OIL ACCUMULATION IN THE CYPRESS SANDSTONE IN THE HERALD POOL, WHITE AND GALLATIN COUNTIES, ILLINOIS*

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INTRODUCTION

The Herald pool is located in White and Gallatin counties in southern Illinois (fig. 1). The pool covers an area of approximately 1600 acres. Since its discovery in 1940, a total of 130 producing wells have been completed, of which 65[1] have produced oil from the Cypress sandstone. This sandstone has been chosen for study, and the discussion following is confined to it.

The Cypress is one of the lower formations of the Chester series. In the Herald pool area it consists of three sandstones, commonly with interbedded shales. The two lower sandstones are thick and fairly consistent, and sometimes separated by thin shale. It is the upper sandy zone which is productive in the Herald pool. It is an extremely variable zone of shale, sandy shale, and sandstone. The sandstone ranges from a tightly cemented sandstone to a clean permeable quartz sandstone, which is the pay zone. Normally the sandstone is overlain by shale or shaly sandstone. Occasionally the whole upper zone becomes a shale or shaly sandstone. In places there is no shale above the sandstone, so that it is directly overlain by the Barlow limestone. However, in most cases, it is the shaly layer over the pay zone which forms the caprock.

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[1] Secs. 27, 33, 34, 35,—6S-9E; Secs. 2, 3, 4, 10, 11, 14, 15, 22, 23,—7S-9E.
Includes three wells producing from other formations also.

STRUCTURE

The Herald pool is in the southern part of the Illinois basin. The structure of the pool consists of three "highs," with a general north-south trend. Figure 1 shows structure contours on the base of the Barlow limestone, that is the top of the Cypress formation. In general the Cypress production is controlled by these features. The northernmost anticline is the largest of the three and has on it the largest number of wells.

Figure 2, (sec. 3, T. 7 S., R. 9 E.) shows oil accumulation in a simple structural trap. The wells high on the structure produce oil and water; those low on the structure are dry holes, often producing water with possible shows of oil. The closure of the pay is about 6 feet.

The strata in the southern part of the pool are cut by a fault or fault zone, which strikes north and northeast and dips eastward about 50° to 65°. The fault there cuts a structural high on the Cypress. On the upthrown side—the west side—the pay dips westward from the fault (fig. 3, secs. 22, 23, T. 7 S., R. 9 E.). Several wells produce oil near the fault. It is probable that the trap is sealed by an impervious bed on the opposite face of the fault which is in contact with the pay.

