

THE UNIVERSITY OF TEXAS  
Bureau of Economic Geology  
Austin, Texas

WELL RECORD IN STARR COUNTY  
Circular 39  
[Second Printing, 1957]

Alcorn Oil Company No. 1 Santo Domingo

Located near the south boundary of Porcion 91, 12 miles south of Garcias and 12 miles west of Samfordyce.

Description of samples by T. L. Bailey; samples submitted by Glenn O. Briscoe, 1923.

	<u>Depth in Feet</u>
Pink and pale green calcareous clay containing a few large sub-angular fragments of dark green glauconite, veined with siderite and containing numerous round brownish concretionary bodies 1/4 to 2mm in diameter, also of siderite. Other concretions of banded whitish to transparent chalcedony occur. This chalcedony contains many small round concretions which resemble oolites. Several small botryoidal waxy, bluish white, oblong concretions of chalcedony between 2 and 1 mm in diameter occur. There is only a small amount of sand present in this sample and it consists principally of greenish, pink, yellow and gray chert, colorless to gray quartz, gypsum, biotite and pyrite. Considerable orthoclase and microcline feldspar are present and one long stout colorless prism of apatite was seen. A few fragments of massive opal were noted and granular tiny calcareous nodules are common. (No. 1). . . . .	200-210
Similar in general appearance to No. 1. There are several large subangular grains of grayish-white calcite which include a large number of small pyrite cubes and sand grains. These appear to be parts of calcareous concretions and several are as much as 4 mm in diameter. The finer sand consists of about 1/4 pyrite cubes and pyritohedrons or combinations of the two. It is similar in general to the finer sand from 200-210 feet. The approximate composition of the total sand is: (1) chert--30%, (2) quartz--20%, (3) pyrite--25%, (4) feldspar--13%, (5) gypsum--7%, (6) calcite--2%, (7) glauconite--2%, (8) other minerals--1% (biotite, chlorite, zircon, magnetite). Practically all the grains are subangular or angular. Most of the sand is 1/4-1/8 mm in diameter. No organisms noted. (No. 2). . . . .	210-220
Similar to last two samples. Several pyrite cubes 1 mm in diameter seen in the unwashed calcareous clay. Also contains one sharply angular fragment of black chert 3 mm in diameter. The medium and fine sand contains many translucent pale bluish to yellowish green greasy-looking angular or subangular grains that are seen to be composed of an aggregate of chlorite in a fine-grained colorless groundmass. Some of the grains show tiny lath-shaped crystals, probably of feldspar, and have a more or less parallel arrangement of the crystals. These are thought to be grains of altered volcanic rock, probably rhyolite. They have been more or less replaced by silica and might be called green chloritic chert. These grains form about 15% of the sand. Grains of dark green glauconite are also frequent. Aggregatal vein quartz and uniform glassy quartz are more common than in the last. Chert is less abundant if the green grains are excluded. (No. 3). . . . .	220-230

NOTE: The samples from 200 to 230 feet are similar in general and probably are from the lower part of the Lagarto formation, namely, the Lapara member, if such a division of the Lagarto exists in that region. This formation is of Lower Pliocene or Upper Miocene age.

Fine-grained grayish green argillaceous sand or soft sandstone. Sand about 60% of sample. The sandstone is loosely cemented with calcite and the great majority of the grains are under  $1/4$  mm. A good percentage of silt grains occurs. The washed sand is of a rather dark greenish-gray color due to the large number of dark gray chert grains, pyrite grains and greenish cherty rhyolite? grains. Under the petrographic microscope in ordinary light, most of the grains have a cloudy grayish or brownish to greenish appearance. Some pink and yellow chert grains also occur. The mineral composition of the sand is approximately: (1) chert--40%, (2) quartz--25%, (3) calcite--15%, (4) feldspar--10%, mostly orthoclase but considerable twinned plagioclase, (5) chalcedony--1%, (6) gypsum--3%, (7) pyrite--3%, (8) glauconite--1%, (9) chlorite--1%, (10) biotite-trace-organic content--1%. Small Textularias and Globigerinas frequent. Also several Globigerinas  $1/4$  mm in diameter seen. Forams possibly secondary. Forams are frequently coated with small calcite crystals. (No. 4) . . . . .

240-242

NOTE: This sample (No. 4) seems to represent the top of the Oakville formation of Upper Miocene age. This division point may be lower than 240 feet.

Strongly calcareous pale greenish-gray calcareous sandy clay with a few small streaks of pink clay in it and containing numerous pyrite cubes, frequent calcareous concretions and a few chalcedonic concretions. A few pyrite concretions also present. The sand resembles that from 230 and 240 feet, and there are a great many green chloritic cherty grains in the coarse sand, but few in finer sand. Feldspar, mostly orthoclase, is very abundant and gypsum plates are common. One glauconitic cast of a foram seen in the medium sand and one part of a shell of a Textularia. A few subrounded grains of quartz and chert. (No. 5) . . . . .

242-280

NOTE: No change noted between 242-280.

Pale greenish-gray fairly arenaceous un laminated clay which contains numerous angular grains of gray to black cherty limestone up to 2 mm in diameter. Pyrite cubes also noted in the unwashed sample. One small lump of pink clay was noted. The washed material consists of a dark gray sand. Most of the grains above  $1/2$  mm and a considerable percentage below consist of sharply angular, generally flattened, dark gray to black cherty limestone and chert fragments. The thin section of these fragments showed an abundance of sponge spicules and resembles sections of the Marble Falls or Dimple cherty limestone of Pennsylvanian age. They may be fragments of a boulder shattered by the drill. There are also some concretions of mixed calcite and pyrite and a few flattened glassy gypsum fragments among the grains above 1 mm and others below this size. In the finer washed material are many oblong or rounded botryoidal chalcedony concretions, many pale greenish cherty rhyolite? grains, sub-angular quartz, feldspar and anhydrite grains and a few rounded glauconite grains. Small whitish calcareous concretions and yellow and pink chert grains are also common. Pyrite makes up about 20% of the sand. Finer sand contains less chert and limestone and is paler gray in color. (No. 6)

280-290

Pale grayish-green hard calcareous marl containing pyrite crystals up to 4 mm in diameter. A small amount of fine sand and frequent oblong bluish-white chalcedony concretions were noted. In the washed material several angular fragments of brownish or pale yellowish-gray laminated limestone up to 4 mm long were found. In thin section this limestone looks like gymnosperm wood consisting of elongated tapering cells full of little oblong pores or pits. These cells are wavy in outline. They dissolve in acid with effervescence. Many small white concretions composed of pyrite and calcite and numerous concretionary chalcedony grains occur. Pyrite, quartz, pink, yellow and gray chert, anhydrite, and feldspar grains are common and occur in the order named. Several fragments of yellowish isotropic volcanic glass fragments were noted.

Mineral composition of washed material (estimated): (1) pyrite--30%, (2) quartz--20%, (3) chert--15%, (4) feldspar--15%, (5) calcareous concretions--7%, (6) gypsum--5%, (7) chalcedony concretions--3%, (8) cherty limestone--3%, (9) volcanic glass--1% or less. (No. 7). . . . . 290-300

A dull white chalky volcanic ash containing numerous flat angular fragments of black chert below 2 mm in diameter. Most of them between 1/8 and 1/2 mm. Pyrite noted in small cubes. The coarser washed material (1/2-2mm) contains pyritiferous calcareous nodules, flattened pieces of pyritiferous pale green hard shaly clay, black cherty, often rounded, sandstone fragments, a few sharply angular and irregular translucent pale bluish-gray chalcedony fragments and several whitish-brassy pyrite crystals or aggregates. A few quartz, colorless anhydrite and volcanic glass grains and a few transparent grains of crystalline calcite occur. The sandstone fragments are abundant. The finer washed material contains the same types of grains as the coarse, but the pyrite is much more abundant as are also quartz, gypsum and glass grains. A few grains of feldspar, chert and chlorite were seen. (No. 8). . . . . 300-320

A chalky whitish sandy volcanic ash resembling No. 8. Washed material contains peculiar angular, generally flattened, large fragments of porous, crystalline, pale greenish-gray calcite which reflects the light from surfaces of considerable size. These fragments reach 1 cm in length. They contain considerable pale green clay and seem to be partially formed crystals composed of parallel plates of calcite with clay or cavities between the thin plates in places. Many transparent cleavage pieces or crystals of yellowish calcite occur in the finer washed material. These calcite grains constitute all the washed material above 1/2 mm except for a few pyrite cubes. They constitute most of the washed material even down to the finest separates. In the finer sand (below 1/2 mm) the grains outside of calcite consist of volcanic glass fragments (often having the shape of a hollow tube broken longitudinally and showing whitish streaks due to alternation), polished, generally yellow, quartz grains, pyrite, angular anhydrite fragments and a few dark gray chert and occasional feldspar grains. The quartz is unlike that found before in that it is mostly well rounded and of transparent yellow color, which is seen to be due to irregularly distributed limonite stain when observed under the petrographic microscope. A few subangular grains of colorless quartz occur. Practically all the rounded grains are yellow. Glass fragments make up fully 30% of the fine sand. Quartz forms about 15% and calcite most of the remainder. (No. 9). . . . . 320-330

Similar to No. 8 except that more glass grains are present. Probably 1/2 of the washed material is made up of glass fragments. Most of the remainder is calcite. Clay material is bentonite. Sand, including glass, about 10% of total sample. (No. 10) . . . . . 330-350

Similar to No. 9 almost exactly. (No. 11). . . . . 350-360

NOTE: There is an alternation of similar strata with more sedimentary grains in Nos. 9 and 11 and purer ash in No. 10. Gray cherty sandstone found in Nos. 8 and 10 and not in 9 and 11 or very rarely.

Sample consists of fragments of white, powdery calcareous volcanic ash. In the washed material were noted fragments of bluish-white chalcedony, calcareous concretions, gypsum, volcanic glass and limestone. A thin section of a fragment of the limestone showed several sponge spicules. A crystal of apatite was noted. (No. 12) . . . . . 360-370

Sample is light greenish-gray calcareous clay. In the washed material were noticed fragments of light gray chalcedony, quartz, calcareous concretions and pyrite in cubes. (No. 13) . . . . . 370-390

Sample consists of white chalky volcanic ash. The washed material contains fragments of gray and mottled chert, calcareous concretions, volcanic glass and pyrite. (No. 14) . . . . . 390-420

Chalky volcanic ash. Contains fragments of white limestone concretions, volcanic glass, chalcedony and a few worn fragments of dark limestone. (No. 15) . . . . . 420-440

Sample consists of slightly calcareous argillaceous volcanic ash. The washed material contained fragments of concretionary limestone, volcanic glass, pyrite, chert and chalcedony. (No. 16) . . . . . 440-461

White powdery volcanic ash, slightly calcareous. This is somewhat coarser material than previous sample. The washed material contained much chalcedony, mottled brown chert fragments and volcanic glass. Fragments of gray limestone, white concretionary calcite and pyrite were noted. (No. 17) . . . . . 461-472

Sample consists of pale gray calcareous clayey volcanic ash. Washed material contained fragments of concretionary calcite, volcanic glass, chalcedony, chert, dark limestone and one or two fragments of light green clay. (No. 18) . . . . . 472-483

Sample consists of white calcareous volcanic ash somewhat coarser than at 440-461. Washed material contains fragments of concretionary calcite, volcanic glass and some pyrite. A few small fragments of dark limestone noted less than 1/2 mm in diameter. (No. 19) . . . . . 483-517

A pale greenish calcareous ashy clay containing pieces of greenish-gray calcite like that from 320-330 ft. and pyrite cubes, octahedrons, and pyritohedrons. Washed material contains many volcanic glass grains and gray angular chert fragments. The glass is most abundant in the fine sand. Chert is abundant between 1 and 1/4 mm. Other grains are quartz, anhydrite, feldspar and chlorite. No organic remains seen. This sample is similar to 290-300 ft. (No. 20) . . . . . 517-529



