THE

FIRST AND SECOND

ANNUAL REPORTS

OF THE

GEOLOGICAL SURVEY

OF

MISSOURI,

BY

G. C. SWALLOW,

STATE GEOLOGIST.

BY ORDER OF THE LEGISLATURE:

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1855.

PART II.

A

PRELIMINARY REPORT

ON SOME OF THE

PRINCIPAL MINES

IN

FRANKLIN, JEFFERSON, WASHINGTON, ST. FRANCOIS AND MADISON COUNTIES, MISSOURI,

BY

A. LITTON, M. D.,

CHEMIST.

DR. B. F. SHUMARD'S REPORT.

St. Louis, *November*, 1855.

Prof. G. C. Swallow,

State Geologist.

Dear Sir: As Assistant Geologist, in the Survey under your direction, I herewith submit my report on the several districts entrusted to me for examination, comprising a description of a geological section on the Mississippi, from St. Louis to Commerce, and the results of my detailed surveys in Franklin and St. Louis counties, with maps and sections illustrating the same.

Agreeable to your instructions, I have prepared, and, also, submit, descriptions of some of the new organic remains discovered in the strata of our State; and a catalogue embracing nearly all the species that have been collected during the progress of the Survey, up to the present time, in which the fauna, occurring in each group of strata of your general vertical section, are arranged in separate lists.

It gives me pleasure to acknowledge here the assistance I have received, at different times, from my associates in the Survey, while engaged in the prosecution of the duties assigned to me. To Dr. A. Litton I am under obligations for valuable aid in the preliminary examinations of St. Louis and Franklin counties. In the palæontology, I am indebted to Mr. F. B. Meek for important suggestions, and for the beautiful and accurate delineations of the fossils described in my report. To Mr. R. B. Price for drawings of the maps, and for reducing and copying sections, which he has executed with neatness and accuracy.

I am, also, under obligations to Messrs. JOHN BRUERE and MONTROSE PALLEN, who accompanied me in the explorations on the Mississippi, and, without charge to the State, proved valuable assistants. To Mr. FORD, Engineer on the Pacific Railroad, for the use of maps, profiles, etc.; and to J. F. EVANS, Esq., Dr. LEWIS, Gen. JEFFRIES, and various other persons, residing in the districts examined, for aid and information.

With an earnest desire that the results of my labors may meet your approbation, and with grateful acknowledgments for your uniform courtesy and friendly assistance,

I remain,

Very truly, yours,

B. F. SHUMARD,

Palaeontologist and Assistant Geologist.

DESCRIPTION

OF A

GEOLOGICAL SECTION, ON THE MISSISSIPPI RIVER,

FROM ST. LOUIS TO COMMERCE.

In descending the Mississippi from St. Louis, the first rock exposure, immediately adjacent to the river, occurs a short distance above the United States Arsenal. At this place the St. Louis Limestone has been quarried extensively for curb-stones, window-sills, and the foundations of buildings. The rocks have been laid bare to the height of thirty feet, and consist of light and dark gray compact limestone, in strata, from a few inches to a foot and a half in thickness, with thin seams of chert interstratified. Some of the layers would burn into a good lime, but others contain too much silicious matter for this purpose. The characteristic fossils are—*Lithostrotian Canadense*, *Syringopora*, *Echinocidaris*, *Terebratula Roisyii*, *Terebratula*, *Spirifer*, and teeth and scales of fishes. These strata are overlaid by the Quaternary deposits, which extend to the level of the Carondelet road; its elevation being about ninety feet above the Mississippi.

Lower down the river, at LaBeaume's quarries, we find, reposing on the above-mentioned rocks, from eighteen to twenty feet of heavy-bedded gray limestone, rather softer and more argillaceous than the rocks of the preceding locality. The layers are from one to four feet thick, separated by thin partings of argillaceous shale. They break with an even, granular fracture, and are quarried quite easily. A stratum, about three feet thick, of a mottled gray color, and more crystalline than the others, is here burned for lime.*

From this place the hills gradually increase in elevation as we descend the river, and, in a little less than a mile, rise to the height of one hundred and forty feet. In this distance the St. Louis Limestone is constantly exposed, forming, at several points, perpendicu-

* An analysis of a pure variety of this rock, by Dr. Litton, yielded as follows:

Insol. residue,	0.50
Carbonate of lime,	99.40
Alumina,	A trace.
	99.90

lar walls, sixty feet high. About a mile and a half below the Arsenal, the following section of the strata is presented, which will convey a good general idea of the lithological features of the St. Louis Limestone. Commencing ten feet above the water level, and proceeding in the ascending series, there is —

1. — Bluish gray, rather coarse textured, sub-crystalline limestone, in thin strata, filled with *Fenestella*, *Productus cora*, *Spirifer*, *Echinocrinus*, *Palæchinus*, and fish remains, 13 ft.
2. — Light gray and bluish gray silico-calcareous rock, containing nodules and thin seams of chert, ... 5 ft.
3. — Buff and bluish gray, hard, silicious limestone, of a finely-granular texture, ... 6 ft.
4. — Same as the preceding, with a good deal of chert disseminated, ... 8 ft.
5. — Compact, light gray silicious limestone, in thick beds, breaking with an even fracture, ... 7 ft.
6. — Light drab, compact, brittle limestone, with a smooth, angular fracture (an excellent lime-rock), . . . 3 ft.
7. — Gray, mottled limestone, of a fine granular texture, with nodules and seams of chert, ... 44 ft.
8. — Bluish gray, sub-crystalline limestone, containing cavities of brown calcareous spar; some layers beautifully ripple-marked, ... 10 ft.
9. — Light drab, compact lithographic limestone, with a smooth, splintery fracture, containing Echinocidaris, Terebratula, and small columns of *Crinoidea*, ... 2 ft.
10. — Earthy, decomposing, ferruginous limestone, . . . 1 ft.
11. — Gray, close-textured limestone, containing same fossils as No. 9, ... 4½ ft.
12. — Earthy, decomposing, ferruginous limestone, . . . 9 in.
13. — Light drab and variegated, brittle, lithographic limestone, 1 ft. 8 "
14. — Light drab, fine-textured, lithographic limestone, with a smooth, splintery fracture, traversed by fine spar veins, and delicately clouded with flesh-color and reddish brown, ... 4 ft. 9 "
15. — Strata like No. 9, ... 7 ft.

The strata included in No. 8 of this section are burned for lime, and make an article of excellent quality.

No. 14 appears to be a local bed. It is a remarkably fine variety of limestone, being nearly a pure carbonate. Some layers are, also, susceptible of a fine polish, the fine spar veins and delicate flesh-colored cloudings forming, with the light drab ground, a pleasing combination. I was not able, however, to satisfy myself whether slabs of a workable size could be got out, free from impurities and cracks.*

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* The analysis of this rock, by Dr. Litton, resulted as follows: —

Insol. residue,	1.12
Alumina,	A Trace.
Carbonate of lime,	97.99
Water,	0.21
	99.32

A few hundred yards lower down the river, these rocks are overlaid with thick-bedded, finely-granular gray limestone, containing *Lithostrotian* and *Productus*, and these again are surmounted by thin strata of even-bedded, compact, sub-crystalline limestone, with *Palachinus multipora*, *Echinnocidaris*, *Poteriocrinus longidactylus*, *Spirigera Roisyii*, *Productus cora*, *Spirifer*, and *Fenestella*.

Several of these fossils are quite characteristic of the superior division of the *St. Louis Limestone*.

Continuing our section down the Mississippi, no marked change in the character of the rocks is observed before reaching Carondelet. The bluffs prevail along the river the whole distance, with an elevation of from 120 to 150 feet. The St. Louis Limestone is constantly exposed in nearly horizontal strata, the lower members projecting at intervals from the inferior slopes of the hills, while the superior beds appear in perpendicular walls near their summits.

At the quarry above Carondelet, a rapid inclination of the strata occurs, in a direction a little south of west; and the St. Louis Limestone dips beneath the water level of the Mississippi.

