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The information in this circular was partly obtained from work carried on by a unit of the WPA Statewide Mineral Resources Survey Project, sponsored by The University of Texas, Bureau of Economic Geology. The purpose of this survey is to assemble information concerning the mineral resources of Texas and make it available to the public. It is hoped that this information will be a contribution to the industrialization of the State.

GYPSUM IN GILLESPIE COUNTY, TEXAS*

by Virgil E. Barnes

INTRODUCTION

A geologic map and a bulletin describing the geology and mineral deposits of Gillespie County, Texas, is being prepared. Awaiting completion of this map and bulletin, abbreviated mimeographed circulars describing the more important mineral deposits will be issued.

In December, 1941, a unt of Work Projects Administration project No. 49036 was inaugurated to investigate the gypsum deposits of Gillespie County. Core drilling was undertaken but proved unsatisfactory and was discontinued. The WPA unit was used for clearing debris out of gypsum-bearing caverns and sinks so that the thickness of the gypsum could be mesured, elevation of the bottom of the gypsum obtained, and samples of the gypsum taken for analysis. This type of work yielded information not otherwise available. The supervision of the WPA unit was under the able direction of Mr. Robert W. Mathis who also obtained some of the elevations used in this report. The writer was assisted by Mr. Lincoln E. Warren.

STRATIGRAPHY

The accompanying sketch map of a portion of Gillespie County shows the area of known gypsum deposits. The gypsum is in Edwards limestone of Cretaceous age, and its base is about 140 feet above the base of the Edwards limestone. The rocks beneath the Edwards limestone are grouped on the map as pre-Edwards rocks and consist of the following formations and members:

Cretaceous	(Comanche Peak limestone (Walnut clay (Glen Rose limestone (Travis Peak formation
	Unconformity
Ordovician	(Threadgill limestone
Cambrian	(Wilberns formation (Disconformity (Cap Mountain formation (Hickory sandstone
	Unconformity
Pre-Cambrian	(Granite (Packsaddle schist (Valley Spring gneiss

The basal part of the Comanche Peak limestone is an impure nodular limestone, and the top part contains some uniform, soft, easily worked limestone beds which have been extensively used in the Fredericksburg area as a building stone. The Comanche Peak limestone is about 25 feet thick in the Fredericksburg area. It thins northward by a progressive change to sandstone at its base until in the vicinity of Crabapple Creek only 6 to 10 feet of the limestone remains.

The Walnut clay (*Exogyra texana* clay) is only 2 or 3 feet thick in the vicinity of Fredericksburg and northward is replaced by sandstone. The Glen Rose limestone likewise is thin in the Fredericksburg area and to the north is replaced by sandstones. The Travis Peak formation is the basal sands of the Cretaceous and in this area is the shoreward facies of the Glen Rose limestone, the Walnut clay, and at least part of the Comanche Peak limestone.

The surface upon which the Cretaceous rocks accumulated has more relief than the present surface and consists of faulted Paleozoic sedimentary rocks and pre-Cambrian igneous and metamorphic rocks. The rocks that will be encountered beneath the Cretaceous cover at any point cannot be predicted, other than that they will be Paleozoic or pre-Cambrian in age. Outcrops in the northwestern

*Assistance in the preparation of these materials was furnished by the personnel of Work Projects Administration Official Project No. 265-1-66-214.

• (Unfortunately, the supply of the map mentioned is now exhausted.)

part of the map area are as young as lower Ordovician. The basal member of the Ordovician exposed in this area is a non-glauconitic limestone, the "Threadgill limestone." (MS. Bridge and Barnes.) The "Threadgill limestone" grades downward into the glauconitic Cambrian Wilberns limestone without a recognizable unconformity. The Wilberns can be divided into several members in some areas of the uplift, but in this area only the bottom sandstone member has been separately mapped. The basal non-glauconitic sandstone of the Wilberns is in sharp contact with the underlying glauconitic sandstone, Lion Mountain member, of the Cap Mountain. The Cap Mountain grades downward into the Hickory sandstone.

An inlier of Cap Mountain limestone outcrops about one-fourth mile southwest of gypsum locality 6 and extends about 140 feet up into the Edwards limestone. This is the highest peak of the pre-Cretaceous surface exposed in Gillespie County. Other inliers are located farther to the southwest.

