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Summary of Progress on Geology and Oil Shale Investigations in San Saba County, Texas

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The Bureau of Economic Geology has been mapping the geology and investigating the mineral resources of the Llano region in central Texas during the last three years. Maps of the Carboniferous rocks in Mason, McCulloch, San Saba, Lampasas, and Burnet counties have been prepared. Studies are being made of the building stone, sand and gravel, caliche, tripoli, clays, oil shale, minerals, springs and underground waters of these counties. It is planned to describe the results of all these investigations in a comprehensive bulletin on the geology and natural resources of the Llano region. However, owing to many requests for information on the geology of San Saba County, it has been decided to make available a preliminary edition of the geologic map and a preliminary summary of the oil shale investigations. The map is the work of the staff of the Bureau of Economic Geology. It is not completed and is subject to correction. It is hoped that anyone using this map will notify the Bureau regarding any errors, additions, and corrections which will improve the map and make it more useful. The oil shale investigations were carried out as a project for mineral investigations in the State Work Projects Administration under the direction of the Bureau of Economic Geology, with Mr. John Petty as supervisor of the project in San Saba County. The testing of the oil shale samples was made by Mr. Bruce Grant in the Department of Petroleum Production Engineering of The University of Texas under the direction of the author.

Summary of Geology

The preliminary geologic map shows the geologic groups which occur in San Saba County and the principal structural features. The geologic groups are as follows:

Pennsylvanian System

Strawn group.—The Strawn group of beds, indicated by the symbol Cst on the map, outcrops in the northern part of the county north of San Saba River and in the Rough Creek syncline east of San Saba. They consist of brown-colored, ferruginous, coarse-grained, massive, and thin-bedded friable sandstones interbedded with blue and gray, soft, sandy shales. Many of the sandstone beds where they dip beneath the surface in the northern part of the county constitute good water horizons. The thin-bedded calcareous members of the sandstone series furnish good building stones.

Smithwick group.—The Smithwick group of beds, indicated by the symbol Csm on the map, outcrops principally in San Saba River, Wallace Creek, and Cherokee Creek valleys. Excellent exposures occur in the vicinity of Bend, east of San Saba. The group consists of black, fissile, carbonaceous, siliceous shale, including near its base a few black, thin, fossiliferous limestones and near its top a few hard calcareous, thin, non-friable sandstone layers. This group of beds weathers to a rich, black, loam soil and constitutes the principal cotton and pecan raising districts in the San Saba River, Wallace Creek, and Cherokee Creek valleys. The thin limestones and thin, hard, flaggy sandstones make good building blocks.

Marble Falls group.—The Marble Falls group of strata, marked by the symbol Cmf on the map, outcrops in a broad belt south of San Saba River and along narrow strips on each side of Wallace Creek, Rough Creek, and Cherokee Creek valleys. The group consists for the most part of black and dark gray, hard, massive, and thin-bedded, fossiliferous, chert-bearing limestone, containing in its upper part some thin beds of calcareous shale. The outcrop in most cases produces rough, oak and cedar-covered, upland country utilized mostly as pasture land. The thin, even-bedded layers in its upper portion furnish excellent building rock. One mottled layer makes a beautiful polished ornamental stone. Some of the chert layers weather to produce a siliceous clay, known as tripoli, which is used as a fine abrasive and as a filtrant.

Mississippian System

Barnett group.—The Barnett group, marked Cba on the map, occurs in a thin band 100 to 300 feet wide bordering the south outcrop of the Marble Falls group. The strata consist of black and brownish-black, extremely thin-bedded, soft, petroliferous, fossiliferous shale, containing large, flattened, spherical, calcareous concretions and a few layers of limestone. In most places there is a single layer of black, petroliferous limestone, 10 inches thick at the top, and two or three thin, fossiliferous layers, 1 to 3 inches thick in the lower portion. No sandstone is present, and the entire thickness of the group averages only 20 feet. A typical section through this group is shown in the following section:

Section of the Barnett shale measured on small branch, 4 miles east of San Saba on north side of San Saba-Bend road on Holoman ranch.

	Thickness Feet	Inches
Limestone: dark gray, in places black, containing numerous small goniatites and other fossils		10
Shale: black, thin-bedded, soft in places, brownish-black, made up of very thin soft, fissil sheets	14	
Limestone: grayish-black, soft, weathering to light gray, petroliferous		2
Shale: brownish-black, petroliferous	1	8
Limestone: grayish-black, soft, fossiliferous, made up of large numbers of small flattened ammonites		2
Shale: brownish-black, soft, petroliferous	2	8
Limestone: grayish-black, petroliferous and fossilferous		1
Shale: grayish-black, silty, containing numerous large, hard, spherical concretions, 1 foot to 2 feet in diameter and 6 to 10 inches thick	1	4
Limestone: grayish-black, fossiliferous		2
Shale: brown, hard, in thin laminated layers	6	8
Total thickness	34	

This shale constitutes the oil shale deposits of San Saba County and is the richest oil shale so far tested in Texas. Other shales which have been tested are Eagle Ford, Del Rio, Val Verde, Smithwick, and several black shales in the Marble Falls.