About two hundred and fifty yards below this place, is an exposure of nine feet of hard silicious limestone, in thin strata, with thin bands of fine-grained sandstone, interstratified, dipping at an angle of about eight degrees west south-west; and, near the center of the town, at an elevation of thirty-seven feet above the river, we find heavy-bedded, fine-grained micaceous sandstone, of white and ferruginous-brown colors, overlaid by dark and ash-gray, sandy, micaceous shale. These strata are much discolored with dark carbonaceous matter, which predominates in the shale. The latter, also, contains concretions, frequently of a branching form, probably the remains of coal-plants, although I was unable to detect any traces of organic structure in any of the specimens examined.

It is evident that we have here an outlier of the Missouri coal-field, occupying a narrow depression in the St. Louis Limestone, and constituting, I believe, the only example where strata belonging to the Coal Measures reach the west side of the Mississippi, south of St. Louis.

Towards the lower end of Carondelet I noticed some interesting sections, through the Quaternary deposits, which can be seen here to good advantage.

Just below the town, on the river, the upper part of the St. Louis Limestone, with its characteristic fossils, is quarried extensively, to be conveyed to St. Louis for harbor purposes. The strata

are about sixty feet high, and dip to the north-east, at an angle of twenty degress. Some of the layers are quite cherty, but most of them would make a pure white lime.

Between this point and the mouth of Meramec river, no change occurs in the character of the geological formations; the St. Louis Limestone continues to be seen, at intervals, the whole distance, forming bluffs sometimes of 175 feet high, and appearing often, near their summits, in perpendicular escarpments, from sixty to eighty feet high.

Just above the Meramec, I observed a fine locality for fossil corals, chiefly *Lithostrotian, Canadense and Syringopora*, the former occurring in lenticular masses, some of them nearly five feet in diameter.

Below the Meramec, the hills recede from the Mississippi, and a bottom land sets in, which continues for two and a half miles, forming a bank from ten to twenty feet high. In Jefferson county, within half a mile of Rock Creek, we find for the first time, below the mouth of Missouri river, the Encrinital Limestone, Chemung and Trenton Groups. The hills are about 170 feet high, and exhibit the following section in the ascending order: —

1. — Perpendicular wall of heavy-bedded, yellowish and reddish subcrystalline limestone, traversed from base to summit by deep vertical fissures, and some of the layers containing cavities from one to five inches in diameter, frequently communicating with each other. The most common fossils of the mass are *Chaetetes lycoperdon, Leptena fillitexta, Leptena sericea, Orthis testudinaria*, and *Receptaculites*, ... thickness, 50 ft.
2. — Slope, covered by soil and debris, ... " 15 ft.
3. — Reddish argillaceous limestone of a granular texture, with thin marly partings, containing *Cyathoxonia cynodon*, an *Orthis* nearly allied to *O. Michelini*, *Productus Murchisonianus*, *Platycrinus*, and *Poteriocrinus*, ... " 15 ft.
4. — Slope with layers as above, projecting from the surface " 30 ft.
5. — Encrinital Limestone, with chert bands interstratified, and filled with crinoids and other characteristic fossils of this group, ... " 60 ft.

The lower beds of this section (No. 1) are Lower Silurian, and, probably, represent the "lead-bearing" or Galena Limestone of Iowa, Wisconsin and Illinois (Upper Magnesian Limestone, in part, of Dr. Owen), although the mass in the two districts differs essentially in lithological appearance, and in Missouri, so far as I know, it contains no productive deposits of lead.

The occurrence of the same species of *Receptaculites* in our strata, *R. sulcata* (*Coscinopora Sulcata, Owen*), leaves but little doubt with regard to the true parallelism, as this fossil in the north-west is never found below the galeniferous beds.

Nevertheless, while there is a marked lithological difference in Iowa and Wisconsin, as well as in Missouri, between the rocks of recognized Trenton age and the so-called Galena Limestone, we have, as yet, but little palæontological evidence for separating them into distinct groups. In fact, by far the greatest proportion of species found in the lead-bearing rocks of the north-west, are Trenton forms. Mr. Whitney states that, of forty-five species collected by Mr. A. Lapham and himself from the lead-bearing beds of Wisconsin, thirty-two were of Trenton age. (Metallic Wealth U. S., page 410.) And Prof. Hall mentions that he has found in the Galena Limestone, besides Receptaculites, the head of an *Illaenus*, *Leptena* not unlike *L. alternata*, *Orthis* (*Spirifer*) *lynx* and *Atrypa increvescens*. The three last-mentioned species are common to the Trenton Limestone and the Hudson river group, while the genus Receptaculites in New York, occurs in the Trenton Limestone, although Mr. Hall thinks the eastern species distinct from ours. For these reasons I have thought it best, for the present, to include our Receptaculite beds in the Trenton Limestone.

The slope, which is marked No. 2 in the above section, is, doubtless, occupied partly by sandstone, and partly by beds like No. 3; the former being exposed in this position a short distance lower down the river.

The fossils contained in the reddish, argillaceous limestone (Nos. 3 and 4), are a mixture of Chemung and Carboniferous forms. Some are identical with species which I have found in the argillaceous layers, interstratified with the fine-grained sandstone of the knobs of Kentucky, hitherto regarded as forming the base of the Carboniferous System in that State; others are species which, everywhere in Missouri, characterize the Chemung rocks. The last-mentioned group is here by no means so thick, or so highly fossiliferous as you found it in Cooper and the adjoining counties, on the Missouri river.

Continuing our way down the Mississippi, just below Rock Creek we find the Trenton Limestone forming low ledges on the river shore, from ten to twenty feet high. The lower strata are quite cherty, and contain but few fossils; the upper layers are filled with *Chaetetes lycoperdon*, *Leptena fillitexta*, and *Leptena sericea*, and other well-known species of the group.

Below this exposure, the bank of the river is twenty feet high, and composed of ash-colored loam, with terrestrial shells embedded.

The hills, removed a short distance from the river, are a hundred feet high, and exhibit, near their summits, perpendicular walls of Encrinital Limestone.

At the Sulphur Spring, just above Grand Glaize Creek, the following section occurs, counting from below, upwards: —

1.— Crystalline Trenton Limestone, with Receptaculites, forty-five feet.
2.— White and brown sandstone, made up of moderately fine quartz grains, loosely cemented, seven feet.
3.— Yellow, compact limestone (Chemung Group), eight feet.
4.— Red argillaceous and compact limestone (Chemung), twenty-five feet.
5.— Encrinital Limestone, highly fossiliferous, forty-five feet.

It will be perceived that, in this section, the Trenton rocks are separated from the Chemung and Carboniferous by only seven feet of sandstone; while the Hudson River Group, Upper Silurian and Devonian Systems, which are well represented in other parts of the State, are entirely wanting.

The water of the Sulphur Springs, at this place, contains a notable quantity of saline ingredients, and is strongly impregnated with sulphuretted hydrogen. In the bottom of the spring, a white deposit of sulphur is found. The water issues from beneath the sandstone, and its mineral properties are, probably, derived from the decomposition of pyrites in the reddish argillaceous limestone.

Between Grand Glaize and Rattlesnake Creeks, the formations of the above section continue the whole way, the Trenton Limestone forming perpendicular escarpments, from the water-level to the height of from sixty to eighty feet. The hills vary from 100 to 170 feet in height.

Just below Rattlesnake Creek, the Trenton Limestone, overlaid by sandstone, the Chemung and Encrinital Limestone, is exposed to the height of seventy-three feet, indicating a rise in the strata of twenty-eight feet in about a mile. It consists of heavy-bedded, white, crystalline limestone, with soft, chalky-looking, calcareous matter, and containing numerous cavities, lined with this substance, disseminated.