Pink and green mottled fairly calcareous stiff clay containing a few large angular blue-gray to almost colorless chalcedony fragments up to 1 cm in diameter, a flattened finely crystalline pyrite concretion 4 mm in diameter, and a small amount of fine sand. Washed material consists of pinkish calcareous concretions grading into fairly coarsely crystalline calcite, pyrite, obsidian (often containing bubbles), quartz (colorless and more or less etched), anhydrite, and feldspar. (No. 21) . . . . . 543-544

A magenta-pink calcareous clay containing rather numerous greenish-gray and pale pink calcareous and chalcedonic concretions and pyrite crystals. The washed material is similar to No. 21 except that the chalcedony and calcite concretions are more abundant and there is more sand present. Several perfect pyritohedrons of pyrite found. No organisms seen. (No. 22) . . . . . 560-583

A somewhat powdery fairly slow-slaking sandy calcareous clay containing a considerable quantity of volcanic ash. Most of sand like in last sample is below 1/4 mm. This sample is very similar to that from 560-583, the last sample (No. 23) . . . . . 583-589

Pale greenish-gray argillaceous sand and pink clay. Contains large coarsely crystalline calcite masses similar to those in No. 9 as well as numerous pink and greenish-gray finely crystalline calcite concretions and much pyrite in washed material. Glass fragments becoming less abundant here. The washed material is otherwise like the last few samples. (No. 24) . . . . . 644-654

Poorly sorted coarse to fine-grained pale gray sand containing a large number of pinkish and greenish calcareous concretions and chalcedonic and pyritic concretions up to 5 mm in diameter. The washed material consists of grains ranging in size from 5 mm to below 1/8 mm with no pronounced maximum in the sizing. The coarse sand and gravel is composed mainly of concretions described above together with a number of angular to subrounded pink, brown and gray chert, pale green flat fragments of hard clay containing much calcite and pyrite, dark gray quartzite and pale green to colorless crystalline calcite grains. One sharp glass fragment 3 mm in diameter and a few angular glassy quartz grains above 1 mm also occur in the coarse sand and fine gravel. Many coarse crystals of pyrite also occur and some composite grains of chalcedony and pyrite were seen. The grains in the fine and medium sand separates are mainly angular and none are well rounded. The mineral composition of the total sand is estimated as follows: (1) chert--20%, (2) pyrite--20%, (3) obsidian--20%, (4) quartz--15%, (5) calcite--10%, (6) feldspar--10%--mostly oligoclase. No microcline. (7) gypsum--5%, (8) magnetite--trace, (9) zircon--trace, (10) apatite--trace, (11) epidote--trace, (12) augite--trace, (13) biotite--trace. No organisms noted. (No. 25) . . . . . 654-667

A pink massive clay, more or less splotted with pale green, which contains numerous small concretions of calcite and chalcedony and pyrite crystals and about 3% of fine sand. The washed material consists mainly of the concretions and pyrite crystals mentioned above. One large irregular-shaped concretion 3 mm in diameter consisted of pale greenish granular calcite intergrown with bluish chalcedony. The calcareous concretions are both pink and pale green. The finer sand is similar to that in No. 24 except that there is less glass present (about 10% of the fine sand). One triangular sharply angular conchoidal plate of pale gray translucent volcanic glass 3 mm in diameter was seen. (No. 26) . . . . . 667-678

This sample consists of somewhat powdery, pale greenish-gray, somewhat sandy, calcareous, bentonitic clay. In the washed material between 4 and 1 mm several grains of dark olive-green to grayish-green rounded to subangular glauconite grains which contain many rounded botryoidal concretions of siderite were seen. Under the petrographic microscope in thin section, these grains are clearly seen to be composed of about equal quantities of finely granular glauconite and pale yellowish-brown siderite intimately intermixed. Also large concretions and veins of pure siderite are scattered through it and one oblong spindle-shaped mass of pyrite was noted in the midst of one grain. One concretion of pure siderite 2 mm in diameter was seen. Concretions of pale green and pinkish finely granular calcite and others of granular and coarsely crystalline pyrite and subangular grains of dark gray quartzite and brownish chert occur. In the washed material below 1 mm numerous beautiful, apparently fresh, glass grains, often enclosing bubbles and of the most sharply irregular shapes imaginable are seen. Most of the glass grains, however, have altered to a whitish bentonitic material on the exposed surfaces and are glassy within. The pores in many grains are greatly elongated and show a parallel structure. Glass comprises fully 50% of the total sand. Abundant greenish calcite concretions, flakes of bentonite and pyrite occur. Less common are grains of glassy quartz, feldspar, anhydrite and gray quartz, feldspar, anhydrite and gray and black chert. Most of the glass fragments, and therefore of the total sand grains, are between 1/2 and 1/4 mm in diameter. (No. 27) . . . . .

678-685

Pale grayish-green and pink calcareous clay which slakes slowly. This is quite similar in composition to No. 21 from 543-544 feet. Contains somewhat more volcanic glass. (No. 28) . . . . .

685-701

NOTE: The samples from 230 to 704 are rather sandy and quite similar in general except that beds of volcanic ash have been intercalated in the clays and sands. They are therefore classed as one formation, the Oakville, of Upper Miocene or Lower Pliocene age.

Core sample. A fairly dark greenish-gray, hard, soapy, calcareous clay containing numerous small pyrite crystals and concretions. A small amount of sand and concretions below 1mm and mostly between 1/4 and 1/8 mm is contained in the clay. Rather dark greenish-gray sub-angular grains of chloritic chert, which may be altered andesite, are abundant in the washed material (probably 25% of washed material). The green color is due to chloritic spots scattered through each grain. The remaining grains are also mostly subangular or angular and consist of quartz, pyrite, chert, feldspar and calcareous concretions. All three varieties of feldspar are found and plagioclase is by far the most common, probably forming fully 20% of the sand. Orthoclase is next commonest while microcline is rare. Most of the quartz is etched with small roundish depressions. Quartz is the most abundant mineral followed by the greenish chloritic cherty grains, feldspar, pyrite and chert (mostly gray). One badly altered glass fragment was noted. (No. 29) . . . . .

704

NOTE: The hard green clay found at 704 feet represents the most marked lithologic break seen for several hundred feet and seems to be a different formation. It is possible that this green clay and some of the partly consolidated volcanic ash beds below represent the Oligocene which has been over-lapped at the surface. However, this is probably still Oakville because the next core sample contains considerable sandstone similar to that above.

Core sample. A pale gray argillaceous calcareous sand. The washed material forms a considerable part of the sample and consists mainly of true sand grains, only 10% or less of the grains (mostly pyrite) being probably of secondary origin. The sand portion is well sorted, the sizing being estimated as follows:

(1-1/2 mm)----	2%	Total sand--60%
(1/2-1/4 mm)---	30%	Total clay--40%
(1/4-1/8 mm)---	60%	Probably clay and sand layers
(1/8-1/16mm)---	8%	have been mixed in the core
		barrel.

Probably 99% of the grains are angular to subangular with angular predominant. Very few are subrounded. The mineral composition of the sand is estimated:

1. Felspar--27%. Mostly fresh and over 1/2 plagioclase. Some felspar as basic as labradorite.
2. Quartz--25%.
3. Chert--20%. Mostly gray and green. Green is due to chlorite.
4. Chalcedony (concretionary)--5%.
5. Calcite (concretionary)--10%. Whitish granular concretions.
6. Andesite and basalt fragments--2%. Composed of laths of plagioclase and chloritic material.
7. Pyrite--5%.
8. Anhydrite--5%. Lower index of refraction than normal.
9. Obsidian--1%. Mostly altered.

Organic content: One doubtful Globigerina encased in granular calcite was noted. The peculiarity of this sand is its high felspar (especially plagioclase) content and the remarkable glassy freshness of these felspars. No microcline was noted and only about 30% of the felspar is orthoclase. The large number of green chloritic chert grains is also noteworthy and they give the sand a greenish-gray tint. This sand is similar in general to that washed out of the last samples, No. 29. (No. 30). . . . .

730

Pale green and pink calcareous sand and clay. The washed material contains several fragments of pale green fine-grained pyrite-bearing very calcareous sandstone as much as 1 cm. in diameter. A few large irregular chalcedony concretions occur and several pyrite concretions and groups of crystals 1 to 2 mm in diameter and white granular calcareous concretions of a similar size are present. The finer sand is rather similar to the last sample except that glass grains are much more abundant, forming probably 15% of the sand under 1/2 mm. (No. 31) . . . . .

739

Pale green sandy calcareous clay with small pieces of pink clay included. About 10% sand present. The washed material contains many concretionary masses of calcite, chalcedony, and pyrite. Many of the calcite concretions are pale grayish green in color and show one cleavage face over most of one side of a fragment like the calcite in No. 9 (320-330 feet). Many fragments of medium-grained pale gray calcareous sandstone are found in the coarse separates (above 1/2 mm). The sorting and mineral composition of the sand excluding the more abundant concretions of lime, pyrite, and chalcedony is quite similar to No. 30 from 730 feet. The sandstone fragments noted here are consolidated portions of the same kind of sand and sandstone beds were evidently encountered at this depth and have been mixed with much clay in the cuttings. (No. 32) . . . . .		739-750
Same as last samples. (No. 33) . . . . .		763-773
Similar to the last two samples. (No. 34) . . . . .		773-784
Green and pink mottled calcareous clay. One very angular and irregular concretion was 12 mm in average diameter and consisted of a mixture of dark bluish gray translucent chalcedony and white granular calcite intergrown. Most of the concretion was chalcedony, and calcite tended to fill in hollows and irregularities. Many pale gray sandstone grains up to 4 mm in diameter are present, like in last samples. One bipyramidal short glassy quartz crystal was seen. Most of the remaining quartz is more or less etched and contains numerous greatly elongated prisms of apatite. Probably 15% of washed material is chalcedony. Otherwise the same as last sample, No. 34. (No. 35) . . . . .		784-795
Green and pink, rather sandy, strongly calcareous clay. The washed material varied from 3 mm down in size of grains, and practically all the grains over 1/2 mm consist of concretions of calcite, chalcedony, anhydrite, and crystals of pyrite and marcasite. The largest separate, excluding the concretionary material, is (1/2-1/4 mm), with the (1/4-1/8 mm) almost as large. The mineral composition and shape of grains is very similar to the last few samples. Sandstone grains not quite so common. (No. 36) . . . . .		795-806
Similar to last sample. (No. 37) . . . . .		806-819
Similar to last three samples except that fragments of pale greenish-gray calcareous sandstone are quite abundant here, possibly 15% of the washed material. More sand present, probably 15% of sample. (No. 38) . . . . .		819-830
Similar to last sample, No. 38. (No. 39) . . . . .		830-841
Similar to last sample. Glass fragments still present sparingly. The green cherty grains that seem to be altered andesite or rhyolite are still common. (No. 40) . . . . .		841-852
Fairly bright pink and green clay containing only about 5% of sand and concretions. Similar to last sample except more grains of subrounded yellow-stained quartz are present. These are mainly below 1/4 mm in diameter. A number of flat grains of black shale or slate are present in separates between 1/4 mm and 2 mm. A number of compound concretions of pinkish anhydrite and chalcedony are found. (No. 41) . . . . .		852-863

NOTE: The samples below 852 seem to be considerably less sandy than most of those above and not so many sandstone fragments are noted in the cuttings. No core samples from this depth were received so that the division line is quite uncertain, but this is considered to be the most likely place to draw the line between the Oakville, or possibly Oligocene, and Frio, or upper Jackson Eocene. The Chara seeds found in the next sample resemble an upper Eocene form from England and seem to be present all through the next several hundred feet of samples at least in the cuttings. The top of the Frio is therefore placed at 852 feet.