DEPOSITIONAL VARIATIONS

Although the Cypress production in the pool is generally controlled

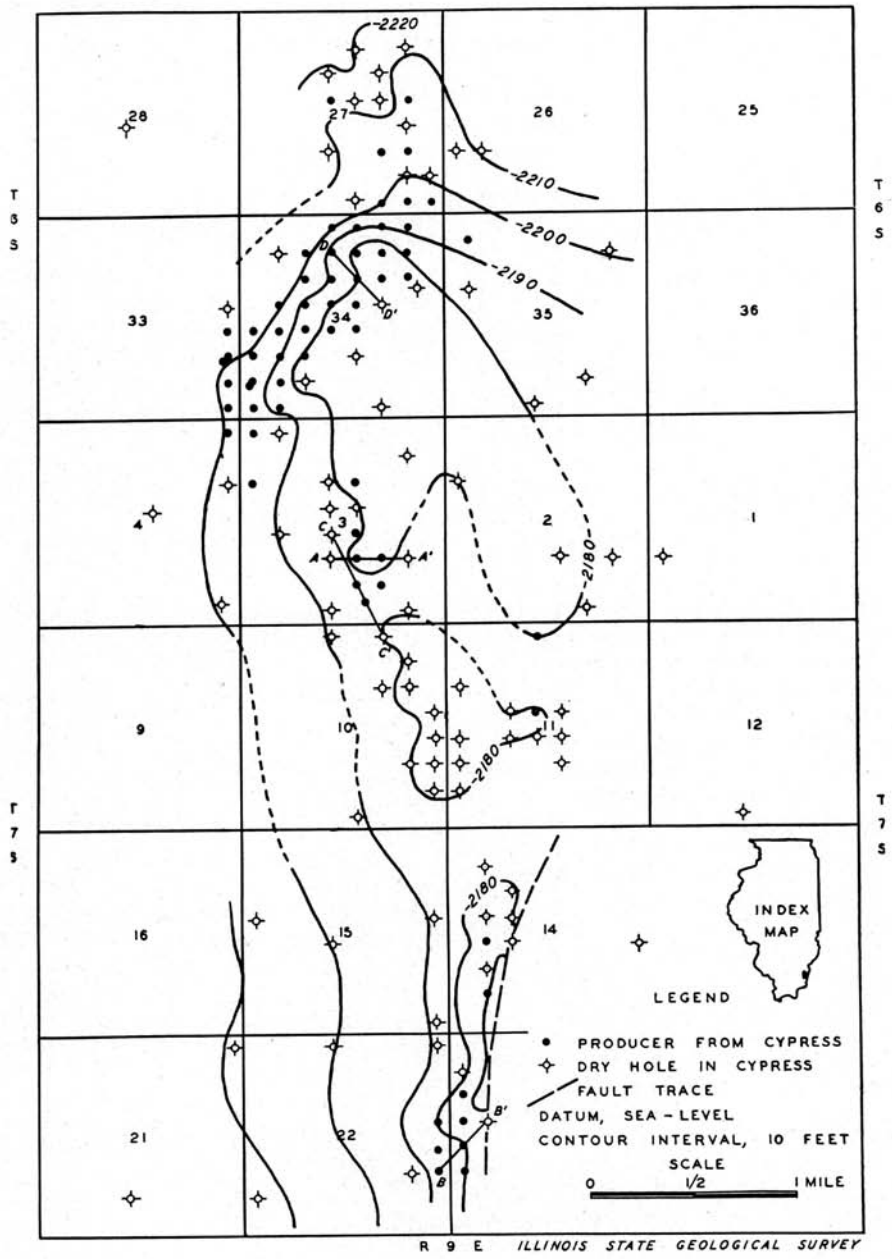

FIG. 1.—Structure map of the Herald pool. Locations of cross-sections are shown by straight lines. Index map of Illinois shows location of the pool.

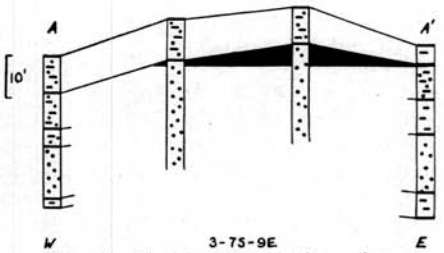

FIG. 2.—A-A′, cross-section of a structural trap.

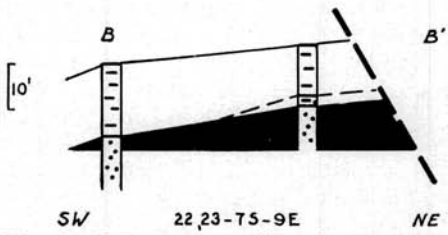

FIG. 3.—B-B′, cross-section of pay zone cut by fault.

by structure, conspicuous deviations of the production pattern from the structure pattern indicate the presence of another significant factor—depositional variations.

The shaly zone above the pay is of variable thickness. Changes in its thickness accentuate or nullify the effect of structure in forming traps. If the shale interval is fairly constant, the pay is high where the structure is high—as in the structural trap shown in figure 2. If the shale thins where structure is low, the pay there may be high. In sec. 3, T. 7 S., R. 9 E. (figure 4) such variation of shale thickness is sufficient to form a trap where the structure is low. Producers are structurally low, dry holes that produce water are structurally high.

Another important depositional variation is a change in the permeability of the pay. The sandstone may become shaly or interbedded with numerous thin shale streaks; commonly the interstitial spaces of the sandstone are filled with siliceous cement; in sandstone that is poorly sorted, the smaller grains fill the spaces between the larger ones; the sandstone may be lenticular. Such permeability changes are typical of Illinois "oil sands," where lateral variation of beds occurs commonly within a few acres, often within a few feet.