A stratum, near the top of it, furnishes the columns for the Court House, at St. Louis. This layer is six and a half feet thick, and is quarried quite easily. Beneath it, we find an apparently solid bed of nearly similar rock, twenty feet thick. The whole of the Trenton Limestone, at this place, would burn into a pure white lime. I found in these beds the following characteristic fossils: — *Chaetetes lycoperdon, Leptaena deltoidea, L. sericea, L. fillitexta, Atrypa capax, Lichas Trentonensis* and *Receptaculites.*

From this place, a rapid rise in the strata takes place, and the Chemung Group and Encrinital Limestone disappear from the tops of the hills. About a mile below Rattlesnake Creek, the lower Trenton beds emerge from beneath the crystalline portion above described; and in less than a mile further, we find them occupying the summits of the hills, which are elevated 150 feet above the bed of the Mississippi. This part of the Trenton Limestone is, in lithological appearance, quite different from the upper portion. It consists of bluish gray, or dove-colored, compact brittle limestone, breaking with a smooth conchoidal fracture. The beds vary in thickness from a few inches to several feet, the uppermost layers being the thinnest. The prevailing fossils are *Orthis tricenaria, O. subaequata, Leptaena deltoidea L. fillitexta, Murchisonia gracilis, Pleu-*

rotomaria subconica, Chaetetes lycoperdon and the columns of a small species of Crinoid.

Two miles below Rattlesnake Creek, we find these strata passing downwards, into beds containing *Gonioceras anceps*, and an *Ormoceras*, closely allied, if not identical with *O. tenuifilum* (Hall) species, which, in New York, are confined to the Black River Limestone. It is, therefore, certain that this group is represented in our State, although there is not, at least at the locality of which we are speaking, any difference in lithological characters between the beds containing Black River species and those with Trenton forms.

Beneath these beds, and just above the edge of the river, the strata assume a cellular character, and some layers are traversed in all directions by cylindrical cavities, varying from a fourth to half of an inch in diameter; many of them are filled with soft, yellow, argillaceous matter, while others are merely lined with this substance. These cavities, it is quite probable, were once filled with a fossil plant, very similar to *Phytopsis tubulosum* (Hall), from the Birds-Eye Limestone of New York; the substance of the fossil having been obliterated, its form is left in the more durable matrix. From the stratigraphical position of these perforated beds, I feel much inclined to the opinion that they will be found to represent the Birds-Eye Limestone of New York and Kentucky.

In the next two miles, there is no change in the formations; the Trenton and Black River Limestone continuing the whole distance, forming bold perpendicular escarpments, facing the river. At the "Old Shot Tower," just above Herculaneum, the bluffs are 170 feet high. The lower twenty feet consists of cellular limestone in thin layers, above which rises a perpendicular wall of heavy-bedded limestone, to the height of one hundred and ten feet. I found here, in addition to most of the species above enumerated, an *Illaenus*, very nearly allied to *I. crassicauda*, and an undescribed *Cythere*.

Below Herculaneum, the same rocks continue to escarp the river for upwards of a mile, and then the 1st Magnesian Limestone and Saccharoidal Sandstone of your general section appear at the base of the bluffs. These strata are best exposed at Plattin Rock, where we find, at the river margin, about fifteen feet of heavy-bedded Saccharoidal Sandstone, colored with oxide of iron. On this reposes 130 feet of buff magnesian limestone, in moderately thick beds, with thin partings of bluish argillaceous shale, passing upwards into thin-bedded magnesian limestone, with crystalline facets of calc-spar disseminated. Then succeeds the Black River and Trenton

Limestones: the latter extending to the summits of the hills. This section indicates a rise in the strata of about one hundred and fifty feet in the distance of a mile.

Below Plattin Rock the hills recede from the river, and do not approach it again for a mile and a half. At two miles from Plattin Rock their altitude is 368 feet, ascertained by barometrical measurements.

At this place, the section in the ascending order is: —

1. — Heavy-bedded, white Saccharoidal Sandstone, . . . 15 ft.
2. — Thick beds of buff magnesian limestone, and thin partings of blue and green argillaceous marl, passing upward into lighter-colored magnesian limestone, in beds from an inch to a foot thick, containing crystalline particles of calc spar disseminated (1st Magnesian Limestone), ... 152 ft.
3. — Perpendicular bluff of compact, heavy-bedded, brittle limestone, containing Black River and Trenton fossils, . . 141 ft.
4. — Slope covered with soil and vegetation, ... 60 ft.

From this point to Selma, the general elevation of the hills does not vary much from 300 feet. A talus, covered with soil and masses of limestone, usually commences at the water margin, and extends to a height of from 100 to 150 feet; from which arises precipitous cliffs of rock, frequently cleft from base to summit by deep fissures.

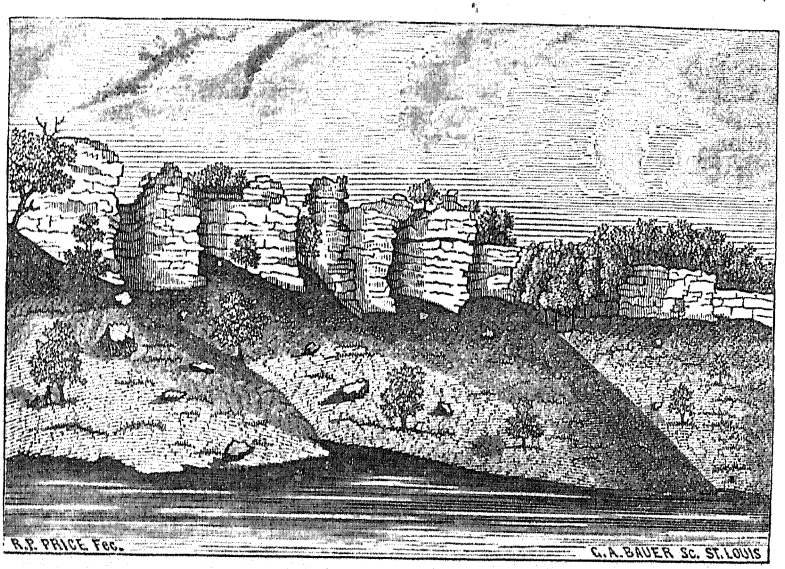
At the upper end of Selma is an interesting section of the Silurian rocks, nearly all the beds being visible from the 1st Magnesian Limestone to the upper crystalline strata of the Trenton Limestone, inclusive. The elevation of this bluff is 413 feet, determined by several observations with the barometer.

The base consists of seventy feet of alternations of buff magnesian limestone, and compact, brittle, smooth-textured gray limestone, in layers from an inch to two feet thick. Then succeeds the limestones of Black River and Trenton age, presenting a thickness of more than 300 feet, the upper third being white crystalline limestone.

Selma has been for many years a prominent shipping point for lead, obtained chiefly from the mines of Washington county. Through the politeness of Mr. Foster, I was furnished with statistics of the amounts of lead received here during a period of twenty-eight years. These will be found in the Report of Dr. Litton.

Leaving Selma, we find a continuous line of bluffs extending to Rush Tower, the distance being about four miles. This portion of the river is remarkable for its picturesque scenery, which reminds one forcibly of the Mississippi above Prairie du Chien. The Silu-

rian strata are constantly exposed in bold, perpendicular cliffs, towards the tops of the hills, while, below, are wooded slopes, covered with huge blocks of limestone, reaching to the margin of the water. In some instances the strata have been weathered in such a manner as to leave standing, isolated, tower-like masses, from twenty to thirty feet high, as represented in the cut.



BLUFFS ON THE MISSISSIPPI RIVER, BETWEEN SELMA AND RUSH TOWER.

Rush Tower is another shipping point for lead, most of which is brought from Perry's Mines, in St. François county.

At Rush Tower the bluffs again leave the Mississippi, and an alluvial bottom sets in and continues six miles, with a width of from one to three miles.

In this distance a considerable depression of the strata occurs, in a direction contrary to that observed at Selma. The Silurian rocks, which, between the latter place and Rush Tower, exhibit a thickness of from three to four hundred feet, here appear only as a low ledge, scarcely ten feet high, while the Carboniferous strata constitute the chief mass of the hills.

About four miles above Salt Point I found the elevation of the hills to be 274 feet, and obtained the following section, given in the ascending order: —

1. — Trenton Limestone, in thin layers, containing *Illaenus crassicauda*, *Receptaculites*, *etc.*, ... 10 ft.
2. — Dark bluish gray, argillaceous shale, containing a small species of *Lingula*, ... 30 ft.