A pale green and pink calcareous bentonitic sandy clay containing a great abundance of chalcedony concretions and fewer of pyrite and calcite. Practically all the washed material above 1/2 mm consists of concretions. Botryoidal, often irregular, pale pink to blue-gray chalcedony concretions form fully 65% of the total washed material. They range up to 4 mm in diameter and are often more or less coated with powdery calcite. These concretions are frequently changed to quartz on the inside which is surrounded by a border of irregularly oriented columnar chalcedony crystals. The composition of the sand between 1/2 and 1/8 mm is as follows: (1) chert--15% (much of green color and containing chlorite plates), (2) quartz--20%, (3) obsidian--20% (much contains bubbles), (4) chalcedony (concretionary--15%, (5) feldspar--15% (all three kinds with altered orthoclase commonest), (6) calcite--5% (granular or small transparent crystals), (7) pyrite--5%, (8) gypsum--5% (part anhydrite), most flat pure white grains, (9) magnetic--trace. A large percentage of grains, probably 60%, are cloudy gray due to alteration or to the presence of gray chert and chalcedony. Organic content--trace. A well-preserved yellow Chara seed with smooth rather flattened spiral ribbing seen in 1-1/2 mm separate. The Chara seed resembles closely Chara tornata, figured from the English upper Eocene, but probably is not the same species. The altered anhydrite plates resemble shell fragments. This whitish color of theirs is probably due to the heating of the gypsum fragments. (No. 42) . . . . .

863-880

A rather light gray stiff bentonitic calcareous clay containing numerous irregular masses and concretions of glassy gray anhydrite and chalcedony intergrown. These concretions range up to 4 mm in diameter. A smaller number of white calcareous concretions are also found. Washed material including both sand grains and concretions--15% of sample. About 90% of the total washed material consists of concretions, while 75% of these concretions are mixed chalcedony and calcite of a grayish-white color. The other concretions are chalky-looking calcareous nodules. The finer sand (below 1/2 mm) has the following approximate composition: (1) chalcedony (concretionary)--60%, (2) calcite--18% (concretionary, largely, possibly also a few shell fragments), (3) anhydrite--5%, (4) quartz--10%, (5) chert (mostly green altered rhyolite or andesite?)--15%, (6) pyrite, feldspar, and volcanic glass--2%. The finer sand has a yellowish-white color, not gray or greenish. The grains are mainly subangular or angular. (No. 43) . . . . .

885



Similar in general to the last sample, No. 43, except that volcanic glass, anhydrite, and quartz are more abundant in the finer separates and there is more anhydrite in the very irregular-shaped concretions of anhydrite and chalcedony than in the last sample. These concretions are dirty yellowish-gray in color and most are over 2 mm in diameter. Some 1 cm. in diameter were noted. The fine sand as in the last sample has a yellowish-white color instead of the greenish-gray color that the sand in the preceding samples, above 885 feet, have had. Very little green and gray chert are found in this sand which causes the change of color as does the larger amount of chalcedony and anhydrite. The yellowish tint seems to be due to stained and altered volcanic glass fragments. (No. 44). . . . .

899

A green and pink calcareous sandy clay. The washed material comprises about 20% of the sample but about half of the washed material consists of mixed concretions of chalcedony, anhydrite, and calcite, and groups of pyrite crystals. The pyrite comprises only about 10% of the concretionary minerals. The two coarsest separates (between 4 and 1 mm) are composed mostly of concretions, though sandstone grains form about 20% of them. Two rounded grains of grey-green glauconite occur also. Mineral composition and shapes of grains: The most of the sand, excluding concretions, is between 1 mm and 1/4 mm in diameter. The grains are mainly subangular, but probably 7% of the grains of sand are subrounded while a few quartz grains are beautifully rounded and polished. Several beautiful white silky fibers of dehydrated gypsum as well as rounded grains of it occur. Much green chert (probably altered rhyolite or andesite) and a considerable number of brownish-green glauconite grains are found.

Probably the green grains form 20% of the sand below 1 mm and give it a greenish tinge. Glauconite forms about 15% of the green grains. The glauconite grains are mostly well rounded though some are composed of two or more spheres. Volcanic glass still is frequent, probably 2% of the total finer sand. Most of the rounded quartz grains are stained with limonite which gives the finer sand a yellowish color. Most of these sand grains are between 1/2 and 1/8 mm in diameter. Several thin plates of brassy marcasite up to 1 mm in diameter are found. The other minerals are about like those in 899 feet. Fossils: 10 well-preserved yellowish Chara seeds of a rounded ovate to elliptical shape were found in the separate between 1 and 1/2 mm and one between 1/2 and 1/4 mm. Several fragments of Chara stems were also noted. These seem to be of one species and resemble that one seen in the sample from 863-880 feet. (No. 45) . . . . .

901-911

Core sample. A pinkish to greenish and brownish-gray calcareous clay containing many small stringers and veins of more or less hydrated anhydrite varying from white to colorless. Most of the washed material above 1 mm is composed of angular fragments of the above-mentioned veins though a very few concretions of chalcedony and anhydrite were noted. This anhydrite forms about 50% of the total washed material. The sand under 1 mm has the approximate composition of No. 43, yellowish, subangular chalcedony grains constituting about 2/3 of the sand. These grains seem to have been oxidized for practically all of them as well as quartz, chert, and felspar grains are stained yellow by limonite. About 15% of the finer sand consists of anhydrite while quartz and felspar in about equal amounts make up most of the rest. No fossils seen in this sample and only one small volcanic glass grain. (No. 46)

(Frio)  
911-912



NOTE: White platy gypsum grains and chalcedony grains are common in surface samples of Frio clay from west of Rio Grande City and the character of these clays also resembles the last few samples.

A greenish and pinkish argillaceous sand or sandy clay resembling No. 45 very closely in general appearance. This sample contains fewer concretions of chalcedony and anhydrite and these are practically all under 2 mm in diameter. The finer sand contains possibly 10% of subrounded grains. More glass fragments (most badly altered) and more pyrite cubes are present. One thin pelecypod shell fragment 2 mm in length was seen but no Chara seeds. Otherwise like No. 45 (901-911 feet). The sand has a green-gray color like No. 45 and most of the grains are between 1/2 and 1 mm in diameter.

(No. 47) . . . . . 912-925

Similar in appearance to the last samples, which it resembles in composition except that the present sample contains probably 20% of plates and elongated slivers of black shale and a few of lignite. About 15% of pyrite cubes and thin plates and aggregations of plates of brassy marcasite also occur. Very few glass fragments seen in this sample. (No. 48) . . . . .

925-936

Similar to the last sample except not nearly so much pyrite and marcasite. A few tubular bodies of granular calcite, probably Chara stems coated with calcite noted. (No. 49) . . . . .

936-950

Similar to last sample. One large elongated tubular body, possible a Chara stem coated with lime carbonate. Somewhat more gypsum or hydrated anhydrite and abundant yellowish chalcedony concretions.

(No. 50) . . . . . 958-969

Similar to No. 49 in mineral composition and appearance. Also contains frequent Chara seeds and stems similar to those from No. 45.

(No. 51) . . . . . 969-980

A green and pink calcareous argillaceous sand similar to the last sample. The washed material has a gray color due to the abundance of gray and greenish chert and pyrite and marcasite. Contains a considerable number of rounded grains and quite a number of well-preserved Chara seeds which seem to be of 2 species, one elongate-oval in outline and the other rounded-oval with a little cylindrical protuberance at the apex. Both types have smooth spiral ribbing.

(No. 52) . . . . . 980-1002

Similar to last sample except that there is very little black shale in the coarser separates of washed material and instead a considerable number of pale gray angular, fine-grained limestone fragments. Chara seeds are common and some are dark brown in color as well as yellowish.

(No. 53) . . . . . 1002-1024

Similar in appearance to the last samples. The washed material is similar in general to the last sample except that few black chert and shale grains, few chalcedony and anhydrite concretions, and no glass fragments were found. Very little of the washed material above 1 mm. The largest separate between 1/2 and 1/4 mm, while in many of the last few samples it was 1-1/2 mm. These (1-1/2 mm) separates contain most of the Chara seeds, as in the other samples. More concretions of white and pink calcite and many more pyrite cubes and pyritohedrons are present. Pyrite constitutes about 25% of the total washed material, but most of the crystals are cubes below 1/2 mm. A few marcasite plates noted. (No. 54). . . . .

1024-1030

This is a pink and green sandy calcareous clay, the cuttings like in the last several samples consisting of small round lumps of clay including sand grains. This clay, like the others, slakes very rapidly and is possibly a bentonite. A few small mostly altered glass fragments were seen. Otherwise like the last sample.

(No. 55) . . . . .

1030-1047

Core sample. A gray fine-grained laminated very calcareous silty clay or argillaceous silt. Most of the grains wash out so that less than 1% of the original sample is left in the washed material. A hand-lens examination of the dry sample shows a large percentage, probably 40%, of silt grains. A petrographic examination shows the material between 1/8 and 1/32 mm to be composed of tiny angular grains of quartz, feldspar, and chlorite, biotite, calcite, and muscovite surrounded by a very minute-grained yellow-brown flocculent material, part of which has an index below 1.54 and maybe lauerierite or bentonite. This clay slakes fairly rapidly also. The washed material contains 5 concretions of mixed calcite and chalcedony above 1/2 mm; pale brownish very angular platy, apparently opaline, grains between 1/2 and 1/8 mm; and a fine yellowish sand below 1/4 mm. The brown platy grains show a finely banded cross section are are possibly silicified shell fragments. Thin sections fail to reveal definitely any organic structure, but they seem to be of organic origin and resemble silicified shell fragments. The fine yellowish sand below 1/4 mm is subangular and consists of the following : (1) quartz--30%, stained and pitted, (2) silicified shell fragments?--20%, (3) plagioclase feldspar--10%, (4) orthoclase feldspar, mostly altered--10%, (5) microcline feldspar--trace, (6) chert--19%, mostly gray and green, (7) muscovite--2%, (8) pyrite--2%, (9) volcanic glass--2%, (10) zircon--trace, (11) chlorite--1%, (12) calcite--3%, (13) chalcedony--trace, (14) anhydrite--1%, (15) titanite--trace, (16) apatite--trace. (No. 56). . . . .

1047-1049

NOTE: Looks like Frio still.

Pinkish and greenish-gray calcareous sandy clay similar in the appearance of the cuttings to No. 55. The washed material is also similar in general to No. 55 with a few exceptions. Possibly 20% of the sample is sand. The sorting of this sand is estimated as follows: 4 to 2 mm, 1%; 2 to 1 mm, 5%; 1 to 1/2 mm, 22%; 1/2 to 1/4 mm, 32%; 1/4 to 1/8 mm, 35%; below 1/8 mm, 5%. The maximen separate is somewhat finer than in No. 55. Most of the grains above 1/2 mm consist of calcareous chalcedonic concretions, pyrite cubes, and marcasite plates, green (rhyolite?) chert, and gray shale. A few Chara seeds often partly encased in white powdery calcite also occur. They are similar to those in No. 55, etc. The average composition of the total washed material is estimated: (1) pyrite--20%, (2) chert--20%, (3) gypsum--20%, (4) quartz--20%, (5) calcite, concretionary mostly--5%, (6) chalcedony, concretionary--5%, (7) feldspar--3%, mostly altered orthoclase, but somewhat altered plagioclase is frequent, (8) black shale--7%, (9) apatite--trace, (10) zircon--trace, (11) epidote--trace, (12) silicified shell fragments, like in No. 56--trace, (13) Chara seeds--trace. One perfect short bipyramidal quartz crystal and a number of small gypsum crystals present. Marcasite plates--trace. The grains are almost entirely subangular, not over 1% of subrounded grains occurring. (No. 57) . . . . .

