Petroleum Corporation began studies of surface and subsurface geology. Ever since the beginning of 1936 the number of companies interested in the area has been increasing. During most of 1936 the number of seismograph parties active in the area has varied from 6 to 8 and during the early part of 1937 as many as 11 were active at one time. At the present writing (March, 1937), 9 seismograph parties are operating in Illinois and 2 in the adjacent part of southwestern Indiana.

RECENT NEW DISCOVERIES

The first successes in the discovery of new oil resulting from the recent activity have come since the beginning of 1937. It is a remarkable fact that the first three wells in Illinois located on the basis of seismograph surveys have all discovered oil in commercial quantities. In view of the fact that sporadic wildcat drilling, located without any scientific basis, had been going on in the Illinois basin for at least thirty years without discovering new oil fields, the recent successes surely demonstrate the value of scientific methods in exploration for oil in this region.

[6] The possibilities of oil in the deeper part of the basin were discussed by the writer in a paper given before the Illinois Academy of Science in May, 1930.

A. H. Bell, "The Relation of Geology to the Development of the Petroleum Industry in Illinois," *Trans. Ill. Acad. Science*, Vol. 23, No. 3 (March, 1931), pp. 367–70.

[7] J. M. Weller and A. H. Bell, "Geology and Oil and Gas Possibilities of Parts of Marion and Clay Counties, with Discussion of the Central Portion of the Illinois Basin," *Illinois State Geol. Survey Rept. of Investigations No. 40* (1936).

The first of the new wells to strike oil was the Adams Louisiana Oil Company's Glenn Merryman No. 1, center SE. ¼, SW. ¼, Sec. 21, T. 4 N., R. 1 E., Marion County, Illinois, completed January 27, 1937, total depth 1,418 feet. Oil was found in the Benoist sand (Chester series, Upper Mississippian), the top of the sand being at a depth of 1,391 feet. The sand was shot with 10 quarts of nitroglycerine in the lower 10 feet, January 26, 1937. After the shot and before cleaning out, the well flowed 86½ barrels of 38° A.P.I. oil through a ½-inch choke. In the first test after cleaning out, the well flowed 52 barrels of oil through a ¼-inch choke. The well is still flowing; the daily production has declined to approximately 40 barrels.

Although the seismograph was used to determine the structure of the deeper horizons, the Merryman well is located on a structural high on coal No. 6 which was mapped in Illinois Geological Survey Bulletin 16.[8] A number of new locations have been made in the vicinity of the Merryman well, and at the present time (March, 1937), a second well is about due to reach the sand. The Merryman well is within ½ mile of the village of Patoka and the new field is called the Patoka field. The nearest old production is the Sandoval field, 8 miles to the south (Fig. 4).

On February 26, the Pure Oil Company's Weiler well No. 1, SE. ¼, SW. ¼, SE. ¼, Sec. 33, T. 3 N., R. 8 E., Clay County, struck oil of 37° A.P.I. gravity in the Cypress sandstone (Chester series) at a depth of approximately 2,600 feet. A pumping test has recently been made, results of which are not yet available. The company intends to drill the well deeper.

On March 4, the Pure Oil Company's George Bradley well No. 1, SW. ¼, SW. ¼, NW. ¼, Sec. 26, T. 1 N., R. 7 E., Wayne County, struck oil at the approximate depth of 2,970 feet. The producing horizon is possibly the McClosky "sand" (Ste. Genevieve formation, Lower Mississippian series), or it may be a basal Chester sand. The well is reported to be flowing and is producing a considerable amount of gas with the oil.

The discovery of oil at the Weiler and Bradley wells is of special interest because of their location near the deepest part of the Illinois structural basin and their distance of 30 to 40 miles from the nearest previous production on the east and on the west. It considerably enhances our estimation of the possibilities for important new oil reserves in the deep basin area. To all of the companies who at great expense have been conducting seismograph surveys during the past

[8] R. S. Blatchley, "Oil Resources of Illinois," *Illinois State Geol. Survey Bull. 16* (1910), pp. 42–176, Pl. XIV, p. 142.