Pre-Cambrian granites, schists, and gneisses underlie both Cretaceous and Paleozoic sedimentary rocks of the area. One inlier of granite, Bear Mountain, is located about 4 miles north of Fredericksburg. The chief pre-Cambrian outcrops are in the vicinity of Enchanted Rock in the northeastern part of the map area. The pre-Cambrian in this area is composed predominantly of gneiss, schist, and granite.

DISTRIBUTION AND OCCURRENCE

The gypsum of Gillespie County occupies a definite horizon in the Edwards limestone. It was at one time a continuous bed which may have extended throughout many counties of the State. Only remnants of this once extensive gypsum bed remain, the rest having been removed by solution. The original extent of the gypsum is not known, but gypsum cores have been recovered from the Edwards of Menard County, and gypsum which may be of Edwards age has been encountered by drilling on the Chittim arch. In highway cuts of Kimble and Menard counties a cavernous zone is found in the Edwards at about the horizon of the gypsum, and the beds above this zone are broken and disturbed.

Above the gypsum horizon in Gillespie County the Edwards is greatly disturbed, whereas below that horizon the beds throughout the county are entirely undisturbed. Everywhere that Edwards gypsum has been seen, it shows evidence of extensive solution. Most exposures show evidence of solution at both the top and the bottom of the bed and many within the bed. The maximum thickness of gypsum seen is 35 feet, and evidence of extensive solution is present. The original thickness of the gypsum bed is unknown, but it must have been more than 35 feet thick.

The known gypsum deposits of Gillespie County extend for a distance of 10 miles along an east-west ridge of Edwards limestone northwest of Fredericksburg. The following table gives the name of the landowner, elevation of the bottom and top of the gypsum, thickness of gypsum, elevation of the ground above the gypsum, and thickness of cover over the gypsum at the immediate points examined. The locality numbers are the same as on the map.

Locality No.	*Landowner*	*Gypsum elevations in feet*		*Thickness of gypsum in feet*	*Elevation of ground in feet*	*Thickness of cover in feet*
		Top	*Bottom*			
1	Emil Cronwelge	2093.7	2085.0	8.7	2098.2	4.5
2	Joseph Stahling	2086.7	2074.7	12.0	2101.2	14.5
3	H. L. Keyser	2079.0	2069.0	10.0	2083.3	4.3
4	E. J. Wendel	2092.3	2071.6	20.7	2118.2	25.9
5	Fritz Rummler	2069.1	2050.6	18.5	2089.5	20.4
6-A	Otto Ketron	2132.6	2103.3	29.3	2144.1	11.5
6-B	Otto Ketron	2105.0	2085.0	20.0	2113.7	8.7
7	Ernst Meier	2101.4	2082.6	18.8	2117.7	16.3
8	Ernst Meier	2100.9	2079.3	20.6*	2109.6	8.7
9	Rienheld Weber	2088.0	2062.3	24.0†	2093.5	5.5
10	Rudolf Oghler	2067.9	2061.7	6.2	2081.8	13.9
11	Fred W. Welgehausen	2074.7	2056.5	18.2	2081.7	7.0

*Two beds. Upper one 16.7 feet thick, lower one 4 feet thick; separated by 1 foot of limestone.
†Two beds. Upper one 16 feet thick, lower one 8 feet thick; separated by 1.7 feet of limestone.

Locality 1. — This locality is 7.3 miles west of the Mason highway at a point 7.7 miles from Fredericksburg. Gypsum was first noticed in this area while a post hole was being dug. Only a small residual boulder was found, but evidence of gypsum, such as caves and sinks, is abundant near by. One of the caves was cleared of debris and a vertical solution channel through the gypsum was cleaned out. A massive 8.7-foot bed of gray gypsum was exposed.

Locality 2. — On Doss road 3.5 miles west of the Mason highway at a point 10 miles from Fredericksburg. Gypsum has been mined sporadically at this locality since 1934 by O. L. Neyland, of San Antonio. Only a rough estimate can be made of the amount of gypsum removed from the property, but it appears that 40 or 50 thousand tons may have been produced. The gypsum ranges from 9 to 16 feet thick and is covered by from 12 to 16 feet of well-bedded mostly hard limestone. The gypsum is mined by underground methods. The limestone above the gypsum is so thin that it is more economical to place shafts about 150 feet apart and mine the gypsum tributary to each shaft. The width of gypsum mined is about 10 to 12 feet, with pillars 10 to 15 feet square left to support the roof. Gypsum has been extensively dissolved from the top of the bed, and there is some evidence of solution at the bottom and at intermediate points. Filled sinks are present and can usually be detected at the surface by a ring of inward-dipping limestone slabs.