1049-1057

Very similar to No. 57. A few Chara seeds. (No. 58) . . . . .

1057-1070

Similar to No. 57. Possibly a few more Chara seeds and black shale grains. The elongated form of Chara with obtuse smooth spiral ribbing and an ovate form with sharp spiral ribbing seen. The sorting is also different, about 35% of the sand being between 1 and 1/2 mm with 1/2 to 1/4 mm next. (No. 59) . . . . .

1070-1091

Very similar to No. 59 except Chara more abundant and only 5 concretions and no sand grains above 1 mm were noted. (No. 60)

1091-1110

No change. Chara seeds common, both elongated and ovate forms present. All ovate forms seen have obtuse ribbing. (No. 61)

1114-1125

Similar to last sample. Probably more small grains of chalcedony. Chara seeds common. (No. 62) . . . . .

1125-1136

Similar to last sample. Many well-preserved Chara seeds. Also a few partly altered volcanic glass fragments between 1/4 and 1/8 mm in diameter seen. (No. 63) . . . . .

1136-1158

Greenish-gray and some pink sandy calcareous clay. The washed material consists of concretionary chalcedony and subangular quartz sand, and some of which is cemented by calcium carbonate. Calcite, vari-colored chert, pyrite, volcanic glass, and gypsum common; feldspar, green shale, and marcasite sparse. Fossils: Chara seeds and Chara stems. (No. 64) . . . . .

1158-1169

Like No. 64 but with more sharp ribbed Chara seeds and probably more gypsum. (No. 65) . . . . .

1169-1180

Like No. 64 but with slightly more pink shale, fewer Chara seeds, no marcasite, and a little anhydrite. (No. 66) . . . . .

1190-1191

Like the preceding, with probably a little more calcareous sand, somewhat more pink shale, and rare crystals of marcasite present. (No. 67). . . . .

1202-1213

Pink and greenish-gray shale like the preceding sample. (No. 68)

1213-1225

A pale greenish and pinkish calcareous sandy clay similar to the last several samples. Very few grains in washed material over 1 mm and the largest separate (about 40% of the total sand) is between 1 and 1/2 mm. The principal minerals are concretionary chalcedony, calcite, quartz, gray and green chert, pyrite, and gypsum. The composition is similar in general to No. 57. Marcasite plates, feldspar, fairly large flat fragments of thinly laminated cherty yellow-gray limestone and black shale are frequent. Fossils: Chara seeds and stems are common. These are the ovate forms with rounded ribbing. (No. 69) . . . . .

12225-1247

Core sample. This sample consists of a pale grayish-green and pink calcareous clay containing very abundant large concretions. The concretions make up probably 80% of the sample. The washed material consists of concretions and a little fine sand. The largest concretion was 3 x 1-1/2 x 3/4 cm and had a finely pitted and botryoidal irregular surface. It consisted of intergrown white calcite, blue-gray chalcedony, and colorless glassy anhydrite. The minerals are named in their order of abundance. About 2/3 of the concretions above 2 mm are of the type just described but many of pure chalcedony or calcite or of argillaceous calcareous material are found. Cubes and concretions of pyrite up to 1 cm in diameter make up above 25% of the washed material above 2 mm. About 60% of the total sample consists of the concretions and crystals described above. One angular flat piece of pale gray chert was also found in this coarse material. The washed material between 1 and 2 mm is similar in composition to the coarser separate and forms about 10% of the washed material. The 1 to 1/2 mm separate consists of: (1) calcareous concretions--30%, (2) chalcedony concretions--30%, (3) pyrite cubes and aggregates of cubes--25%, (4) anhydrite (often altered to gypsum)--15%, (5) Chara seeds--trace. The Chara seeds are fat ovate forms with rounded spiral ribbing. The sand below 1/2 mm consists of the following minerals: (1) pyrite--40%, (2) green and gray chert--15%, (3) quartz--15%, (4) gypsum and anhydrite--15%, (5) feldspar (mostly badly altered orthoclase)--2%, (7) magnetite--trace, (8) volcanic glass--rare. (No. 70). . . . .

1247-1249

Core sample. A hard, grayish-white almost noncalcareous fine-textured, flaky rhyolite or trachyte tuff. Most of this material is a fine argillaceous material that has been hardened by silicification. The slaking is not so rapid as in typical bentonite on account of the siliceous cement. The washed material is between 1/4 and 1/8 mm. The separates (below 1/8 mm and 1/2 to 1/4 mm) are about equal and 1 to 1/2 mm only 10% of the washed material. All this washed material has a creamy color with a few dark specks of pyrite in it. The grains above 1/2 mm consist of a few whitish calcareous concretions, a pyrite cube, three gray or yellowish subangular chert grains, and a glassy subangular quartz grain. The sand under 1/2 mm consists largely (probably 60%) of cream-colored altered volcanic glass fragments. Very little of the original

glass is left in many of the grains but still preserve the peculiar irregular angularity of those grains and a few glassy fragments showing bubbles were noted. Most of these igneous fragments are between 1/2 and 1/8 mm in diameter and the separate below 1/8 mm contains about 2/3 quartz, feldspar, chert, and other mineral grains. The approximate composition of all the washed material from this sample is: (1) altered volcanic glass--60%, (2) feldspar--20%, mostly fresh or pale yellowish sharply angular orthoclase grains but many of plagioclase, (3) gypsum--5%, (4) quartz--5%, (5) pink and yellow, often practically opaque cherty grains (probably mostly rhyolite fragments)--5%, (6) calcareous concretions--7%, (7) magnetite--1%, (8) pyrite--1%, (9) apatite crystals--trace, (10) zircon crystals--trace, (11) biotite--1%. Fossils--none. (No. 71) . . . . .

1253-1255

NOTE: This sample resembles the Gueydan tuff from Live Oak County. (T. L. B. 10/12/23)

A rather coarse sand, most of the grains of which are coated with rather bright-colored green and pink calcareous clay. Sand, 60%, has a greenish-gray color due to numerous grains of altered rhyolite. Clay, 40%. The sorting is approximately: 2 to 1 mm, 2%; 1 to 1/2 mm, 38%; 1/2 to 1/4 mm, 30%; 1/4 to 1/8 mm, 25%; below 1/8 mm, 5%. The composition is similar to No. 69, except green cherty rhyolite, or andesite, grains (called green chert in most descriptions) are commoner probably making up 20% of the sample. Gray chert is also common as is glass. Chara seeds and stems are quite frequent. The seeds are mostly smooth, rounded-ribbed forms. (No. 72) . . . . .

1255-1266

Similar to the preceding sample except that sand is not quite so abundant and is finer. The largest separate of washed material is 1/2 to 1/4 mm followed by 1/4 to 1/8 mm, 1 to 1/2 mm, and below 1/2 mm. The very fine sand constitutes about 20% of the washed material. (No. 73) . . . . .

1266-1289

Similar to the last sample except that glass fragments are rather rare and black shale is common. Pink and yellow chert and yellow-stained quartz somewhat more abundant especially in the finer sand. Chara seeds rare but stems common. (No. 74) . . . . .

1289-1314

Similar in appearance and mineral composition to the preceding. Chara seeds and stems frequent. Several undoubted thin shell fragments seen, one white calcareous fragment and the rest brownish. The shells probably represent brackish-water forms. The grains are somewhat better rounded than in the last three samples. (No. 75) . . . . .

1332-1354

Similar to the preceding. Many green rhyolite and pink chert grains. Some of the green grains are evidently altered igneous rock fragments. Chara rare and small. Many thin marcasite plates. No shell fragments noted. (No. 76) . . . . .

1354-1376

Similar to the preceding except that a few pieces of lignite are present. Quartz is somewhat more abundant and chalcedony less so. Rounded grains more prominent, possibly 10% subrounded or rounded. Most of rounded grains are yellowish quartz. (No. 77) . . . . .

1376-1398



Similar to last sample. Sand somewhat better sorted, none over 1 mm and 1 to 1/2 mm separate is larger than 1/2 to 1/4 mm.  
(No. 78) . . . . .

1398-1420

Similar to preceding sample. Chara is the sharp-ribbed ovate form. (No. 79) . . . . .

1420-1444

Core sample. Pale grayish-magenta fine-textured but somewhat porous, altered volcanic ash or tuff. If fairly tough and hard, probably due to silica infiltration. This sample resembles very closely No. 71, from 1283-1255 except in color. Cream-colored altered glass probably forms 75% of this sample. (No. 80) . .

1444-1446

NOTE: This sample resembles the Gueydan tuff from McMullen County. (T. L. B. 10/12/23)

A powdery medium-grained pale yellowish-gray tuffaceous sand. This sample seems to be volcanic ash like the last sample mixed with a large amount of water-worn or wind-worn sand grains. Sand about 40% of the sample, rest bentonitic clay mostly. The washed material or sand is very well sorted, the sorting and composition being approximately 4 to 2 mm, trace; 2 to 1 mm, none; 1 to 1/2 mm, 10%; 1/2 to 1/4 mm, 30%; 1/4 to 1/8 mm, 40%; below 1/8 mm, 20%. About 15% of the total grains over 1/8 mm are beautifully rounded. These rounded grains are mostly quartz but some gray chert is rounded. The mineral composition is approximately: (1) quartz--30%, (2) chert--20%, (3) feldspar--8%, mostly glassy sanidine that resembles gypsum under binocular microscope; plagioclase and microcline frequent, (4) pyrite--18%, (5) anhydrite--10%, (6) calcite, mostly concretionary--8%, (7) volcanic glass--2%, (8) chalcedony--2%, (9) apatite, zircon and magnetite--trace, (10) biotite--trace, (11) rhyolite, fragments--trace, (12) chlorite--trace, (13) marcasite plates--2%. One perfect secondary quartz crystal noted. Fossils: One small Chara seed about 1/4 mm in diameter seen. (No. 81) . . . . .

1446-1449

A pinkish sandy calcareous clay. The washed material resembles fairly well that from the last sample except that there was only about 5% of rounded grains in the present sample. Also many flat fragments of black shale or slate with rounded edges were present, most of the fragments above 1 mm consisting of this black shale. No grains over 2 mm were seen and no large volcanic rock fragments present. Chalcedony (concretionary) much more abundant, about 10%. Fossils: A few Chara stems, but no seeds noted. Otherwise like the preceding sample. This sample is really more like No. 78. (No. 82) . . . . .

1469-1489

Similar to the preceding sample except that green chert (probably altered and silicified volcanic rock) grains are abundant. A considerable number of pink, orange, and yellow translucent chert grains noted. (No. 83) . . . . .

1489-1512

Similar to the preceding except that not over 2% of the grains are rounded. (No. 84) . . . . .

1512-1535

Similar to the preceding sample. One Chara seed seen, smooth ovate form. (No. 85) . . . . .