The distribution of producing wells on the anticline in sec. 34, T. 6 S., R. 9 E. is a striking illustration of the effect of permeability change, figure 5. There are many producers on the northwest flank of the anticline and several on the crest. On the highest part of the structure, however, are several dry holes. Sample studies show the pay in these wells to be shaly or cemented. The tight zone, cutting across the anticline, forms an effective seal for the oil accumulated along the flank of the structure.

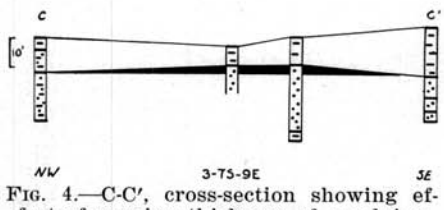

FIG. 4.—C-C′, cross-section showing effect of varying thickness of overlying shale on the trap.

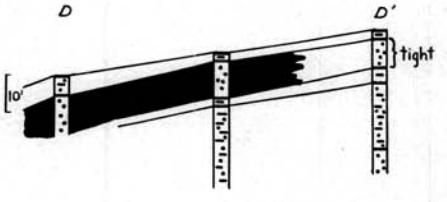

FIG. 5.—D-D′, cross-section of pay zone sealed by tight zone.

The small anticline in secs. 10 and 11, T. 7 S., R. 9 E. is a structure almost completely dry because of tightness of the sandstone. Only one well produces on this structure. The pay zone in the other holes on the anticline, though high, is shaly. The tested permeability of the sandstone in one of the highest wells averages only twelve millidarcies. Permeability of the pay in some producers in the pool averages eighty millidarcies.

These are primary features, related to conditions of deposition. In contrast, the structural features are the result of deformation.

Depositional variations on producing structures account for a number of dry holes throughout the pool.

Summary

Production from the Cypress sandstone in the Herald pool shows the effect of both structural and stratigraphic features on oil accumulation. There are examples in the pool of oil in the Cypress sandstone in the following types of traps:

Simple structural trap.
Trap sealed by an impervious bed at the fault contact.
Trap closed by thickening of overlying shale.
Trap sealed by a tight zone in the pay across an anticline.

There are also examples of areas high on structure which are dry because of depositional variations:

Thickening of overlying shale.
Tightness of producing sandstone.

Location Sec.-T.-R.	Spot	Company	Farm and Well	Depth to Base of Barlow	Surface Elevation	Subsurface Elevation: Base of Barlow	Producer or Dry Hole
26-6S-9E	SW NW SW	Angle-Gilpin	Marlin 1	....	412	.....	Dry
	SE NW SW	Angle-Gilpin	Marlin 2	....	389	.....	Dry
	NE SE SE	Gilpin	Marlin 1	2617	403	–2214	Dry
27-6S-9E	SE NW SE	Shaffer-Stoll	A. B. And 1	2645	440	–2205	Producer
	NE NW SE	Shaffer-Stoll	A. B. And 2	....	...	.....	Dry
	SW SE NE	Carter	A. G. And 1	2635	431	–2204	Producer
	SW NW NE	N. V. Duncan	A. G. And 1	2643	424	–2219	Dry
	SW NE SE	Shaffer-Stoll	A. G. And 1	2641	439	–2202	Producer
	NW NE SE	Stoll	A. G. And 4	2641	432	–2209	Dry
	SE SE NW	Skelly	E. T. And 1	2704	488	–2216	Producer
	NE SE NW	Skelly	E. T. And 2	2664	453	–2211	Dry
	SE NE SW	Pure	J. And A-1	2670	457	–2213	Dry
	SE SW SE	Pure	J. And A-2	2650	447	–2203	Producer
	SW SW SE	Pure	J. And A-3	2661	453	–2208	Dry
	NE NE SW	Bates & Lichlyter	M. D. And 1	2705	495	–2210	.....
	SE SW NE	Skelly	M. D. And 1	2660	446	–2214	Dry
	SW SW NE	Skelly	M. D. And 2	2686	469	–2217	Dry
	NE SW NE	Skelly	M. D. And 3	2639	427	–2212	Dry
	SW NE NE	Carter	Austin 3	2625	411	–2214	Dry
	NW NW NW	Pure	Austin-Wilson 1	2688	443	–2245	Dry
	NE SE SE	Angle-Gilpin	Marlin 1	....	432	.....	Dry
	SW SE SE	Gilpin	Marlin 1	2605	410	–2195	Producer
	NW SE SE	Gilpin	Marlin 2	2624	424	–2200	Dry
	SE SE SE	Gilpin	Marlin 4	2614	415	–2199	Producer
28-6S-9E	NE NE SW	Amsco	Austin 1	2721	451	–2270	Dry
33-6S-9E	SE SE NE	Carter	And 1	2717	510	–2207	Dry
	NE SE SE	Pure	Holland 1	2736	538	–2198	Producer
	SE SE SE	Pure	Holland 2	2720	521	–2199	Producer
	SE NE SE	Yoder	Holland 4	2719	517	–2202	Producer
	SE NE SE	Yoder	Holland 4-A	2718	517	–2201	Producer
	NE NE SE	Yoder	Holland 5	2720	515	–2205	Producer
34-6S-9E	SE NW NW	Pure	Austin Consol. B-1	2704	496	–2208	Dry
	NW SE SW	Pure	Holland A-1	2694	516	–2178	Dry
	NE SW SW	Yoder	Holland 1	2695	508	–2187	Producer
	NW SW SW	Yoder	Holland 2	....	499	.....	Producer
	NW SW SW	Yoder	Holland 2-A	....	501	.....	Producer
	SW SW SW	Yoder	Holland 3	....	504	.....	Producer
	SE SW SW	Yoder	Holland 6	2687	501	–2186	Producer
	SE NW SW	Carter	McCallister 1	2722	532	–2190	Producer