Locality 3. — Along the Mason highway 12.3 miles from Fredericksburg. Gypsum was mined at this locality during 1932 and 1933 by O. L. Neyland, of San Antonio. The workings are west of the Mason highway and are now rather dangerous to enter.

Locality 4. — This locality is 0.5 mile west of Cherry Mountain road at a point 8.8 miles from Fredericksburg. Gypsum was not previously known at this locality. A test pit was dug at the south edge of a partly filled sink, and the top of the gypsum was reached at a depth of about 26 feet. A vertical solution channel was cleared of debris, exposing 20.7 feet of massive gypsum.

Locality 5. — This locality is 0.7 mile west of Cherry Mountain road at a point 9.7 miles from Fredericksburg. Six feet of gypsum could be seen in a cave, and a vertical solution cavern was cleared of debris, exposing a total of 18.5 feet of gypsum. At least two other caves in this vicinity have gypsum exposed in them. Some core holes drilled in the area had gypsum cores about them, but the amount of gypsum encountered is not known.

Locality 6. — Along east side of Cherry Mountain road 7 miles from Fredericksburg. Mr. Bart Moore, Jr., of San Antonio, produced gypsum from this property for several months during 1940. The gypsum was mined by open pit method, and two pits about one-fourth of a mile apart were opened. One pit, near the main road, had 20 feet of gypsum exposed on one side, and the other sides expose chiefly cave-fill in solution channels in the gypsum. Solution of the gypsum has been very extensive, and the entire block of gypsum remaining has been sharply tilted because of unequal solution at its base. The southeastern pit, bordering the road to Ketron's house, has a 29.3-foot vertical face of gypsum exposed in one side of the pit. The maximum thickness of exposed gypsum in the area is in this pit. During mining operations a 35-foot face of gypsum was at one time developed. Solution of gypsum has been very extensive with much of the gypsum now removed. From exposures in the mine pits, and in test pits, it appears that only irregular columns of gypsum remain, and that many of these are laced by small solution channels. The gypsum in this area is structurally high. A small outcrop of Cap Mountain limestone is exposed toward Fredericksburg and within a quarter of a mile of the gypsum pits. The Cap Mountain limestone exposure is a high peak of Paleozoic rocks which extended about 140 feet up into the Edwards limestone. It is possible that differential compaction of the Cretaceous sediments about the high Paleozoic rock mass may account for the structurally high area.

Locality 7. — This locality is 1.4 miles east from Cherry Mounstin road at a point 7.7 miles from Fredericksburg. Gypsum is exposed in a cave frequented by goats. One solution cavern about 12 feet deep, usually with one or more goats trapped at the bottom, was enlarged and cleared of debris, exposing a total of 18.8 feet of massive white gypsum. Abundant evidence of solution is present.

Locality 8. — This locality is 1.7 miles east from Cherry Mountain road at a point 7.7 miles from Fredericksburg. A test pit, partially refilled, had at one time exposed gypsum in a small sink. The test pit was cleaned out and a vertical solution channel cleared of debris, exposing 20.6 feet of gypsum. The gypsum is in an upper 16.6-foot bed and a lower 4-foot bed separated by 1 foot of limestone. Another exposure of gypsum in a test pit is located between localities 7 and 8.

Localities 9, 10, 11. — These localities are from 1.1 to 1.8 miles wet of upper Crabapple road at a point about 8.5 miles from Fredericksburg. Gypsum was found at these three localities and ranged from 6.2 to 24.0 feet in thickness. At locality 9 an upper 16-foot bed of gypsum was separated from a lower 8-foot bed of gypsum by 1.7 feet of limestone.

Locality 12. — North of Doss road about 1 mile west of Mason highway at a point about 10 miles from Fredericksburg. A core hole was drilled to a depth of 130.5 feet. No gypsum was found, but at a depth of 113 feet a 2-foot cavern indicates that the gypsum may have been removed by solution.