1535-1540



Similar to the preceding sample. Little volcanic glass present. <u>Chara</u> seeds also rare. (No. 86) . . . . .	1540-1558
Similar to the preceding sample. Two <u>Chara</u> seeds were seen. (No. 87) . . . . .	1558-1581
No change. Many green grains of rhyolite still present. (No. 88)	1581-1590
Similar to the preceding except that a few glauconite and siderite grains were noted here and no <u>Chara</u> seeds were seen. (No. 89)	1590-1612
Core sample. Brownish-red or deep magenta (often called chocolate) stiff calcareous sticky clay containing recognizable pyrite cubes and compound concretions of chalcedony, anhydrite, and calcite. Contains about 5% concretions and crystals of secondary minerals and much less than 1% of true sand grains. The washed material contains about 90% secondary minerals of which about 50% consist of mixed concretions of chalcedony, anhydrite, and calcite and 50% of pyrite cubes. The true sand grains are mostly subangular but about 5% are subrounded. About 80% of the true sand is under 1/4 mm in diameter. The mineral composition is approximately: (1) quartz--30%, (2) feldspar--20%, (3) chert--25% (in part altered and silicified andesite or rhyolite), (4) anhydrite--20%, (5) pyrite--5%, (6) calcite--5%, (7) zircon--trace, (8) magnetite--trace, (9) apatite--trace. Fossils--none. (No. 90) . . . . .	1612-1614
A pinkish-gray calcareous sandy clay. Like 1590-1612. A few volcanic glass fragments seen. (No. 91) . . . . .	1633-1656
Greenish and pinkish-gray calcareous sandy clay. Washed material similar to the preceding sample except that one <u>Chara</u> seed fragment was noted. (No. 92) . . . . .	1656-1679
Chunk off bit. Magenta and greenish-gray calcareous sandy clay mixed with abundant concretions mostly over 2 mm in diameter. Concretions are almost as abundant in this sample as clay. About 90% of the washed material consists of concretions of inter-grown chalcedony, calcite, and anhydrite, concretions composed only of chalcedony or calcite, and pyrite concretions and cubes. Two subangular fragments of or pale brownish limestone and an angular fragment of weathered rhyolite porphyry all over 2 mm were noted. A few grayish sandstone fragments and a subrounded brown chert fragment were noted in the coarse washed material. Practically all the grains were over 1 mm and are concretionary. The grains under 1 mm resemble in mineral composition the washed material in the preceding sample except that more yellow and pink chert and yellow-stained quartz grains are present. No fossils noted. (No. 93) . . . . .	1686

NOTE: Still Frío.

Like 1656-1679 except that less pyrite is present. A few <u>Chara</u> fragments noted. (No. 94) . . . . .	1689-1711
Like the preceding except that there are fewer pink and yellow chert grains and green altered andesite or rhyolite fragments are not so abundant. A few <u>Chara</u> seeds and stems present. (No. 95) . . . . .	1711-1723

Core sample consisting of a large chunk of greenish-gray medium-grained sandstone 3 inches long, and several smaller chunks also. Several smaller rounded pieces of brownish-red or deep magenta sandy clay; a few rounded pieces of pale yellowish-white bentonite; abundant irregular concretions of intergrown chalcedony, and anhydrite, and calcite and concretions and crystals of pyrite. Over 90% of the washed material is over 2 mm in diameter and some of the concretions reach 2 cm in diameter. About 25% of the washed material over 1 mm consists of sandstone fragments. A few subangular quartz grains between 1 and 2 mm were noted, but all the other non-secondary sand grains were below 1 mm. The composition of the washed material over 1 mm in diameter is approximately: (1) concretions composed of intergrown chalcedony, anhydrite, and calcite--60%, (2) pyrite cubes and concretions--10%, (3) gray sandstone--25%, (4) magenta-colored hard sandy clay--5%. The sorting of the washed material under 1 mm in diameter is: 1 to 1/2 mm, 30%; 1/2 to 1/4 mm, 25%; 1/4 to 1/8 mm, 30%; below 1/8 mm, 15%. This finer washed material has a pale brownish-gray color. The mineral composition of the washed material under 1 mm is as follows: (1) calcite--20%, pinkish granular and colorless crystalline calcite from the sandstone cement, and calcareous concretions, (2) quartz--25%, (3) feldspar--15%, over half more or less altered orthoclase, rest plagioclase, (4) chert--9%, mostly pinkish and yellowish, (5) altered andesite or rhyolite--3%, greenish siliceous grains, (6) chalcedony--10%, mostly in long bluish white angular splinters, (7) anhydrite--3%, colorless rectangular or platy grains, (8) marcasite and pyrite--15%, (9) magnetite--trace, (10) apatite--trace, (11) zircon--trace. Many horizontally striated rectangular--prismatic crystals of brassy marcasite capped by two prominent curved dome faces are noted, mostly between 1/2 and 2 mm in length. These are very different from the platy marcasite crystals noted in the Frio, higher up in the well. Fossils: One somewhat eroded pale yellow Chara seed 3/4 mm noted. This seed has sharp low ribs and broad interspaces and four of the ribs form a slightly raised spiral band thus giving the seed a peculiar lobed appearance. A partially silicified cylindrical plant stem, possibly a large Chara stem, was also noted. This stem fragment was 1 cm long and 2 to 1/3 mm in diameter. It had rather prominent longitudinal ribbing. A transverse thin section of this stem showed it to be composed of regular roundish-hexagonal cells and evidently belongs to some low order of plant life. The cells are elongated rectangles in the longitudinal section, but some show in cross section here, probably where a branch came out from the main stem. (No. 97)

1733

NOTE: The core sample from 1733 is considerably unlike the preceding samples and is thought to represent the Fayette sandstone. The top of the Fayette may be a little above this depth, but the chunk off the bit from 1686 was almost certainly Frio, so the top of the Fayette (Jackson Eocent) is between 1686 and 1733 feet. The cutting samples are generally mixed with material from higher up in the hole so they are rather unsatisfactory. However, the cuttings above 1733 feet look more like the previous (Frio) cuttings so the top of the Fayette is placed at 1733 feet. The Chara seed found in the core from 1733 feet also seems to be a different species from any of the Chara above this depth.

Similar to last sample except no fragments of sandstone and argillaceous sandstone over 1 cm in diameter were noted, there were no Chara seeds noted, and more pyrite and no marcasite were present. Most of the quartz and feldspar grains subangular and stained yellow with limonite. (No. 98) . . . . .

1733-1735

Consists of lumps of pale yellowish, laminated, argillaceous sandstone, medium-grained greenish-gray sandstone, sea-green slickensided clay, numerous concretions, and a few chert pebbles. The washed material above 1 mm consists mainly of concretions of chalcedony, anhydrite, and pyrite and cubes of pyrites, platy crystals of marcasite often grown together, beautifully rounded and polished chert and chalcedony pebbles, medium-grained gray sandstone fragments, and many rounded lumps of purplish pink, hard sandy clay and green clay. The chert pebbles comprise about 5% of the washed material and are mainly between 2 and 4 mm in diameter. Not over 2% of the washed material is under 1/2 mm and not over half of this finer material consists of original sand grains, most of the other half being pyrite and marcasite. The original sand grains consist of quartz, chert, and feldspar mainly, and a little biotite and magnetite are also present. Fossils: Two well-preserved Chara seeds, one 1 to 1/2 mm in length and the other of smaller size, were noted. They were rounded oval in outline and the larger one possessed 12 beautifully smoothed, low, rounded spiral ribs with sharp narrow interspaces. It is probably the same species as the rounded-ribbed form found higher up in the well. (No. 99). . . . .

1737-1745

From bit. A hard soapy calcareous clay of a beautiful sea-green color and containing frequent small white spots which are seen to be ostracods and foraminifera when examined under the microscope. This clay slakes rather slowly. It is extremely fine-grained and contains frequent small concretions. However, a number of large concretions were mixed with this bit sample though they do not seem to have been included in the green clay. The concretions washed out of the green clay are mostly less than 1 mm in diameter and none are over 2 mm. They consist of calcite, anhydrite, chalcedony, and pyrite, either intergrown or in separate concretions. The total washed material forms only about 2% of the sample and concretionary minerals form about 35% of this. The most of the original sand grains are under 1/2 mm and the largest separate is 1/4 to 1/8 mm. The mineral composition of the washed material, excluding fossils, is: (1) calcite concretions, often containing pyrite,--25%, (2) pyrite--15%, (3) chert--20%, (4) quartz--20%, (5) feldspar--10%, orthoclase and plagioclase, (6) anhydrite--3%, (7) chalcedony--5%, (8) biotite--2%, (9) glauconite--trace, (10) magnetite--trace. Most of the grains are subangular, but 10% are rounded or subrounded. Fossils: 30% of washed material. Ostracods--25% of organisms. Foraminifera (Polystomella)--75%, Chara fruit--trace. The ostracods reach 2 mm in length by 1 mm wide and are smooth with flattened valves. They are bean-shaped shells. There are possibly 2 species of Polystomella present, one a thin closely coiled nautiloid form with a lobate outline and a very prominent outside or end chamber. This is close to P. striatopunctata. The other form is thicker, has a smooth outline, has more chambers, and not such a prominent end chamber. These Polystomella are very largely between 1/4 and 1/8 mm in diameter though a few reach 1/2 mm. The well-preserved forms show depressed punctate suture lines. Many do not show those pores in the suture lines, probably due to poor preservation. One Chara fruit was noted. It was a small ovate form with broad low rounded ribs. It may have come from higher up in the hole. (No. 100). . . . .

1745

Similar to No. 99 except that this sample contains more pyrite and marcasite. A few roundish concretions of columnar marcasite were 3 mm in diameter. Practically all the grains in the washed material under 1/8 mm consist of pyrite and marcasite. Only a trace of primary sand grains in the washed material. (No. 101). . . . . 1747-1752

Similar to the preceding sample except that more quartz, feldspar, and anhydrite grains below 1/4 mm are found and only a few Polystomella and ostracods, similar to forms noted at 1745 feet, occur. Also considerably more sandstone fragments up to 4 mm in diameter are present. (No. 102). . . . . 1752-1765

Core sample. A rather dark pinkish-purple calcareous clay irregularly splotted with a minor amount of pale sea-green. The washed material consists of sand and calcareous concretions under 1/2 mm in diameter and Foraminifera and ostracods. The composition of the washed material is similar to 1745 feet except that fewer concretions are present here and the washed material forms probably less than 1% of the total clay. Fossils: ostracods and Polystomella similar to those at 1745 feet. (No. 103). . . . . 1765-1766

Purplish-pink clay, gray sandstone, concretions, and sand similar in appearance and mineral composition to 1752-1765 feet. This sample, however, contains numerous fossils. These fossils are (1) Chara fruit, (2) ostracods, (3) Polystomella. The Chara and ostracods are practically all between 1 and 1/2 mm in smallest diameter and the ostracods reach 2 mm in length. The Polystomella are between 1/4 and 1/8 mm in diameter. The Chara are all broad ribbed forms with nine spirals. They are rounded-ovate in outline and have sharp narrow interspaces between ribs. They are pale yellow to dark brown in color. The ostracods are similar to those from 1745 feet but in this sample most of them are stained pinkish or purplish. The Foraminifera are all one species of Polystomella, the rather thin lobate form described under 1745. There are ten chambers in the outside whorl and the junction lines of the chambers are sharp grooves, not raised. These Polystomella are also all stained pinkish or purplish. (No. 104). . . . . 1766-1777

Similar to preceding sample. Contains numerous Polystomella and a few ostracods. (No. 105). . . . . 1777-1797

Cuttings composed of lumps of green clay, pinkish argillaceous sandstone or sandy clay, and many concretions of marcasite, anhydrite, calcite, and chalcedony. A few round pyrite concretions 4 mm in diameter are noted. Many of the concretions are composed of two or more of the above minerals intergrown. Also several fragments of fine-grained siliceous and calcareous sandstone occur. Pyrite cubes and marcasite prisms up to 4 mm in diameter form probably 25% of the total washed material. The marcasite crystals are grown together into the typical coxcomb structure. Contains a very few Polystomella but no Chara, otherwise like No. 99. (No. 106). . . . . 1797-1820