3. — Reddish and yellowish argillaceous and sub-crystalline limestone, of Chemung Group, ... 34 ft.
4. — Encrinital Limestone, with *Pentremites Sayi*, *Productus punctatus*, and *Spirifer striatus*, ... 200 ft.

The dark argillaceous shale of this section is exposed in a ravine, a couple of hundred yards distant from the river, where it is seen immediately beneath the Chemung rocks and above the Trenton Limestone, which occurs in a low ledge, scarcely elevated above the water margin. This shale appears to replace the sandstone, which, at Sulphur Springs and below the mouth of Rattlesnake Creek, divides the Silurian rocks from the Chemung. It has been here penetrated twenty-five feet in search of coal, at which depth the workmen reached the Trenton Limestone, and further operations were abandoned. This labor and expense might have been saved, had the eye of a Geologist rested on the spot, for he would have seen at once that these strata lie several hundred feet below the coal formation. May not this slate represent the black, bituminons slate of Indiana and Kentucky, which, in those States, forms the line of separation between the Devonian strata and fine-grained micaceous sandstone, with its intercalated fossiliferous shales? It appears to occupy the same stratigraphical position, since we find it here directly under the Chemung rocks, in which we have found a number of fossils, identical with species that occur in the blue argillaceous limestone and marls, which lie a little above the black slate of Kentucky.

Continuing our way down the river, we find the rocks of the above section prevailing, uninterruptedly, to the mouth of Establishment Creek, and the hills varying from 120 to 180 feet in elevation. In the first three-quarters of a mile there is a pretty constant dip to the north-west, the rate being about eighty feet per mile. The dip then changes to a contrary direction, but is so gradual that it is barely perceptible.

On Establishment Creek, a couple of hundred yards above its confluence, dark argillaceous slate is again well exposed, in a ledge three feet high. It is precisely similar to that observed four miles above Salt Point, and contains a small undescribed species of *Lingula*.

The next good exposure occurs two miles and a half below the mouth of Establishment Creek; and here I observed, for the first time since leaving St. Louis, the Archimedes Limestone of your general vertical section, containing the usual fossils of this formation. The hills are 180 feet high, and the rocks project at intervals from various portions of the slopes, with a south-easterly dip. A mile below this place the hills decline in elevation to a hundred feet, and consist of alternations of quartzose sandstone and chert. Lower down, the Archimedes Limestone appears in perpendicular walls, facing the river, presenting a peculiar fluted appearance. A half of a mile still lower, the bluffs are 180 feet high, and the strata consist of sub-crystalline limestone, of a moderately coarse

texture, and light gray and blue colors. Nearly all the beds here would make excellent lime. They, also, afford a good building material, being the same as are quarried on the Pacific Railroad, for the Custom-House at St. Louis. For the whole distance from this place to Ste. Genevieve, the Archimedes Limestone appears in perpendicular cliffs, near the tops of the hills.

Two miles above Ste. Genevieve the strata present a considerable local dip to the north-east; and just above the town they are to be seen in heavy massive beds, with a layer of calcareous oolite interstratified.

After passing Ste. Genevieve, no exposures of rock occur for a distance of nine miles. The river courses through alluvial bottoms, from one to five miles wide, and the banks vary from ten to twenty feet in height.

About one mile above St. Mary's we find, just above the water margin, an exposure of fifteen feet of quartzose sandstone, in thin layers, passing into gritstone and coarse conglomerate. The pebbles in the latter consist of milky and ferruginous quartz, jasper, and dark porphyry, varying from the size of a pea to that of a hen's egg. Above these beds is a slope of twenty-five feet, covered with soil and debris, and then succeeds the Archimedes Limestone, with its usual fossils.

Just above St. Mary's we find, at twenty feet above the Mississippi, alternations of yellow and purple clay, surmounted by compact and very hard Silicious Limestone, and, at a lower level, near the center of the town, the Archimedes Limestone.

At St. Mary's the bluffs again recede from the river on the Missouri shore, and do not approach it again for the distance of twenty-five miles. The banks are from ten to twenty feet high, and, beneath the soil and sub-soil, consist of ash-gray loam and sand, with the common terrestrial and fluriatile shells of this part of the Quaternary Group, embedded.

The point at which the hills reach the river again, is about a half of a mile above Bailey's Landing, in Perry county. Here their elevation is 150 feet, and they consist entirely of sandstone, resembling, very closely, the Saccharoidal Sandstone of the general section. The rock is exposed in massive rugged cliffs, and is composed of moderately fine grains, rather loosely cemented, with a silicious paste. Its color is white and reddish brown. Some portions of the mass crumble readily when exposed to the action of the weather; other beds are not so friable, and have the appearance of a good building rock.

Further down the river, a few hundred yards above Bailey's Landing, occurs a low ledge of thinly-stratified, blue silicious limestone, presenting a banded appearance on the weathered face, and traversed by vertical joints, which separate the layers into flattened quadrangular masses. These are surmounted by thick beds of the same lithological appearance, and the whole exhibits a dip of fifteen degrees north-east.

The mass contains remains of *encrinities*, and a small *Atrypa*, but fossils are scarce and badly preserved.

A quarter of a mile below Bailey's Landing, is a bluff 130 feet high, composed of heavy-bedded, gray magnesian limestone, very compact and fine-textured. Near the top I found a small species of *Atrypa*, an *Orthis*, like *O. subaequata*, and a *Leptaena*, very similar to *L. fillitexta*. I refer these strata, with some doubt, to the Trenton Limestone, as all the fossils I found, after a diligent search, were so badly weathered that their specific characters could not be determined. These bluffs continue along the river a quarter of a mile, presenting an irregular dip. At one point, about midway the exposure, the strata are inclined at an angle of twenty-five degrees to the east.

About a mile below Bailey's Landing, in fractional Sec. 11, Town. 35, R. 12, E., the hills are 130 feet high. On the river shore we find shaly layers of magnesio-calcareous limestone, containing silicious masses and a variety of interesting fossils. The rock is compact-textured, and has, evidently, been derived from fine sedimentary material. On the newly-fractured surfaces, it is of a light gray color, clouded with yellowish gray; but, after being exposed for some time to the air, it assumes a light buff color. The fossils are: *Leptaena depressa Leptaena*, several species; *Orthis*, two species, very similar to *O. hybrida* and *O. elegantula;* an *Atrypa*, allied to *A. camura* (Hall); *Platyostoma*, several species; *Dalmania tridentifera*, and *Phacops*, *Cheirurus* and *Haplocrinus*, of undescribed species.

Some of the fossils here enumerated cannot be distinguished from species which I found, several years since, in the Upper Silurian strata of the glades of Perry county, Tennessee, which, Mr. Meek informs me, have been found by Prof. Hall, in the Delthyris shaly Limestone of New York, and are regarded by him as quite characteristic of that group. And recently, through the kindness of Prof. Hall, I have been permitted to examine a number of the plates of his third volume on the Palæontology of New York; and, if we may be permitted to judge from excellent figures without descriptions, our collection from the locality now under notice contains several other Delthyris Shale species. Regarding, therefore, the parallelism as being pretty well established, I have, in my section, referred these rocks, and some

others, presently to be noticed, to the age of the Delthyris Shale, in preference to giving them a new name.

The most characteristic fossil of the mass is the remarkable *trilobite*, which I have described in the Palæontology, under the name of *Dalmania tridentifera*. (Pl. B., fig. 8, a b.)

Above these fossiliferous layers, and at an elevation of 100 feet above the river, perpendicular ledges, presenting similar lithological characters, project from the slope of the hill to the height of thirty-five feet.

About three hundred yards lower down the river, is a massive cliff of yellowish gray limestone, sixty feet high, containing remains of Encrinites, and presenting on the weathered face no marks of stratification. These, probably, correspond in age to the rocks last described.

From this place the dip of the strata is very rapid, in a direction corresponding to the course of the river. In less than a half of a mile, we find the Archimedes Limestone, with its characteristic fossils, exposed at the margin of the river, while the Silurian strata above described, are far beneath the surface.