STRUCTURE

Structural contours on the base of the Edwards limestone are shown on the map. The interval between the base of the Edwards and the base of the gypsum is approximately 140 feet, and these same contours can be used to depict the position of the base of the gypsum if 140 feet is added to them. Attention should be given to elevations of both the ground surface and the base of the gypsum during gypsum prospecting in this area. During 1940 some drilling to locate gypsum was done without adequate elevation control and without a knowledge of the position of the base of the gypsum; consequently some holes were started beneath the gypsum horizon, and others did not penetrate to it.

The elevations for making the structural contour map are rather widely spaced; consequently the map is not as detailed as could be desired. The highest point on the base of the gypsum is in the vicinity of locality 6. The gypsum-bearing area as a whole may be structurally higher than the surrounding country, which may explain the presence of gypsum in this area and its absence by solution in other areas. The structurally high areas might have been by-passed by most of the ground water which would tend to follow structurally low areas.

CHEMISTRY AND MINERALOGY

Partial chemical analyses of 12 samples of gypsum were made by Mr. R. M. Wheeler. These analyses, using the same identifying number as on the map, are given in the following table.

Analyses of Gillespie County gypsum.

Locality No.	*Landowner*	*CaO Per cent*	*SO_3 Per cent*	*Ins. Per cent*
1	Emil Crenwelge	32.96	44.06	—
2	Joseph Stehling	32.08	44.34	0.11
3	H. L. Keyser	32.64	46.04	tr.
4	E. J. Wendel	32.64	46.28	—
5	Fritz Rummler	32.64	44.08	—
6-A	Otto Ketron	32.08	44.64	tr.
6-B	Otto Ketron	32.64	45.70	tr.
7	Ernst Meier	32.96	45.18	—
8	Ernst Meier	32.64	46.36	—
9	Reinhold Weber	32.42	44.56	—
10	Rudolf Oehler	32.96	46.16	—
11	Fred W. Welgehausen	32.52	44.30	—

These analyses are not complete, no attempt having been made to determine water and carbon dioxide. Insoluble residues were determined on half of the samples, and on the rest an insufficient amount was present to warrant making determinations. Iron was either absent or present in very small traces.

If the SO_3 is all allotted to the mineral gypsum, an excess of CaO remains. A small amount of effervescence, observed while dissolving the samples, indicates the presence of calcite. If the excess CaO is all allotted to calcite, then the mineral composition of the samples may be stated as follows:

Calculated mineral composition of Gillespie County gypsum.

Locality No.	*Landowner*	*Gypsum Per cent*	*Calcite Per cent*
1	Emil Crenwelge	94.5	4.1
2	Joseph Stehling	95.2	2.0
3	H. L. Keyser	98.8	0.9
4	E. J. Wendel	99.3	0.6
5	Fritz Rummler	94.6	3.3
6-A	Otto Ketron	95.8	1.8
6-B	Otto Ketron	98.1	1.2
7	Ernst Meier	97.0	2.6
8	Ernst Meier	99.6	0.4
9	Reinhold Weber	95.6	2.4
10	Rudolf Oehler	99.1	1.4
11	Fred W. Welgehausen	95.2	2.5

The accuracy of such a mineral calucation is not great since only a limited number of radicals are estimated, and the hydration of gypsum probably varies. The ground samples were examined under the microscope, and the predominant mineral in all is gypsum. Calcite is also invariably present in very small quantities.

CONCLUSIONS

Gypsum is present over a rather wide area in Gillespie County and is now only a remnant of that which was once present. Numerous solution channels and caverns complicate the mining of the gypsum. The present work is not in sufficient detail to make tonnage estimates for the area as a whole. Considerable gypsum has been blocked out around the O. L. Neyland mine, locality 2. The area including locality 8 to 11 inclusive appears to be a favorable locality for prospecting. The surface rocks are not as disturbed as in many of the other localities, and a relatively thin layer of limestone covers the gypsum. Open pit mining could be used to recover the gypsum. The ridge, including localities 8 to 11, is in excess of three-fourths of a square mile in area. If gypsum is present under half of the area, and the average thickness of gypsum is conservatively taken as 10 feet, than about 7,500,000 tons of gypsum would be present. Without additional work, since the amount of solution which has taken place cannot be predicted, it would be unsafe to accept the above tonnage estimate.