Cuttings of sea-green and magenta stiff calcareous clay which slakes rather easily. Somewhat similar to last sample. The washed material does not contain nearly so many concretions as in the preceding sample. The sorting of the washed material is: 4 to 2 mm, 40%; 2 to 1 mm, 25%; 1 to 1/2 mm, 20%; 1/2 to 1/4 mm, 5%; 1/4 to 1/8 mm, 10%; below 1/8, trace. The composition of the washed material above 1/2 mm is as follows: (1) strongly calcareous more or less sandy fragments of hard magenta clay which practically grades into argillaceous and arenaceous calcareous concretions--45%, (2) calcareous concretions, pink to whitish--20%, (3) greenish-gray medium-grained poorly sorted sandstone with subangular grains--12%, (4) pale yellow angular almost transparent chalcedony concretions--12%, (5) pale greenish to whitish hard calcareous clay lumps--10%, (6) pinkish bean-shaped ostracods--trace, (7) Chara fruit--trace, (8) pyrite--trace. The composition of the washed material below 1/2 mm is estimated: (1) quartz, colorless to yellowish--45%, (2) chert, pinkish, yellowish and grey--10%, (3) feldspar, mostly orthoclase--15%, (4) anhydrite--5%, (5) pyrite, cubes--trace, (6) marcasite columnar--trace, (7) partly altered obsidian--trace, (8) calcite, concretionary--20%, (9) bluish green to grayish green grains, probably altered rhyolite--2%, (10) chalcedony--trace, (11) fossils--3%. Fossils foraminifera, Polystomella, 90% of fossils, Globigerina, trace; ostracods, 4% of fossils; Chara seeds, 1% of fossils. Practically all the forams are between 1/4 and 1/8 mm in diameter. Only one small fragmental Globigerina was seen. The sand grains are mainly subangular, but practically all show worn edges. Probably 5% of the grains are subrounded. (No. 107). . . . . 1820-1825

Core sample. A very hard deep purplish-red shaly calcareous clay containing practically no sand and only a trace of small calcareous concretions. One yellowish quartz grain about 1/2 mm in diameter was noted. There are irregular small green splotches in the clay and portions of it are harder due to concentration of calcareous matter. Under the petrographic microscope, this clay is seen to consist mainly of roundish or rhombohedral grains of calcite from one to 10 microns in diameter surrounded by a colloidal mass of reddish argillaceous material which it cements together. The clay breaks up into tiny rounded grains 1 to 20 microns in diameter when put on a slide with water. These present a rather characteristic appearance not like water mounts of most clays and the material resembles a mass of rounded silt grains. No fossils were noted. (No. 108). . . . . 1828-1830

Similar to No. 107 except more pyrite and anhydrite concretions are present in the washed material. Also two well-preserved Chara seeds were noted. One was 1 mm long and had low rounded rather narrow ribs and broader flat interspaces. Also several ostracods and Polystomella present. (No. 109). . . . . 1830-1838

Similar to preceding. Contains a few Chara, Polystomella, and ostracods. (No. 110). . . . . 1842-1845

Very similar in composition and appearance to No. 99. Somewhat less pyrite present. A few rounded chert pebbles occur. Fossils: Two Chara seeds, one with low rounded ribs and narrow interspaces and the other with low narrow sharper ribs with wide flat interspaces. Both ovate in outline. No forams or ostracods noted. (No. 111). . . 1845-1864

Similar to the preceding except much more pyrite and marcasite and no Chara or other fossils were noted. (No. 112). . . . . 1864-1887



Similar to the preceding except pyrite and columnar marcasite are still more abundant, forming probably 20% of the total sample. No fossils noted. Orange chabazite rare. (No. 113) . . . . . 1887-1910

NOTE: No orange chabazite was noted above 1887, but it is present in the majority of the samples below this.

Similar to No. 109. Contains the same fossils. Polystomella quite common in 1/4 to 1/8 mm separate and a few above 1/4 mm. No chabazite noted. (No. 114) . . . . . 1910-1933

Cuttings of purplish and greenish calcareous clay and small lumps of pale gray sandstone similar to the preceding sample. Orange chabazite is rare. The washed material is also similar except that it contains no Chara and only a few ostracods and Polystomella. (No. 115) 1933-1956

Similar to the preceding except that two small Chara fruits and a few stems were also noted. Very few ostracods and Polystomella present. Orange chabazite rather rare. (No. 116) . . . . . 1956-1975

Similar to the preceding except that there are not so many coarse concretions, few being over 2 mm. Marcasite is probably the commonest secondary or concretionary mineral. Several glauconite and orange chabazite grains noted. No ostracods noted, but a few Chara with broad rounded ribs and a few Polystomella are present. (No. 117) 1995-1997

Similar to the preceding. Orange chabazite present but rare. Small Chara and Polystomella frequent. (No. 118) . . . . . 1997-2018

Similar to the preceding. Orange chabazite frequent. Forams and Chara still present. (No. 119) . . . . . 2018-2041

Like the preceding. (No. 120) . . . . . 2041-2056

Fine cuttings of green and pink calcareous clay mixed with considerable sand. In the washed material no grains over 2 mm occur while the largest separates are 1 to 1/2 mm and 1/2 to 1/4 mm. These are of about the same size followed by 1/4 to 1/8 mm. Very little washed material is noted that is not between 1 and 1/8 mm. The mineral composition of the total sand is similar to that of the sand below 1/2 mm in No. 107 except that pyrite forms about 20% in the present sample and chalcedony, colorless crystalline calcite, glauconite, green altered rhyolite? grains, and glass fragments are more common. Magnetite is also frequent. Orange chabazite forms 2% of the washed material. Fossils: A few Chara seeds and stems, ostracods, and Polystomellas present, probably less than 1% altogether. (No. 121) . . . . . 2056-2061

NOTE: The sample from 2056-2061 is the first sample noted in which orange chabazite was common.

Core sample. A dark purplish-red to brownish-magenta clay containing a few small irregular splotches of pale green. This is very similar to No. 108. The only difference between this and No. 108 is that there are a number of quartz, felspar, and chert grains present and several white, rounded calcareous concretions occur. However, much less than 1% of the sample remains after washing out the clay. Three orange chabazite grains were noted. No fossils noted. (No. 122) . . . 2061-2062



NOTE: The samples between 1733 and 2062 are apparently largely marine and probably belong to the Fayette formation of Jackson Eocene age.

Cuttings composed of hard gray fine-grained limestone, glassy, generally rounded small quartz pebbles, fragments of green and magenta clay, and some coarse, medium, and fine sand. The washed material forms about half of the sample. The sorting is approximately: 4 to 2 mm, 25%; 2 to 1 mm, 30%; 1 to 1/2 mm, 35%; 1/2 to 1/4 mm, 5%; 1/4 to 1/8 mm, 5%; below 1/4 mm, trace. About a fourth of the quartz grains up to 3 mm are subrounded or rounded. The composition of the total washed material is estimated: (1) quartz--29%, (2) gray limestone--30%, (3) pink calcareous concretions--20%, (4) felspar--7%, (5) anhydrite--3%, (6) chalcedony--2%, (7) pyrite and marcasite--2%, (8) chert--5%, (9) glauconite--trace, (10) magnetite--trace, (11) orange chabazite--1%, (12) organic fragments--trace. Fossils: (1) Bryozoa--columnar branching forms about 1 mm in diameter. Much of the limestone is composed of these Bryozoa or at least contains many fragments of them. (2) Chara (fruit and stems)--rare, (3) pelecypod fragments (thin white shells)--frequent, (4) gastropod casts, two fragments of gastropods 1 mm in diameter (probably Turritella).

(No. 123). . . . .

2071-2084

NOTE: The limestone fragments so abundant in this sample are all angular and fresh. They are fragments of Pennsylvania limestone pebbles encountered. A Nodosaria-like foram and some sponge spicules also noted in the limestone. This sample is apparently still Fayette.

Cuttings of pale green purplish-red shaly calcareous clay. This clay is very hard and almost lithified. The sorting of the washed material is similar to the preceding sample. However, no gray limestone fragments were noted in this sample and no fossils were seen except two rounded-ribbed Chara fruit. No large rounded quartz grains were noted here either. Chabazite grains frequent. (No. 124)

2094-2116

Similar in general to the preceding except no fossils of any kind were noted. Orange chabazite constitutes about 2% of the washed material. (No. 125) . . . . .

2116-2138

Thin platy cuttings of pale grayish-green and purplish-pink calcareous clay shale or very hard shaly clay. Very little washed material is present and none is over 1 mm in diameter. This washed material consists largely of white and pinkish calcareous concretions and yellow-stained to transparent quartz grains. Minor amounts of gray limestone, pink and gray chert, felspar, chalcedony, marcasite, pyrite, and magnetite occur. A few small orange chabazite grains also noted. Fossils: Several white, thin pelecypod or gastropod shell fragments and a few marcasitized or pyritized Chara stems? occur. Also a few calcareous Chara stems seen. (No. 126) . . . . .

2138-2161

Similar to the preceding except that no shell fragments were noted while several rather thick whitish ostracods between 1/2 and 1/8 mm. in diameter and shaped like a black-eyed pea were noted. These are probably of a different species from the ostracods noted from 2061 and above. A few orange chabazite grains present. (No. 127). .

2161-2185

Similar to the preceding except that more ostracods of the same type and several Polystomella occur. Also black shale fragments comprise about 20% of the washed material. Orange chabazite grains frequent. (No. 128) . . . . .

2185-2202

Core sample. Light greenish-gray silty to fine sandy marl. The washed material comprises probably 10% of the sample. About 90% of the washed material above 1/2 mm is composed of pale gray calcareous concretions. There are a few quartz grains 1/2<sup>mm</sup> in diameter. The sorting of the washed material is estimated: 2 to 1 mm, 5%; 1 to 1/2 mm, 15%; 1/2 to 1/4 mm, 15%; 1/4 to 1/8 mm, 30%; below 1/8 mm, 35%. The mineral composition of the total washed material is estimated: (1) quartz--20%, (2) calcareous concretions--25%, (3) plagioclase feldspar--20%, mostly fresh and glassy and resembling quartz or anhydrite under binocular microscope, (4) orthoclase--15%, some fresh and glassy and some slightly altered, (5) microcline feldspar--trace, (6) gray to black chert--15%, (7) anhydrite--1%, (8) chalcedony--1%, (9) marcasite concretions--2%, (10) apatite--trace, (11) altered greenish rhyolite--trace, (12) pyrite cubes--1%, (13) magnetite--trace, (14) glauconite--trace. The grains are largely subangular, often rectangular. Fossils: Three tiny forams were noted. One was apparently an Orbulina and the others probably portions of Globigerina. The Orbulina may possibly have been a Globigerina chamber also. (No. 129) 2202-2203

NOTE: The high percentage of fresh feldspar is noteworthy in the above sample.

Hard greenish-gray and purplish-pink marly clay shale cuttings. This is similar to No. 127. Very little washed material is present. A few ostracods and Polystomella noted. (No. 130) . . . . .

2203-2208

Similar to the preceding sample, except that many bright orange chabazite grains and many grayish-green chert or altered volcanic rock grains are present. Fossils like the preceding sample. (No. 131) 2208-2226

Like the preceding sample. (No. 132). . . . . 2226-2249

Like the preceding. Fossils rare. (No. 133). . . . . 2249-2265

A purplish and pale greenish-gray marly shale, similar to preceding sample. Very little washed material, probably not over 2%. The washed material is like the preceding sample except that fossils are quite numerous. Ostracods and Polystomella probably comprise 10% of the washed material under 1/2 mm. Chabazite still frequent. (No. 134). . . . .

2284-2295

No change. (No. 135) . . . . . 2314-2320

No change except a little more fine sand is present and more quartz and less chert is contained in the sand. (No. 136). . . . .