A quarter of a mile below this place, the Archimedes Limestone constitutes hills 200 feet high. At the base the strata consist of alternating beds of gray limestone, and bluish and ash-colored marl, abounding in fossils.

The fossils occur most abundantly in the marly layers, where, after heavy rains, they may be procured in great perfection. Above these fossiliferous layers, are massive beds of compact, earthy gray limestone, with thin partings of argillaceous shale interstratified, extending to the summits of the hills.

The Archimedes Limestone now preserves nearly a horizontal position for the distance of two miles, when it begins to dip, and at the same time receives a capping of sandstone, which increases in thickness as we descend the river; and, at three miles below the point where it first appears, occupies nearly the entire mass of hills, two hundred feet high.

The lower part of this sandstone occurs in heavy beds, but the upper strata are often quite schistose. The rock is sometimes very hard, but usually it is so loosely cemented, that a blow with the hammer reduces it to fine sand. The color varies from white to ferruginous brown. At this point there seems to be an abrupt synclinal axis, for, in a few hundred yards, we find the Archimedes Limestone rapidly rising again, and, in a little upwards of a mile,

the line of junction between it and the sandstone, is seen near the tops of the hills.

These rocks now continue, uninterruptedly, to *Brazos Bottom;* and the Archimedes Limestone being frequently exposed, excellent opportunities were afforded for collecting its characteristic fossils. At Wittenburg, the bluffs are 150 feet high; and from the lower two-thirds, ledges of gray limestone, with Productus, Echinocrinus and fish-teeth, occasionally appear. These strata are highly inclined, and resemble the beds observed just above Ste. Genevieve. The upper third of the hills is covered with soil and loose masses of sandstone.

Nearly opposite this place, on the Illinois shore, is the "Devil's Bake-Oven"—an isolated mass of rock, sixty feet high, with a large opening on the southern face.

Opposite "The Oven," on the Missouri shore, the bluffs are 120 feet high, and exhibit, near the base, perpendicular cliffs of thin-bedded calcareo-magnesian limestone, containing a small *Atrypa* and fragments of an Encrinite, which I refer, with some doubt, to the genus *Heterocrinus* of Hall. These rocks bear a very close resemblance to the Delthyris Shale, noticed a mile below Bailey's Landing, and, doubtless, belong to the same geological period.

The Grand Tower rises from the bed of the Mississippi, about a mile and a half below Wittenburg. It is an isolated mass of rock, of a truncated-conical shape, crowned at the top with stunted cedars, and situated about fifty yards from the Missouri shore. It is eighty-five feet high, and four hundred yards in circumference at the base. During high water, the current rushes around its base with great velocity, and the passage on the Missouri side is regarded as being a very dangerous one. The rock of which the tower is composed, is a buff and bluish gray silicious limestone, very compact and thin-bedded, and it dips at an angle of twenty-five degrees to the south-east. I could not discover any fossils here; but, from the lithological character of the mass, I am disposed to place it with the Delthyris Shaly Limestone, and, consequently, beneath the rocks of the Devil's-Oven, which, as I am informed, by Dr. Norwood, State Geologist of Illinois, contain many characteristic species of the Devonian System.

About a half of a mile below the Tower, near the middle of the river, is a huge mass of chert, of a quadrangular shape, which, at an ordinary stage of water, rises several feet above the surface. In the next two miles the Missouri shore is bounded by hills from 75 to 200 feet in altitude.

These hills are mostly covered with soil and vegetation; but not unfrequently at their bases, on the side facing the river, we find exposures of ferruginous and white silicious clay, filled with fragments of chert, derived from the decomposition of Upper Silurian rocks, which, further down the river, are seen to present a marked cherty character. This white clay sometimes gives to the faces of the hills a peculiar chalky appearance; hence, they have received, from travelers, the name of "Chalk Bluffs."

Two miles above Birmingham, in Cape Girardeau county, Delthyris Shaly Limestone again appears, just above the water margin, containing the same fossils that characterize the silico-magnesian limestone, observed a mile below Bailey's Landing. It is constantly exposed for the distance of four miles, appearing in ledges at the base of the hills, from ten to fifty feet high. The strata along the line of this exposure consist of alternations of silicious and earthy gray limestone, and ferruginous chert in moderately thin layers. The limestone frequently contains rounded masses of hornstone, from the size of a hen's egg to that of a bushel-measure. These masses often exhibit a concentric structure, and impart to the weathered surfaces of the strata an exceedingly rough appearance.

Fossils are not abundant, except at Birmingham, where I procured most of the species that were observed at one mile below Bailey's Landing. Three miles and a half below Birmingham, the same rocks appear in a mural escarpment, extending from the water's edge to the height of seventy feet. The lower part of the mass consists of limestone and chert, the latter predominating and occurring in layers, from an inch to a foot thick: the upper layers have the appearance of hydraulic limestone, and contain a beautiful species of *Conularia*.

Below this place, the faces of the cliffs are cut into deep vertical fissures, presenting a rude castellated appearance; and this feature prevails to within a short distance of Neily's Landing, situated in Town. 33 N., R. 14 E., Sec. 33.

Three-quarters of a mile lower down the river, the Delthyris Shaly Limestone is visible to the height of 100 feet above the Mississippi, presenting the same characters as the beds last mentioned. At the upper end of the exposure, is the "Devil's Tea-Table," a curious mass of rock, of an inverted conical form, standing on a rocky base, sixty feet above the river. It is eight feet high, two yards wide at the top, but contracted below to two feet. It is composed of horizontal layers of limestone and chert, and has been formed from the removal by denudation of the regular strata, with which it was once continuous.

The Missouri shore now exhibits a constant succession of high bluffs, with precipitous escarpments, until we reach Bainbridge, the distance being about six miles. Near Vancil's Landing, they attain an altitude of 330 feet, with perpendicular faces to the river of 120 feet. Towards the tops of the cliffs, are bluish and ash-colored, earthy-looking layers, which have the appearance of hydraulic lime-

stone. An analysis of this rock will be found in the report of Dr. Litton. It contains *Phacops*, *Spirifer Orthis* and *Conulana* of undescribed species. The lower part of the mass contains fossil of the Delthyris Shaly Limestone.

After leaving Bainbridge, bottom-land sets in, and no rocks are again seen on the river, for the distance of six or seven miles.

From one and a half to two miles above Cape Girardeau, is an exposure of about forty feet of bluish gray limestone, in layers from two to six inches thick, and traversed by numerous vertical joints. The rock is very compact, and breaks with a smooth, splintery fracture.* The weathered surfaces are frequently covered with a thin film of oxide of iron. In some portions of the mass, fossils occur in great variety and abundance.

They are *Cyphaspis Girardeauensis (new sp.)*, *Acidaspis Halli (new sp.)*, *Proetus depressus (new sp.)*, *Encrinurus deltoideus (new sp.)*, *Cheirurus (undt.)*, *Homocrinus flexuosus (new sp.)*, *Glyptocrinas fimbriatus (new sp.)*, *Tentaculites, incurvus*, *Protaster? (new sp.)*, *Atrypa*, *Leptena*, *Orthis*, *Pleurotomaria* and *Turbo*. In addition to these, I found forms of Crinoids, which will not admit of being placed in any known genera. All the fossils of this locality appear to be distinct from any hitherto described, and they, therefore, constitute an interesting feature in the palæontology of our State.

The trilobites are especially abundant, and usually finely preserved. In a specimen before me, not more than four inches square, I am able to count four species of these Crustaceans, belonging to as many different genera. The Tentaculite, which I have described as *T. incurvus*, is also quite numerous, some slabs being completely covered with them. I have referred these beds to the Upper Silurian system, from their stratigraphical position, and from the occurrence of genera of trilobites, which, according to Barrande, in his valuable work on the Silurian System of Bohemia, are types which exhibit the greatest development of species in the strata of that period.

These rocks we have designated, provisionally, under the name of Cape Girardeau Limestone. They constitute the lowermost beds of Upper Silurian age, yet found in the State.