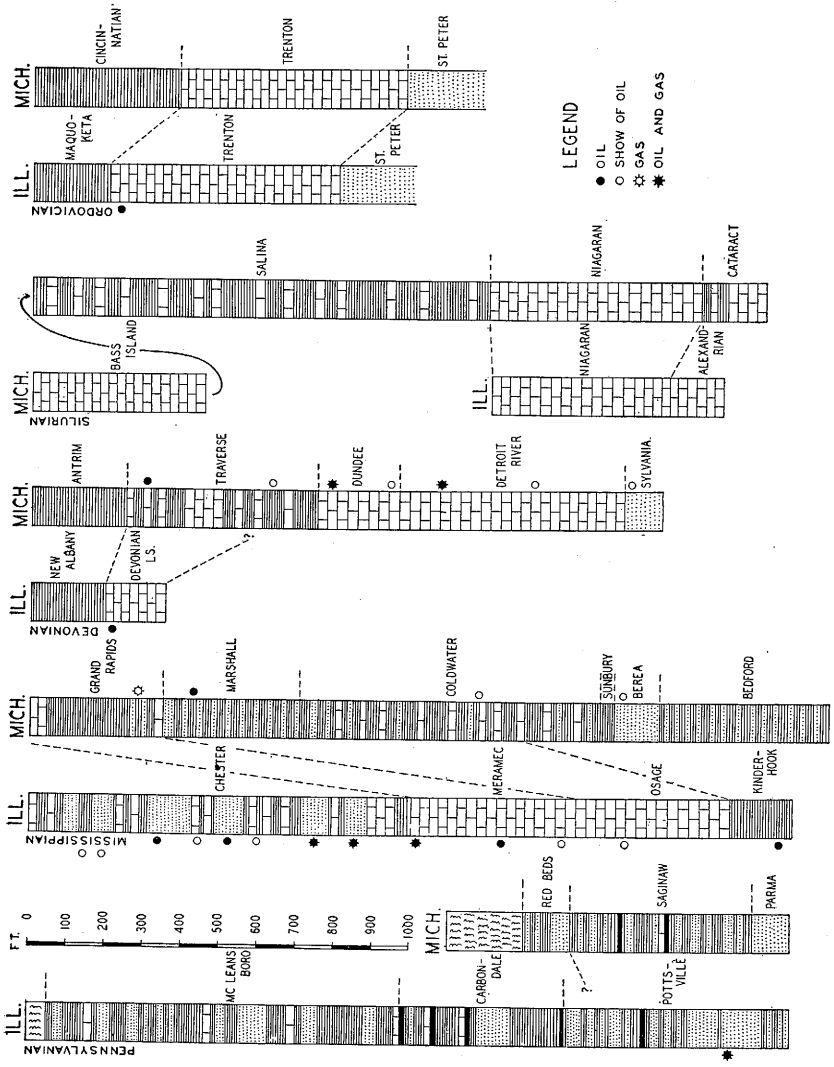

FIG. 6.—Generalized columnar sections for Illinois and Michigan basins showing principal horizons of oil and gas production. (From "Geology and Oil Possibilities of the Illinois Basin," *Illinois State Geol. Survey Illinois Petroleum No. 27*, July 11, 1936, p. 7.)

year and a half the recent successes demonstrating the utility of the method in this area must surely be gratifying. Of course only time will reveal whether the quantities of oil produced in the newly discovered fields will ultimately yield a profit on the investment.

POSSIBLE PRODUCING HORIZONS

A stratigraphic column for Illinois and for Michigan, showing the principal producing horizons in each state is shown in Figure 6.

Based on past experience, the relative order of importance of possible producing formations is as follows.

1. Pennsylvanian sands, mostly of lenticular form, and in part of the shoestring type.
2. Chester (Upper Mississippian) sands, productive on anticlines and domes.
3. Lower Mississippian limestones, productive on large closed structures; the distribution of production controlled in part by porosity which may or may not be related to an overlying unconformity.
4. Devonian limestone; small production on some closed structures.
5. Trenton limestone; production confined to high parts of large structural closures.
6. St. Peter; no production to date and no well authenticated oil showings in Illinois; contains fresh water in northern Illinois and salt water where drilled (3 wells to date) in southeastern Illinois.

The average depth of drilling for oil and gas has shown a tendency to increase progressively since the industry began. This is due in part to exhaustion of shallower oil reserves and in part to improved technique of drilling and of lifting the oil to the surface. To many persons familiar with the current drilling operations in California and the Gulf Coast where great depths prevail in many fields, it may seem strange that any considerable amount of oil at shallow depths remains undiscovered. Many from the Mid-Continent area think that the St. Peter sandstone, considered as correlative with the "Wilcox" sand, is the most important prospective oil horizon in Illinois. Little is actually known of St. Peter possibilities in the basin area, where it lies at depths probably as great as 7,000 to 8,000 feet. Experience, however, seems to indicate better prospects in shallower formations.

Although exact figures are not available, the following is an approximate division of the total oil production to 1936 from the various geologic systems in Illinois.

Geologic System	*Per Cent of Total Production to 1936*
Pennsylvanian	60±
Mississippian	39±
Devonian and Ordovician	1—
Silurian	0

The location of the oil and gas fields and of the new discoveries with respect to known structural trends is shown in Figure 4. The dashed east-west axes west of the Weiler and Bradley wells are in accordance with a subsurface contour map on the base of the Pennsylvanian (Fig. 5) prepared by the writer.[9] No doubt the seismograph has revealed the trends of the structures on which these wells are located, but the information is not available at this time.

The new data now being obtained from drilling will doubtless give new light on the subsurface stratigraphy and structure of the Illinois basin. This will unquestionably be of value in guiding future drilling and if properly used it will minimize expenditures for needless drilling in unpromising areas.

[9] J. M. Weller and A. H. Bell, "Geology and Oil and Gas Possibilities of Parts of Marion and Clay Counties with Discussion of the Central Portion of the Illinois Basin," *Illinois State Geol. Survey Rept. Investigations No. 40* (1936), Fig. 2, p. 14.