2314-2320

Core sample of typical Fayette sandstone. A pale gray medium-grained, rather friable sandstone cemented with calcite. Contains practically no clay or silt (less than 1% probably). Calcite cement forms about 20% of the rock. The sorting is rather perfect as follows: 1 to 1/2 mm, trace; 1/2 to 1/4 mm, 65%; 1/4 to 1/8, 35%; below 1/8 mm, trace. The shape of the sand grains is estimated as follows: (1) subrounded--30%, (2) subangular--60%, (3) rounded--5%, (4) angular--10%. This estimation is based on sand from which the calcareous cement has been removed. The mineral composition of this sand (cement removed), is as follows: (1) quartz--30%, (2) orthoclase--25%, (3) plagioclase (albite to Andesine)--20% (fresh), (4) chert (gray, black, greenish and yellowish)--20%, (5) chalcedony--2%, (6) greenish altered volcanic rock fragments--3%, (7) glauconite--1%, (8) magnetite--rare. No fossils present. (No. 137) . . . . .

2320-2321

NOTE: The high percentage of feldspar in the above sample is noteworthy. The plagioclase was mostly fresh and glassy, while about half of the orthoclase was fresh and the rest partly altered. Part of the orthoclase is the sanidine variety common in eruptive rocks and shows that at least part if not much of the feldspar in this sandstone was derived from volcanic rather than plutonic rocks. No microcline was noted. This is possibly a way of distinguishing Fayette from Oakville sandstone, for microcline is often abundant in the Oakville.

Sample is composed of about 80% of greenish and purplish-gray hard clay or shale and 20% of gray sandstone fragments. The sandstone fragments are similar to the preceding sample. The clay is similar to No. 134. Some of the small lime concretions are almost perfectly spherical. The washed material contains numerous ostracods from 1/4 to 1 mm in diameter and a number of Polystomella. A small eroded Chara seed, somewhat flattened by compression was noted also. No orange chabazite is present. (No. 138) . . . . .

2321-2336

Similar to the preceding except fewer sandstone fragments are present and a great many very dense-grained grayish-white calcareous concretions from 1/4 to 5 mm in diameter occur. These concretions make up about 15% of the sample and are of a very different type from the calcareous concretions above 2000 feet. Similar concretions of a smaller size have been noted in other samples below 2000 feet, especially below 2150 feet. The crystals in these concretions are not over 1 mm in diameter and do not show crystal form. These concretions often show a brecciated structure. Some of these concretions may have been fairly large originally and caused some difficulty in drilling because the driller labelled this sample "Nest of Concretions." Ostracods and Polystomella are present, no chabazite. (No. 139) . . . . .

2336-2339

- Core sample. A strongly calcareous grayish-white sandy tuff or tuffaceous sand and a few lumps of hard grayish-green clay. The sample on being washed showed that a residue of 20% of the total sample was sand. The other 80% was bentonitic clay and powdery calcite. The sand washed out of this sample is very similar in sorting, rounding, and mineral composition to No. 137 except that more of the chert is tinted yellow, pinkish, and pale greenish. Plagioclase felspar is not so abundant, probably only 10%. The total felspar still surpasses the quartz in abundance apparently. No fossils were seen. The volcanic material must have been very fine and practically all has altered. Some of the green grains are probably altered rhyolite or andesite. (No. 140) . . . . . 2339-2340
- A hard purplish and grayish-green calcareous clay and a small amount of bentonitic sand. This is similar to 2336-2339 feet, except that a few grains of orange chabazite are present. Several flat fragments of lithified shaly limestone composed largely of ostracods were noted in the washed material. Ostracods and Polystomella fairly common. Also a few round concretions of marcasite were noted. (No. 141). . . . . 2341-2354
- Like No. 139, except very few sandstone fragments are present and orange chabazite is more common. (No. 142). . . . . 2354-2368
- Core sample. A hard soapy greenish calcareous clay similar to No. 100, except that the present clay is not such a vivid green. Ostracods can be noted in the clay with a hard lense. Very little washed material, and much of this consists of small calcareous concretions. The washed material is rather similar to the washed material in the preceding sample, except that the present sample contains more gray and greenish chert and probably less felspar. The grains are mostly subangular. A number of rather poorly preserved ostracods were noted. Polystomella was not seen and is probably rare if present. No chabazite was noted. (No. 143) . . . . . 2368-2369
- A grayish-green and pinkish calcareous clay mixed with about 15% of powdery and sandy tuffaceous material. The washed material is similar to that of the last sample, except that more sand is present. Several sandstone lumps and pyrite and marcasite concretions present. Also a few orange-colored glassy grains of chabazite. A few ostracods noted. (No. 144). . . . . 2369-2377
- Similar to the preceding, except that more orange-colored chabazite grains are present from 1/16 to 1/2 mm in diameter. These have an index of refraction of 1.485, are apparently biaxial, and have a very low birefringence. This mineral occurs in glassy irregular aggregates of tiny cubic crystals and fuses with intumescence of heating. It forms about 1% of the sample. Ostracods and Polystomella frequent. (No. 145). . . . . 2377-2381

NOTE: The sample from 2377-2381 feet marks the reappearance of chabazite in abundance after being almost absent for 82 feet.

Similar to the preceding. Not quite so many chabazite grains.  
Ostracods and Polystomella frequent. (No. 146) . . . . .

2384-2394

Similar to the preceding except that two pearly fragments of oyster shells 5 x 3 x 1 mm were noted. Considerable orange chabazite is present and one piece showing a mass of minute cube-shaped crystals was also noted. A few ostracods and Polystomella are present.  
(No. 147) . . . . .

2394-2422

Angular flattened cuttings of hard purplish, greenish-gray, and creamy shaly calcareous partly bentonitic clay containing a few calcareous concretions. This sample is similar to No. 146.  
(No. 148) . . . . .

2422-2445

NOTE: Practically all the greenish and purplish-pink shaly caly noted from 1765-2422 feet slakes rather easily in water and seems to contain a considerable amount of bentonite.

Similar to No. 147, except that very little greenish clay is present and more cream-colored bentonite occurs. Many fragments of dark flinty gray shale or slate were noted in the washed material. Also several fragments of gray sandstone and only a few calcareous concretions occur. The washed material has a dark gray color due to the abundance of the dark shale. Otherwise similar to the washed material of the preceding sample. A few ostracods and Polystomella were seen. (No. 149) . . . . .

2445-2468

Similar in appearance to the preceding sample, except that more green clay and less creamy bentonite is present. The washed material is similar to No. 147. Chabazite is quite frequent. Polystomella and ostracods noted. (No. 150). . . . .

2468-2481

NOTE: The sample from 2468-2481 feet seems to represent the base of the Fayette which gives to this formation a thickness of 748 feet. Some of the cuttings below 2481 feet look like Fayette still but the sample off the bit at 2481 feet is very different from Fayette both in mineral composition and fossils. This sample from 2481 feet is practically identical to most of the samples from 2580-3000 feet.

Cuttings composed of fragments of hard greenish and purplish-pink calcareous clay apparently fallen in from the Fayette, and a number of chunks of dark gray (apparently Yegua) calcareous clay. The washed material is similar to the preceding except that more quartz and gray chert and less felspar is present. Several ostracods, a few Polystomella, and also a few small Textularia and Cristellaria? were noted. The cuttings of the two formations have evidently been mixed. (No. 152) . . . . .

2495-2520

Core sample. Half of this sample consists of medium-grained gray, soft bentonitic silty sandstone and the other half is a dark gray very fine-grained slag. This slag evidently represents a slightly sandy clay or shale that has been fused by the heat generated in drilling. The sandstone resembles the Fayette sandstone from 2320 feet in general appearance. The sorting and rounding of the sand also resembles No. 137. However, there is about 5% of clay in this sample. The mineral composition is also very similar to No. 137, feldspar being even more abundant. Fossils: Small Globigerina and Textularia are also fairly frequent in this sandstone. There were no fossils noted in No. 137. (No. 153) . . . . .

2550-2551

NOTE: This is thought to be still Yegua in spite of its general resemblance to No. 137. Its forams are like those of the Yegua rather than the Fayette.

Similar to No. 148. Ostracods and a few Polystomella and Textularia present. (No. 154) . . . . .

2551-2558

Similar to the preceding sample, except more greenish clay and less pinkish clay is present. Also a few fragments of a very thin-shelled gastropod were noted but the fossil was not identifiable. The washed material resembles No. 148 in mineral composition. A few ostracods and Polystomella are also present. In addition one well-preserved Pulvinulina between 1/2 and 1 mm in diameter was noted. It resembles in general Pulvinulina schreibersu. The dorsal surface is resette-like in arrangement of chambers. (No. 155) . . . . .

2558-2568

Core sample. A core consisting of hard strongly calcareous, pale gray, medium-grained sandstone. All of the cement is calcareous. This sandstone does not appear laminated but breaks up into platy pieces with a smooth fracture. It is much better cemented than any other sandstone from this well and is fairly well sorted also. Also many cuttings of purplish-pink and greenish clay said to come from below the sandstone are included in the sample. Many orange chabazite grains probably from the clay were noted in the washed material. A thin section made of the sandstone showed this rock to be composed of generally subangular sand grains between 0.54 and 0.05 mm in diameter imbedded in a large amount of very pale gray to colorless transparent crystalline calcareous cement. The calcite cement makes up about 35% of the total rock. Probably 70%, by volume, of the grains are between 1/4 and 1/8 mm; 25% between 1/2 and 1/4 mm; 5% between 1/8 and 1/16 mm. There are very few grains below 1/16 mm and a few above 1/2 mm. Probably 90% of the grains are subangular while 3% are subrounded and 7% angular. The composition of the sandstone is estimated: (1) calcite (cement)--35%, (2) quartz--23%, (3) plagioclase--12%, (4) orthoclase--13%, (5) chert--5%, (6) andesite (altered)--5%, (7) rhyolite (altered)--2%, (8) magnetite--1%, (9) glauconite--1%, (10) biotite--trace, (11) chlorite--trace (outside of andesite and rhyolite), (12) apatite--trace, (13) zircon--trace, (14) hemanite (stain in chert, quartz, etc.)--trace, (15) limonite--2% (stain in many grains), (16) kaolin and sericite (alteration products of feldspar)--trace, (17) hornblend--trace, and (18) Foraminifera--1%. About half of the orthoclase altered, appears brownish or grayish, and is practically opaque under petrographic microscope. The remaining orthoclase and practically all the plagioclase is fresh and glassy. It is apparent from this thin section that a considerable proportion of the so-called chert in specimens



of this sandstone is really somewhat silicified, altered andesite and rhyolite. Under cross nicols numerous tiny lath-shaped felspar crystals in a dark chlorite groundmass are seen. These are plagioclase and show widely divergent orientation in the andesite (or diabase) and a rough parallelism in the rhyolite. These volcanic rock grains generally appear brownish in transmitted light and grayish or greenish in transmitted light. Fossils: The Foraminifera seen were mainly small. They belong to the genera Globigerina, Textularia, Nodosaria?, and Anomalina. One well-preserved diatom inside of a gray chert grain was also noted and is of course secondary. (No. 157) . . . . . 2579-2580

A pale gray fairly hard calcareous clay and a smaller amount of purplish clay. The gray clay contains a small amount of lignitic material. Very little washed material is present and this is mainly fine sand except for frequent white fine-grained calcareous concretions. The composition of the washed material resembles No. 152. No orange-colored chabazite was seen. Ostracods, Anomalina, Textularia, and Polystomella are present. (No. 157). . . . . 2580-2591

Similar to the preceding sample, except less purplish-pink clay is present. Very few ostracods and Polystomella noted and a Truncatulina like that in No. 155 was also noted. A very few orange chabazite grains were noted. (No. 158) . . . . . 2591-2607

Chunk off bit. A laminated gray calcareous clay resembling almost exactly No. 150. There is only a trace of washed material. The washed material resembles No. 150 also except for the Foraminifera. No chabazite seen. In the present sample Polystomella or Nonionina was the only foram noted while in No. 150 no Polystomella, but several other genera were noted. (No. 159) . . . . . 2607-2611