At Cape Girardeau, the Trenton Limestone is again well exhibited; and here we find the following section from below, upwards: —

1.—Blue schistose limestone, highly fossiliferous. Some of the layers are almost completely made up of *Chaetetes lycoperdon*, *Leptena filitexta* and *Orthis subaequata*, ... 2 ft.

2.—White crystalline limestone, in moderately-heavy beds, with *Illaenus crassicauda*, *Leptaena alternata*, &c., ... 35 ft.

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* The composition of this rock, as ascertained by Dr. Litton, is as follows: —

Insoluble residue,	8.60
Alumina, and peroxide of iron,	1.93
Carbonate of lime,	86.00
Carbonate of magnesia,	3.70
	100.23

3.— White and bluish white, massive-bedded crystalline limestone, of fine texture, containing characteristic Trenton fossils, . 60 ft.
4.— Fine-grained argillaceous sandstone, of a light ferruginous brown color, ... 10 ft.

The strata included in No. 3 of this section constitute the well-known Cape Girardeau marble. The principal quarries are situated about three-quarters of a mile from the river, where the marble has been wrought to the thickness of forty feet. We find here two distinct varieties: one of a bluish tinge, and somewhat coarse-textured, affords an excellent and durable building stone, and is burned on the spot for lime; the other, a purer white, and more compact variety, answers all the ordinary purposes of marble.* It is extensively cut for tomb-stones in the neighborhood; and, if judiciously selected, takes a tolerable polish. It has been extensively shipped to St. Louis and other points; and I am informed that it was employed for the construction of the State-House, at Baton Rouge, Louisiana. This marble is also quarried on the river shore, in front of the Convent. It occupies precisely the same geological position as the quarry at Rattlesnake Creek, which affords the columns for the Court-House, at St. Louis.

On the summits of the hills, in the vicinity of Cape Girardeau, we find a reddish brown argillaceous sandstone, in heavy and thin beds. It is soft when first quarried, but becomes hard on exposure to the air. It is employed for the outside work of lime-kilns, and for walling and flagging stones.† The position of this rock is immediately above the "Cape Girardeau marble," and beneath the Upper Silurian strata, observed two miles above Cape Girardeau, on the Mississippi.

Resuming our journey, the Trenton Limestone was found to prevail for about a half of a mile, forming low ledges along the river

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* The proportions of the different constituents of this marble are, according to Dr. Litton's analysis, as follows: —

Carbonate of lime,	99.57
Silica,	*a trace.*
Alumina,	*a trace.*

† Dr. Litton's analysis of this rock resulted as follows: —

Silica,	87.58
Alumina, and peroxide of iron,	9.67
Lime, not determined,	
Water,	1.35
	98.60

shore; then, alluvial lands, from ten to twenty-five feet high, succeed, and continue to a small creek, five miles below Cape Girardeau.

Just below the mouth of this creek, the Trenton Limestone is again exposed, in bold escarpments, fifty-five feet high. The blue schistose layers present a thickness of fifteen feet, and are densely crowded with fossils, usually in a most perfect state of preservation. These are surmounted by the white crystalline beds of the last section, which exhibit a thickness of forty feet. The upper portion appears to present all the characters of the Cape Girardeau marble; and there is, in my opinion, no doubt but that a marble of good quality may also be quarried here. This exposure extends along the river for several hundred yards, the schistose layers disappearing towards the lower extremity, whilst the crystalline beds form cliffs ninety feet high. In the uppermost strata, I found *Receptaculites*, and good specimens of a prettily-sculptured crinoid, of the genus *Echinoencrinites*.

At the foot of the "Grand Chain," on Oerter's land, the Trenton Limestone is capped with sandstone, similar to that noticed on the higher elevations in the vicinity of Cape Girardeau. The hills are about a hundred feet high; and on the declivities of some of them, deposits of potter's clay occur, of good quality. The variety preferred by Mr. Oerter, who has a pottery at this place, is of a yellowish ash color, and contains masses of ochre disseminated. It is, however, generally mixed with a white clay, obtained three-quarters of a mile west of the pottery, the mixture forming a better quality of ware than when either is used separately.*

A mile below the Grand Chain, the river shore is covered with huge blocks of white and brown sandstone, some of them weighing many tons; and a half of a mile below this locality, it is seen in place, reposing on clay and shale, with a dip of twenty degrees south-east. The section here, in the ascending order, is: —

1.— Slope, covered with large blocks of sandstone, ten feet.
2.— Gray and purple shale, with thin laminations of sandstone, eight feet.
3.— Ferruginous, highly plastic, silicious clay, with fragments of decomposing chert, embedded, twenty feet.
4.— White and brown heavy-bedded sandstone, thirty to forty feet.

A short distance from this place, and three-quarters of a mile above Commerce, is a deposit of pure white silicious clay, contain-

* I am indebted to Dr. Litton for the following analyses of these clays: —

No. 49. — Clay, from a point on Mississippi river, three-quarters of a mile above Commerce, gave —

ing masses of flint and ochre. It commences at the river margin, and extends to the height of twenty-five feet, where it is surmounted by sandstone.

Between this point and Commerce, the hills do not vary much from a hundred feet in height, and sandstone is the only rock to be seen. At the village, it reaches from the water level to the height of fifty feet. This rock exposure is the last to be seen on the Missouri shore in descending the Mississippi, and our section, therefore, terminates at this point.

FRANKLIN COUNTY.

This county embraces rather less than twenty-four townships, or an area of about eight hundred and sixty square miles.

By referring to the accompanying geological map, it will be seen that it is remarkably well watered by numerous streams, the most important of which, besides the Missouri, are the Meramec, Bourbeuse, St. John's, Bœuf and Berger. The three last-mentioned traverse the north-western portion of the county, receiving in their course a number of small tributaries, and flowing in a north-easterly direction to join the Missouri. The Meramec, a confluent of the Mississippi, is the largest stream that meanders through the county. It enters in Town. 40 N., R. 2 W., and, flowing in a north-easterly direction, leaves it in Town. 43 N., R. 2 E. It is exceedingly tortuous in its course, and its descent is often quite rapid. The valley through which it runs is very variable in width; it sometimes presents

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Silica,	86.82
Alumina, with a trace of peroxide of iron,	9.09
Lime,	0.33
Water,	3.13
	99.37

The silica obtained was dissolved in hydrofluoric acid.

No. 50. — Clay, from creek on Oerter's place — whiter variety —

Silica,	80.50
Alumina, with some peroxide of iron,	14.05
Lime,	0.35
Magnesia,	0.44
Water,	3.71
	99.05

No. 51. — Clay, from the same place as the last, blue variety —

Silica,	62.73
Alumina, with some peroxide of iron,	23.17
Lime,	1.69
Magnesia,	1.42
Water,	10.49
	99.50

a broad valley, susceptible of a high state of cultivation, and at others confined between hills, which attain an altitude of 300 feet, with abrupt declivities down to the water level, and occasionally perpendicular escarpments 200 feet high.

The valley of the Bourbeuse, in its general features, resembles that of the Meramec. It enters Franklin from Gasconade county, in Town. 41 N., R. 4 W., and after a remarkably sinuous course, joins the Meramec in Town. 42 N., R. 1 E.

The surface of Franklin county consists chiefly of ranges of hills, elevated from 100 to 300 feet above the level of the adjacent streams, and often separated from each other by deep valleys, some of them very narrow, others wide. The general direction of the main ridges is pretty uniformly north-east and south-west. In the southern part, the country is very uneven, particularly in the mining districts. The soil throughout the county is, in general, of good quality, and well suited for cultivation. On the summits of the sandstone ridges, it is often too light and sandy, but, even here, we find some excellent farm sites. In the townships underlaid by the magnesian limestones, and in the valleys of the streams, the soil is generally remarkably productive, and well adapted to the culture of corn and different varieties of small grain.