TABLE 1.—DATA FOR WELLS ON STRUCTURE MAP—Continued

Location Sec.-T.-R.	Spot	Company	Farm and Well	Depth to Base of Barlow	Surface Elevation	Subsurface Elevation: Base of Barlow	Producer or Dry Hole
	SW NE SW	Carter	McCallister 2	2709	530	–2179	Producer
	SW NW SW	Carter	McCallister 3	2723	525	–2198	Producer
	NE NW SW	Carter	McCallister 4	2728	531	–2197	Producer
	NW NE SW	Carter	McCallister 5	2657	472	–2185	Producer
	NE NE SW	Carter	McCallister 6	2638	461	–2177	Producer
	NW NW SW	Carter	McCallister 7	2729	526	–2203	Producer
	SE SW NW	Yoder	McAllister 2	2727	524	–2203	Producer
	SW SE NW	Yoder	McAllister 3	2663	474	–2189	Producer
	SE SE NW	Yoder	McAllister 4	2618	436	–2182	Producer
	NE SE NW	Yoder	McAllister 5	2657	467	–2190	Producer
	NW SE NW	Yoder	McAllister 6	2702	504	–2198	Producer
	SW NW NE	Carter	Merritt 1	2632	453	–2179	Producer
	NW NW NE	Carter	Merritt 2	2643	452	–2191	Producer
	SE NW NE	Carter	Merritt 3	2606	429	–2177	Producer
	NE NW NE	Carter	Merritt 4	2619	429	–2190	Producer
	SW NE NE	Carter	Merritt-Webb C-80-1	2606	423	–2183	Producer
	NW NE NE	Carter	Merritt-Webb C-80-2	2628	429	–2199	Producer
	SE SW SE	Gilpin	Newcomb 1	2654	479	–2175	Dry
	SE NE NW	Texas	Pool 1	2635	448	–2187	Producer
	NE NE NW	Texas	Pool 2	2684	482	–2202	Producer
	SW NE NW	Texas	Pool 3	2647	445	–2202	Producer
	NW NW SE	Pure	B. Weasel 1	2638	463	–2175	Producer
	SW NW SE	Pure	B. Weasel 2	2649	478	–2171	Dry
	C SE NE	Carter	C. Weasel 1	2581	409	–2172	Dry
	SW SW NE	Carter	C. Weasel 2	2614	440	–2174	Producer
	NW SW NE	Carter	C. Weasel 3	2598	417	–2181	Producer
	NE SW NE	Carter	C. Weasel 4	2584	410	–2174	Producer
	NW SE NE	Carter	C. Weasel 5	2578	405	–2173	Producer
	SE SW NE	Carter	C. Weasel 6	2633	458	–2175	Dry
35-6S-9E	SE SE SW	Carter	And 1	2625	441	–2184	Dry
	C SW NW	Carter	Marlin 1	2638	456	–2182	Dry
	NE SW SE	McBride	Porter 1	2604	419	–2185	Dry
	SW NE NE	Slagter	Questell 1	2634	433	–2201	Dry
	C NW NW	Carter	Webb C-81-1	2593	397	–2196	Producer
1-7S-9E	SW NW SW	Kingwood	Pyle 1	2917	497	–2420	Dry
2-7S-9E	NW SW NW	Kingwood	Bayley 1	2690	510	–2180	Dry
	SE SW SE	McCummings	Bayley 1	2668	481	–2187	Dry
	330SL, 410WL, NE SE	McGraw-Simon	Dagley 2	....	492	.....	Dry