Cuttings similar to the preceding sample except that a few chunks of purplish shaly clay are also present. The washed material contains more and larger calcareous concretions and several small sandstone fragments. Orange chabazite is also frequent. A few small Polystomella?, Cristellaria, Globigerina, and ostracods noted. The Cristellaria is scaphitiform and similar but probably not identical to Cristellaria italica. (No. 160). . . . . 2611-2624

Similar to the preceding. Considerable marcasite present in small concretions. A few Polystomella and frequent ostracods 1/4 to 1/2 mm in diameter were noted. Several flat rounded plates of marcasite? having a cross-like indentation in the center were observed. One Textularia sagittula, one Textularia (Gaudryina) pupoides, and a Globigerina, 1/2 to 1/8 mm in diameter, were also seen. (No. 161) 2624-2640

Similar to the preceding. Fossils: Ostracods are frequent, one Pulvinulina schreibersu (same as in No. 155) seen, a few Polystomella cf. striatopunctata, one Globigerina, and one Anomalina ammonoides were noted. (No. 162). . . . . 2640-2645

Core sample. A rather soft and porous pale gray sandy calcareous tuff. Considerable bentonite present. About 20% of the sample is left as washed material when the clay has been washed out. The sizing of the washed material is 4 to 2 mm, 5%; 2 to 1 mm, 1%; 1 to 1/2 mm, 25%; 1/2 to 1/4, 23%; 1/4 to 1/8 mm, 35%; below 1/8 mm, 2%. Practically no sand grains over 1/4 mm occur. All the washed material above 1/4 mm consists of partly silicified shell fragments (or partly calcified leaf impressions), calcareous concretions, and marcasite concretions. The composition of the sand under 1/4 mm is estimated: (1) orthoclase--35%, (2) plagioclase--10%, (3) quartz--30% (4) chert, mostly gray, often opaque--20%, (5) magnetite--1%, (6) glauconite--1%, (7) pyrite and marcasite (oolitic)--3%, (8) apatite--trace, (9) orange chabazite--trace, (10) forams--trace. Probably most of the so-called chert grains are altered volcanic rocks. Fossils: Only one tiny Textularia (Gaudryina) pupoides? was noted. The grains of sand are mostly angular or subangular. (No. 163) . . . . .

2645-2646

Similar in general to No. 162 (calcareous clay). A very few shell fragments are present. Many grains of orange chabazite were noted in the present sample. Also more forams of several genera were seen. Fossils: Foraminifera were the only fossils seen except for a few gastropod or pelecypod shell fragments. One Pulvinulina schreiberi, one Cristellaria rotulata? (1 mm in diameter), several small Polystomella, and a Globigerina were the Foraminifera noted. (No. 164) . . . . .

2646-2669

Similar to the preceding except more purplish clay is present. Also a few flat pieces of pale green serpentine and a few plates of biotite were noted. The washed material is also similar except that two creamy pelecypod shell fragments 3 mm in length and 1 mm thick were noted. Also a Textularia, with its chambers filled with granular pyrite, 1 mm in diameter, was noted. A few Pulvinulina, Globigerina, and Polystomella, and two ostracods noted. (No. 165)

2669-2692

Similar to the preceding except only a very few Polystomella and ostracods were the only small fossils noted. Also no large shell fragments and no serpentine grains were noted. Many marcasite concretions present and a small amount of orange-colored chabazite occurs. (No. 166). . . . .

2692-2715

Sample consists of pale to dark shaly, gray, calcareous clay, purplish-pink, shaly calcareous clay and pale grayish-white, sandy, bentonitic clay. The sandy bentonitic clay is similar to No. 163. The washed material has the following composition: (1) chabazite--3%, (2) serpentine--trace, (3) orthoclase--30%, (4) plagioclase--20%, (5) quartz--20%, (6) Chert--5%, (7) altered volcanic rock fragments (often greenish in color)--15%, (8) marcasite (oolitic)--2%, (9) biotite--trace, (10) magnetite--trace, (11) calcite--5%. Fossils: (12) ostracods--trace, (13) Polystomella--trace, and (14) Globigerina--trace. Possibly 2% (quartz and chert) are subrounded. The sorting is like No. 147 approximately. (No. 167) . . . . .

2715-2730

Platy cuttings of slightly sandy medium gray calcareous shaly clay. The washed material is similar to the preceding sample except that chabazite is not so common and the fossil content noted was somewhat different. 2% of creamy aragonite in prismatic grains also occurs. Fossils: A few ostracods occur. The Foraminifera include (1) Polystomella cf. Striatopunctata, frequent; (2) Pulvinulina schreibersu, rare; (3) Cristellaria cf. rotulate, rare; and (4) Globigerina sp., frequent. (No. 168) . . . . .

2730-2739

Piece off bit. Pale gray, strongly calcareous, slightly sandy, shaly clay. Washed material is similar to the preceding sample. About 10% sand present. (No. 169). . . . .

2739

Similar to the preceding sample, except more ostracods are present. These are elongated and thick at right angles to the valves. These have been noted in many of the preceding samples. Biotite fairly common. (No. 170). . . . .

2740-2755

Similar to the preceding sample, except that biotite is more abundant, chabazite is rather rare, and the Foraminifera were a little different. In the present sample Textularia (Gaudyina) pupoides?, Globigerina, and Polystomella cf. striatopunctata were the Foraminifera noted. Ostracods were frequent also. (No. 171). . . . .

2755-2778

Similar to the preceding except that Pulvinulina and Cristellaria are also present. Chabazite frequent and mostly flesh pink. (No. 172) 2778-2796

Similar to the preceding except that about 25% of the clay is purplish in color. The same fossils as in the preceding noted. Ostracods common. (No. 173). . . . .

2796-2819

Similar to the preceding sample. Many sandstone fragments among the coarse washed material. The chabazite is mostly flesh pink instead of orange. The only foraminifera noted was Polystomella. Ostracods common. (No. 174). . . . .

2819-2835

Piece off bit. A hard, medium gray, laminated, calcareous shaly clay. This clay contains about 5% of washed material which is mostly fine sand. The sorting is approximately as follows: 4 to 2 mm, 1%; 2 to 1 mm, 1%; 1 to 1/2 mm, 8%; 1/2 to 1/4 mm, 10%; 1/4 to 1/8 mm, 50%; below 1/8 mm, 30%. All the washed material above 1 mm except a few forams consists of concretions of marcasite and calcite and lumps of lime-cemented sandstone. The mineral composition of the total sand is approximately: (1) chert, mostly gray (including also grayish fine-grained volcanic rock fragments)--25%, (2) orthoclase--20%, (3) plagioclase--10%, (4) quartz--20%, (5) calcite--20%, (6) chalcedony--1%, (7) obsidian (partly altered but plainly glass)--trace, (8) chlorite--trace, (9) biotite--trace, (10) chabazite--trace, (11) marcasite (oolitic)--1%, (12) magnetite--trace, (13) apatite--trace, (14) glauconite--trace, (15) anhydrite--trace, (16) foraminifera--3%, (17) ostracods--trace. Several round oolitic concretions of marcasite noted. Fossils: Foraminifera of several genera are abundant and vary in size from 2 mm to 1/8 mm.

The forms noted are: (1) Cristellaria cultrata?, (2) Nonionina scapha, (3) Textularia gramen, (4) Textularia pseudocarinata, (5) Textularia conica?, (6) Textularia (Gaudryina) cf. flintii, (7) Clayulina? angularis, (8) Pulvinulina schreibersu, (9) Pulvinulina pauperata, (10) Pulvinulina exigua, (11) Anomalina ammonoides, (12) Potymorphina sp., (13) Polystomella? striato punctata?, (14) Cristellaria cf. rotulata, (15) Ammobaculites cylindricus?. Many forams are filled with marcasite or pyrite. Pulvinulina, Textularia, and Anomalina are the commonest genera. A few smooth ostracods which are broader, especially at one end, than the ostracods previously seen, noted. (No. 175) . . . . .

2835

Similar to the preceding sample except that not so many Foraminifera are present. Anomalina ammonoides, Pulvinulina schreibersu, Textularia gramen, and Polystomella striatopunctata were fairly common. One Cristellaria cf. italica was also noted. (No. 176) . . . . .

2835-2853

Core sample. A medium bluish-gray somewhat sandy and silty calcareous shaly clay. There is no washed material above 1 mm and only 1 grain above 1/2 mm. Washed material comprises about 10% of the sample. The sorting and mineral composition of the washed material resembles No. 175. The only fossils noted were a few Pulvinulina schreibersu, Lagena sp.?, Textularia, and ostracods. (No. 177) . . . . .

2859-2860

Similar to preceding except no Lagena seen, and a number of concretions up to 2mm present. However, a few Polystomella are present. (No. 178) . . . . .

2860-2874

Like the preceding sample. Orange chabazite still frequent. The forams noted were: Pulvinulina, Cristellaria, Textularia, Anomalina, and Polystomella. Ostracods of the elongated type are common. A few beautifully oolitic marcasite concretions are present. (No. 179) . . . . .

2874-2882

Similar to No. 175 except more chabazite and fewer forams present. Pulvinulina, Anomalina, and Textularia are the commonest forams. Also a small Natica 2 mm in diameter was noted. (No. 180). . .

2882-2908

Like the preceding. Anomalina, Truncatulina, Textularia, and ostracods are the commonest fossils. A part of a tiny Natica and a small echinoid spine. (No. 181). . . . .

2908-2932

Similar to the preceding sample. Chabazite rather rare. Sandstone grains frequent still. Fossils about like the last sample. No oolitic marcasite concretions noted. (No. 182). . . . .

2932-2945

Similar to the preceding except more pyrite is present and forams are not so common. Anomalina, Cristellaria, and Pulvinulina were the forams noted. Ostracods of elongated type are common. (No. 183)

2953-2975

Very similar to No. 175, both in mineral and organic content. Cristellaria cf. rotulata, Textularia pseudocarinata, Pulvinulina schreibersu, and ostracods are the commonest fossils. Also a few oyster shell fragments. (No. 184). . . . .

2975-2998

Core sample. A pale gray platy-bedded calcareous, argillaceous and silty, calcareous, very fine-grained sandstone containing numerous lignitic streaks, a few grass or rush leaf impressions and a pale yellow-brown radially and concentrically ribbed fish scale that resembles slightly a Pecten. Also a few thin pelecypod shells are present. The sample consists of approximately: Clay--35%, silt--30%, fine sand--35%. Lime content estimated at 25%. The sorting of the washed material is as follows: 1 to 1/2 mm, trace; 1/2 to 1/4 mm, 1%; 1/4 to 1/8 mm, 29%; 1/8 to 1/20 mm, 70%. The grains are mainly angular. No well-rounded grains noted. The mineral composition of this sand is approximately like that of No. 175, except that marcasite, pyrite, and biotite are more abundant. Biotite constitutes about 1% of the sand and pyrite and marcasite together about 5%. Plagioclase constitutes about 15% and orthoclase 20% of sand. The microscopic fossils seen were a few ostracods and many Foraminifera. Most of the Foraminifera were below 1/4 mm in diameter. The foraminifers seen are: Textularia gramen, Textularia pseudocarinata, Textularia (Gaudryina) pupoides?, Anomalina ammonoides, Pulvinulina schreibersu, and Globigerina sp.? (No. 185). . . . . 2998-2999

NOTE: The bottom of the well is considered to be in the Yegua clays.

#### Summary of Formations

		<u>Thickness</u>
Lower Lagarto	200-2307	30
Oakville	2307-863	633
Frio	863-1733	870
Fayette	1733-2481	748
Yegua	2481-3000	519