The Quaternary deposits are pretty widely spread over the county. They consist of ash gray and light-colored clays, sandy clay and sand, in alternating layers, and lie immediately beneath the soil. At a few points, I have observed terrestrial and fluviatile shells embedded, belonging chiefly to the genera Helix, Lymnea, Physa and Planorbis, mostly of existing species. The greatest thickness that I have observed the formation to attain, in the county, is about thirty-five feet. It is often finely exhibited along the shores of the Missouri, Meramec and Bourbeuse. These deposits often furnish the very best materials in the county, for the manufacture of bricks.

All the rocks in Franklin county, beneath the soil and Quaternary deposits, belong to the Lower Silurian system. They represent the inferior part of this system, and are equivalent in age to the Trenton and Black River Limestones, and Calciferous Sandrock, of the New York series.

The general inclination of the strata is to the north-east, though there are frequent local variations from this direction. In many places, the beds appear to lie perfectly horizontal; sometimes they are inclined at angles, varying from one to thirty degrees; and at other, they exhibit an undulating dip.

In describing the several groups, we will commence with the uppermost, and proceed in the descending order.

Of the *Trenton Limestone*, we find only the inferior beds of the mass represented, and these confined to a limited portion of the county. It enters at the north-eastern corner, and makes its appearance at intervals, within a space about eight miles long, with an average breadth of about two miles. Over this area it constitutes the surface rock of all the higher elevations; but, in the valleys and on the inferior slopes of the hills, we find strata which belong to the inferior groups.

The best exposures that I have observed, occur on the Missouri river, at St. Albans, on Fox Creek, in the vicinity of Gray's Gap, and near the town of Franklin. At all these places it presents the usual characters of the lower part of the mass—a bluish gray, compact limestone, with a smooth angular fracture. The most characteristic fossils are *Leptaena filitexta, Leptaena sericea, Orthis disparilis, Orthis subaequata,— Orthis tricenaria* and *Chaetetes lycoperdon.*

The *Black River Limestone*, which underlies the last, may be seen at St. Albans, on Fox Creek, and in the vicinity of Franklin. The superior part cannot be separated from the Trenton Limestone, the lithological characters being precisely the same, and fossils are by no means abundant. The lower part is an exceedingly compact, brittle, pure limestone, of a pale drab color, and resembles very closely the upper beds of the St. Louis Limestone. In hand specimens, it would puzzle any one to perceive any difference between them. This rock is seen to advantage at Gray's Gap, near the summit of the hill.

The two groups we have described are the most valuable in the county for quicklime; nearly all the strata will answer for this purpose; but the light drab beds, at the base, will probably make the purest variety. The Trenton Group, also, affords some good materials for building purposes; and, if desirable, good quarries might be opened at points along the line of its exposure.

The 1*st Magnesian Limestone* of your general section is the next rock that appears in the descending order. This, also, occupies but a limited part of the county. It forms a narrow belt on the north side of Meramec river, in Town. 43, R. 2 E., its eastern limit being in Sec. 17. At several points on the Meramec it appears in perpendicular cliffs. It, also, shows itself beneath the Black River Limestone on the Missouri river, at St. Albans. Quarries have been opened in this rock at Gray's Gap, and on Keatley's farm, near Franklin.

At Gray's Gap it presents the following section, from above downwards: —

1. — Buff-colored, ferruginous, magnesian limestone, in thin layers, separated by thin partings of soft argillaceous shale, banded with blue and yellow, ... 4½ ft.
2. — Seam of bluish marl, ... 4 in.
3. — Heavy-bedded, brown and buff magnesian limestone, with masses of calc spar disseminated, ... 12 ft.
4. — Even-bedded, buff magnesian limestone, in thin layers, . 35 to 40 ft.

The strata marked 3 in this section have been selected for the construction of culverts and bridges on the Pacific Railroad, for which the rock answers a good purpose, having the appearance of durability, and being tolerably free from cherty intermixture.

The fossils of this formation are a small species of *Cythere*, which I have named *C. sublaevis*, and some small gasteropods, too imperfect for accurate determination. In this county, the fossils are invariably casts. It is difficult to decide whether this portion of the 1st Magnesian Limestone should be grouped with the Calciferous Sandrock, or with the Black River Limestone, or whether it is distinct from either, and representing the Chazy limestone of the New York Geologists. Regarding it lithologically, we would include it in the Calciferous group, with which it presents considerable analogy; but, on the other hand, the fossils are most like those of the Black River and Trenton Groups.

The next formation below is the *Calciferous Sandrock*, which occupies all the remainder of the county. It is a very important mass, not only on account of its extent and thickness, but as being the repository of valuable ores of lead, iron and copper. Its thickness is much greater than the same group in New York. It is the equivalent of the St. Peter's Sandstone, or Lower Magnesian Limestone of Iowa, Wisconsin and Minnesota, described by Dr. D. D. Owen, in his official reports to Congress; but its thickness is much greater.

In Franklin county, as elsewhere in Missouri, the mass consists of beds of magnesian limestone and sandstone, of greater or less thickness, which, for the sake of more easy reference, have been divided into several subordinate formations.

The first of these, beneath the 1st Magnesian Limestone, is the *Saccharoidal Sandstone*. By reference to the map, it will be seen that this division of the Calciferous Group (marked F. U.) prevails to a considerable extent in the county, and particularly in the northwestern quarter, where it occupies the summits of nearly all the

highest ridges. It would be impossible to indicate, in this description, all the points where it appears. I shall, therefore, merely designate those places where it shows to the best advantage.

In the north-eastern portion of the county, we find it underlying the groups already described. On the Missouri river, in Town. 44 N., R. 2 E., it appears toward the base of the bluffs. It is, also, frequently exposed in the south-east quarter of this township, where it occupies the lower part of the hills, and constitutes the surface rocks of all the lower grounds. In Town. 43, of the same range, the sandstone occurs in all the sections, from five to thirteen inclusive; and, also, in sections 2, 3, 16, 17 and 18. In Wilhelm's field, north-west quarter of section 9, the junction of the sandstone with the 1st Magnesian Limestone may be seen to good advantage. On the south side of Meramec river, it forms the summit of the dividing ridge between the Little Meramec and Calva, occupying a narrow belt, scarcely a half of a mile in width, extending in a curve through the north-east corner of Town. 42 N., R. 2 E. Again, in the same township, it caps the ridges between the Meramec and Little Meramec rivers; thence, passes into Town. 41 of same range, and appears on all the higher elevations in that township. The sandstone again shows itself in Town. 43, and fractional township 44 N., R. 1 E., and 1 W., but here it occurs as mere outliers, of no great extent. The greatest development of the mass, as before stated, is in the north-west quarter of the county, where it occupies the summit of the dividing ridges between the St. John's, Bœuf and Berger rivers, and, also, between the heads of these streams and the waters of the Bourbeuse. As these ridges are separated from each other by valleys, often excavated through the sandstone, and deeply into the subjacent magnesian limestone, it frequently happens that the former occurs in bands, varying from a few yards to more than a mile in width, and several miles in length, along which we sometimes find the rock projecting above the general level, in the form of huge knobby cliffs, from sixty to eighty feet high.

On the accompanying geological map, I have represented, with as much accuracy as possible, the boundaries of the several areas in this district within which the sandstone prevails, from which a better idea of its extent can be gained than from any detailed description that could be written.

South of the Bourbeuse, the rock under consideration is again found capping the hills, in townships forty and forty-one, occupying a space from one to three miles wide on both sides of the line, be-

tween ranges two and three, west; it also occurs in Town. 40, Rs. 3 and 4 W.

The Saccharoid Sandstone usually occurs in thick beds, though it occasionally exists in thin layers, particularly near its junction with the formations that lie above and below it. The color varies from white to a dark ferruginous brown. Near the top it assumes, sometimes, a bluish tinge, from the presence of argillaceous matter. It is generally made up of quartzose grains, which often cohere so slightly, that, when struck with the hammer, it falls to fine sand. Sometimes the grains are firmly cemented with a silicious paste, and, at other times, though rarely, it passes into quartz rock.

The friable character of the mass renders it unfit, as a material, for the construction of buildings. The white variety is, from its pure quartzose character, well adapted for glass making, and for all purposes for which a fine quality of sand is required.