Location Sec.-T.-R.	Spot	Company	Farm and Well	Depth to Base of Barlow	Surface Elevation	Subsurface Elevation: Base of Barlow	Producer or Dry Hole
3-7S-9E	SW NE NE	Gilpin	And 1	2667	490	–2177	Dry
	SW NE SE	McBride	And 1	2655	472	–2183	Dry
	NW NW NW	Carter	Bayley 1	2673	480	–2193	Producer
	NE NW NW	Carter	Bayley 2	2669	474	–2195	Dry
	NW SW NE	Gilpin et al	Bayley 1	2670	494	–2176	Producer
	SW SW NE	Gilpin	Bayley 2	2669	488	–2181	Dry
	NW NW SE	Gilpin	Bayley 3	2680	497	–2183	Producer
	SW NW SE	Gilpin	Bayley 4	2670	493	–2177	Producer
	SE NW SE	Gilpin	Bayley 5	2669	495	–2174	Producer
	580SL, 580WL, SE	McBride	Bayley 1	2675	491	–2184	Producer
	SW SE SE	McBride	Bayley 2	2666	477	–2189	Dry
	NW SW SE	McBride	Bayley 3	2697	510	–2187	Producer
	NE SW SE	McBride	Bayley 4	2673	490	–2183	Producer
3-7S-9E	NW SW NW	Q. B. Mitchell	Fulkerson et al-1	2722	530	–2192	Producer
	SE SE SW	Tidewater	Millikan 1	2659	470	–2189	Dry
	NE SE NW	Fox & Fox	O'Neal 1	....	496	.....	Dry
	SE SE NW	Fox & Fox	O'Neal 2	2677	491	–2186	Dry
	NE NE SW	Kingwood	O'Neal 1	2677	493	–2184	Dry
	SE NE SW	Kingwood	O'Neal 2	2682	497	–2185	Dry
	NE NW SW	Mitchell	O'Neal 1-B	2708	519	–2189	Dry
4-7S-9E	NE NE NE	Pure	Holland B-1	2726	528	–2198	Producer
	NE SE NE	Pure	Holland B-2	2709	514	–2195	Dry
	560SL, 560EL,	McBride	Millikan 1	2640	441	–2199	Dry
	SW SW NE	Carlson	Orr-Fulkerson	....	515	.....	Dry
10-7S-9E	NW SE NE	Kingwood	Bayley 1	2614	438	–2176	Dry
	SE SE NE	Kingwood	Bayley 2	2612	436	–2176	Dry
	NE NE NW	Shulman Bros.	Bayley 1	2643	454	–2189	Dry
	NE NW NE	Mabee	Harris 1-A	2652	472	–2180	Dry
	SW NE NE	Carter	Hendrix 1	2624	444	–2180	Dry
	NE NE SE	Kingwood	Knight 1	2614	439	–2175	Dry
	SE NE SE	Kingwood	Knight 2	2617	444	–2173	Dry
	NE SE SE	Kingwood	Knight 3	2612	434	–2178	Dry
	SW NE SE	Kingwood	Knight 4	2613	432	–2181	Dry
	SW SW SE	Mabee	Knight 1	2608	417	–2191	Dry
	NE SW NE	Carter	Weas 1	2623	436	–2187	Dry
11-7S-9E	NW NW SW	Gulf	Bayley 1	2607	430	–2177	Dry
	SW NW SW	Gulf	Bayley 2	2603	427	–2176	Dry
	NW NE SW	Gulf	Bayley 3	2617	438	–2179	Dry
	NW SW SW	Gulf	Bayley 4	2598	419	–2179	Dry