Chappel group.—The Chappel limestone, indicated by the symbol Ccp on the map, underlies the Barnett shale everywhere in the county. Its outcrop, unless covered by the loose shale, marks the west boundary of the shale. It is a white, hard, crinoidal limestone, 1 foot to 3 feet thick, containing in its basal portion some chert conglomerate. In a few places the limestone has developed into a remarkably even texture which is fairly thick and not badly broken by cracks and joints. It takes a good polish, forming a white or cream-colored, fossiliferous marble.

Ordovician System

Ellenburger group.—The Ellenburger group, indicated by the symbol Coe on the map, outcrops over most of the southern portion of the county. It is white or cream-colored in color, heavy, fine-grained, dense, massive, or thin bedded, in many places highly dolomitic, and is badly broken by joints and bedding planes. Most of the water for the large stock ranches south of San Saba is obtained from permeable layers in this dolomite. Some layers contain beautiful dendritic markings. Still other layers are impregnated with a little iron and have a beautiful pinkish color. The dendritic and ferruginous layers take a fine polish and will make beautiful ornamental stones. The rock has been quarried in a few places and large blocks utilized in building some of the public buildings in San Saba and elsewhere. The San Saba building stones constitute a major resource.

The Oil Shale Deposits

Sampling.—The Bureau of Economic Geology has no facilities for sampling the oil shale deposits by means of core drills, obviously the best method of obtaining fresh samples. Consequently all samples had to be obtained from the outcrop. Localities were selected, however, near the bottoms of young valleys where the shale was least weathered, and pits were dug about 4 feet in diameter through the shale section of W.P.A. labor. Then samples were taken from the walls of the excavation at distances 1 foot apart. The samples were enclosed in air-tight jars and shipped immediately to The University of Texas. Altogether 32 pits were excavated and sampled. The pits were located at least 1 mile apart and were distributed at most good localities across the county. The localities are indicated on the map by small numbered squares.

Testing.—The samples were roasted in iron retorts constructed according to the design used by the U. S. Bureau of Mines in making similar tests. A temperature of 750° was maintained by means of special temperature control devices, and the heating was continued in all cases for 5 hours so that all volatile oil and hydrocarbons were driven out of the shale and collected through condensers in flasks. The shale was ground up in a mortar, dried, and weighed at the beginning of the tests, and the oil and liquids obtained from each distillation were weighed at the end of the test.

Results of tests.—The results of 63 typical tests of the shale are shown in the following table:

Location No.	Land owner	Oil Yield in Gallons per Ton Minimum	Maximum	Average	Number of Samples
3	W. Holman	5.75	15.6	10.67	11
5	B. Lively	1.60	42.2	19.00	9
7	J. Sloane	1.20	12.0	7.30	7
8	R. Ellis	4.80	17.5	11.70	5
9	R. Ellis	11.50	25.5	17.10	3
12	J. C. Hewgley	4.20	21.5	13.20	5
16	J. Sloane	1.60	40.0	15.80	17
18	J. Solane	2.40	20.1	14.10	6
	Total average			13.4	63

There was considerable variation in oil content in the shale from locality to locality and from top to bottom. The shale had the best yield in the lower portion of the section where it was freshest and the poorest yield where it was most weathered. This suggests that core drilling at a distance from the outcrop will yield richer shale. At no place, however, where reasonably deep pits were dug was the shale anywhere entirely barren of oil. The average yeild of 63 samples was 13.4 gallons per ton. The largest yield was 42.2 gallons per ton; the smallest yield 1.2 gallons per ton.

Utilization of oil shale.—It is clear in the case of this Texas oil shale, as in the case of that of Colorado and other states, that it has little commercial value as a source for crude oil as long as there is an abundant supply of petroleum to be had by drilling of wells. Obviously oil can be produced from wells much cheaper than it can be obtained by mining and roasting shale. It is thought, however, that this rather rich shale in San Saba County may constitute a future reserve of oil which may be of value after the principal oil fields of the Southwest have been exhausted.

It is considered also that these shale deposits are fully worthy of more investigation and research, particularly in the effect of the process of hydrogenation on the yield of by-products from this shale. Also an investigation of the by-products themselves is fully justified. It is possible that valuable products such as ichthyol, ammonium nitrate (a fertilizer), and valuable dyes and chemicals could be found in the products of distillation from these shales.