TABLE 1.—DATA FOR WELLS ON STRUCTURE MAP—Concluded

Location Sec.-T.-R.	Spot	Company	Farm and Well	Depth to Base of Barlow	Surface Elevation	Subsurface Elevation: Base of Barlow	Producer or Dry Hole
	NE NE SW	Gulf	Bayley 5	2613	432	−2181	Dry
	NW SW NW	Kingwood	Bayley 3	2637	462	−2175	Dry
	NW NW SE	Leach	Bayley 1	2607	424	−2183	Dry
	SW NW SE	Leach	Bayley 2	2619	431	−2188	Dry
	SW SW NE	Carter	Dagley 2	2623	437	−2186	Dry
	NE NE NW	Bennett Bros.	Questell 1	....	479	.....	Dry
	SW SE NW	Lewis	Questell 1	2622	442	−2180	Dry
	SE SE NW	McCummings	Questell 2	2617	438	−2179	Producer
	300NL, 330EL, NE NW	McCummings	Questell 6	2662	482	−2180	Producer
12-7S-9E	SE SE SW	Wilson	Dagley 1	2745	417	−2328	Dry
14-7S-9E	NE SW SW	Oil Management	Bayley 1	2577	407	−2170	Producer
	SE SW NW	Oil Management	Harrell 1	2606	433	−2173	Dry
	SW SE NW	Oil Management	Harrell 3	2603	423	−2180	Dry
	NW SE NW	Oil Management	Harrell 4	2617	439	−2178	Dry
	SE NW NW	Carter	Knight 1	2618	432	−2186	Dry
	NW NE SW	Oil Management	Williams 1	2634	394	−2240	Dry
	SE NW SW	Oil Management	Williams 2	2578	405	−2173	Dry
	NE NW SW	Oil Management	Williams 3	2582	404	−2178	Producer
	NE NE SE	Spires	Williams 1	2719	396	−2323	Dry
15-7S-9E	SE SE SE	Phillips	Bourland 1	2633	445	−2188	Dry
	SE SE NE	Phillips	Bourland 2	2591	402	−2189	Dry
	SW SW NW	Anderson	Knight 1	2603	400	−2203	Dry
	NE NE SW	Self	Knight 1	....	412	.....	Dry
21-7S-9E	NE NE NE	Skelly	Hale 1	2611	404	−2207	Dry
	NE SE SW	Ryan	Mills 1	2596	387	−2209	Dry
22-7S-9E	SW NE SE	Aetna & Oil Management	T. H. Boyd 2	2607	411	−2196	Dry
	NE NE SE	Aetna & Oil Management	T. H. Boyd 4	....	402	.....	Producer
	SE NE SE	Aetna & Oil Management	T. H. Boyd 5	2586	401	−2185	Producer
	NW SW SW	Carter	Hale 1	2632	413	−2219	Dry
	NE NE NE	Fryer	Jones 1	....	428	.....	Dry
	SE SE NE	Oil Management	Jones 2	2593	414	−2179	Producer
	NE NE NW	N. V. Duncan	Knight 1	2613	412	−2201	Dry
23-7S-9E	SW NW NW	Fryer	C. H. Boyd 2	2588	399	−2189	Dry
	NW SW NW	Red Bank	C. H. Boyd 1	2567	394	−2173	Producer
	SW SW NW	Red Bank	C. H. Boyd 2	2568	390	−2178	Producer
	SE SW NW	Red Bank	C. H. Boyd 3	2709	389	−2320	Dry
	SW NW SW	Claude Neon Lights	T. H. Boyd 2	....	390	.....	Producer
	NW NW SW	Red Bank	T. H. Boyd 1	2571	390	−2181	Producer