I have not been able to see its whole thickness at any point in Franklin county, but it may be estimated at not less than 175 feet.

Organic Remains.—No traces of fossils have been observed in the Saccharoid Sandstone in this county, although diligent search has been made, wherever the rock appeared likely to yield them. The absence of these remains, and the resemblance which portions of the mass bear to the sandstones beneath, have often rendered it difficult to recognize it with certainty.

2d Magnesian Limestone (F. v, of the general vertical section).—This formation, which underlies the sandstone we have just described, is generally known under the name of "Glade Rock," from the fact that barren places, termed glades, prevail, where certain portions approach the surface. Some layers are, also, frequently called "Cotton Rock," a name probably derived from their whitish appearance.

The mass is widely spread over the county, occupying rather more than half its entire extent. It frequently shows itself in perpendicular escarpments along the Missouri river, from the western limit of the county to within five or six miles of its eastern border. It occupies the valleys of all the streams flowing into the Missouri, except a few small branches in the eastern tier of townships, and it, also, exists on the dividing ridges between these streams.

East of St. John's river it underlies a wide district between the Missouri and Bourbeuse, limited on the east by the Saccharoidal Sandstone, already noticed. The two principal towns in the county, Washington and Union, are underlaid by this rock. From Union

it may be traced in a narrow belt, running parallel with the Bourbeuse, but from a quarter to a half of a mile distant, as far as the western limit of the county.

The mass is again largely developed south of Meramec river, in Towns. 42 and 43, R. 2 E., and in the north half of Town. 41, of same range. It is, also, frequently visible in the south-west corner of the county, in the valley of the Red-Oak Creek, a small tributary of the Bourbeuse.

The thickness of this formation may be seen to good advantage on the Meramec, two or three miles below the mouth of the Bourbeuse. Here it rather exceeds, than falls short of, 300 feet. I have not observed so great a thickness elsewhere in the county.

In many cases we can readily distinguish the mass under consideration from the magnesian limestone, above and beneath, by its lithological appearance alone. It may be described, in general terms, as an even-bedded magnesian limestone, occurring on layers, from a couple of inches to two or three feet in thickness, with occasional intercalations of sandstone and silicious oolite.

At the top, we usually find thin alternations of magnesian limestone, sandstone and silicious oolite; the latter sometimes passing into hard chert. The thickness of these layers is from fifteen to thirty feet.

Below these, we have the "Cotton Rock," with thick beds of buff and gray magnesian limestone intercalated, the whole exhibiting a thickness of about 200 feet. The "Cotton Rock," which is by far the most important part of the 2d Magnesian Limestone, is usually of a light cream color, sometimes dull white, and sometimes light buff or gray. It breaks with an even fracture, has a dull earthy appearance, and, sometimes, contains crystalline particles of calc spar disseminated. Its texture is, in general, finely granular, and, owing to the presence of earthy matter, it is not susceptible of polish. The layers vary from a couple of inches to two feet in thickness, and are often separated by partings of argillaceous shale. Beneath these beds the strata assume a light gray, or buff hue, and contain more calcareous matter than any part of the mass; and, at the same time, resemble so closely some beds of the 3d Magnesian Limestone, that it is exceedingly difficult, if not impossible, to distinguish the one from the other. Below these again, we have alternations of sandstone, magnesian limestone and oolite, similar to the beds at the top of the formation.

Fossils are extremely rare in the 2d Magnesian Limestone. I have only noticed them at two localities, close together, on the Springfield road, not far from the point where it crosses the Bourbeuse. They are confined to the oolitic layers, near the base of the formation, and consist of *Pleurotomaria*, *Murchisonia* and *Straparollus*, but they are invariably casts, and good specimens of even these are not common. I have figured one of these shells in the third plate of the Palæontology, under the name of *Murchisonia melaniaformis*.

Economically considered, the mass is of great importance. All the workable ores of iron in the county are contained in this formation. It is, also, now known to contain productive deposits of lead, though by no means so extensive as occur in the 3d Magnesian Limestone. The Golconda Mines, situated about four miles northeast of Union, are in this formation; and I have received, through the politeness of Mr. Reese, Engineer on the Pacific Railroad, specimens of galena, which were obtained from this rock, on the Mississippi river, a short distance below Washington.

I do not purpose, however, to enter here into a description of the deposits of lead and iron that characterize the mass, since a particular account of these will be found in the report of Dr. A. Litton, on the mines.

Building Materials. — The 2d Magnesian Limestone furnishes some of the most beautiful rocks for buildings, in the county. The Cotton Rock is generally well adapted for this purpose. It is wrought easily, and many of the layers have the appearance of durability. Buildings constructed of this rock have a peculiarly neat and elegant appearance; and, as it frequently contains but a small proportion of iron, very little change in color takes place from exposure. Several quarries have been opened in the mass, near Washington and Franklin, and at various other localities in the county. It is not usually well suited for hearth-stones and fire-places, since it is liable to crack and fly to pieces when submitted to the action of much heat. The lower part of the formation will afford, perhaps, the best material for this purpose.

For *quicklime*, the mass is inferior to the rocks of the Trenton, and Black River Limestones; and some portions of it will not slake at all, after having been burned. However, throughout the district over which it prevails, beds may nearly always be found, that contain enough calcareous matter to make a tolerably strong lime. In

the vicinity of Washington, and in other portions of the county, are kilns where some of the cream-colored layers are burned for lime, and furnish a good article for ordinary use.

Hydraulic Cement.—Some of the light-colored, earthy, granular varieties, resemble hydraulic limestone, but the rock has not yet been sufficiently tested to allow me to speak positively as to whether it really possesses such properties or not. For tomb-stones, fine selections may be made from the layers of the Cotton Rock; the light cream-colored and finely granular varieties being best adapted for this purpose.

The next sub-group of the Calciferous Sandrock, in the descending order, is the *2d Sandstone* (F. w, of the general section). This division of the formation lies mostly south of the line, between townships forty-two and forty-three. North of this line, we find it occupying merely a narrow strip, not exceeding a half of a mile wide, on both sides of the Bourbeuse, in Town. 43 N., R. 1 E., and a small space, a quarter of a mile north of this stream, in Town. 43, R. 1 W.

In the south-east corner of the county, it constitutes the prevailing surface rock of the high-lands, over an area of about twenty-two square miles, in townships forty and forty-one, of range two, east. It then enters into range one, east, of the same townships, where it occupies the summit levels of the ridges, between the small streams that traverse these townships, and extends in a narrow strip on the east side of the Meramec, passing in the vicinity of Messrs. Skewes and Vallé's, and Mr. Evans' lead mines.

Between the Meramec and Big Indian Creek, we find it overlying the 3d Magnesian Limestone on all the higher elevations; and between the former stream and its main tributary, the Bourbeuse, it occupies, for the most part, the summit of the divide, over which runs the surveyed route of the south-west branch of the Pacific Railroad; forming here an irregular belt, from one to six miles in width, and from sixteen to eighteen miles in length. Further west, it follows the valley of the Bourbeuse in a south-westerly course, from Voss Mill, in Town. 42 N., R. 2 W., Sec. 7, to Renick's Mill, in Town. 41 N., R. 4 W., Sec. 27, appearing frequently on the shores of the river, in bold perpendicular escarpments, sometimes capped with the 2d Magnesian Limestone.

Although the 2d Sandstone, as we have seen, is rather widely distributed, horizontally, in Franklin county, it, nevertheless, does not exhibit a great vertical thickness. In Town. 42 N., R. 3 W., near Mr. Park's farm, a half of a mile from the Bourbeuse, I saw an ex-

posure of 120 feet; and on the dividing ridge, between the Bourbeuse and Big Indian Creek, and, also, near the Meramec, in Town. 41 N., R. 1 E., I estimated its thickness at 140 feet, but generally we do not find it to exceed eighty feet.

This sandstone may, in many cases, be readily distinguished from the Saccharoidal Sandstone. It generally occurs in thinner and more even beds, is not so friable, and is often most beautifully ripple-marked. Sometimes, however, we find it in heavy, massive beds, and tolerably friable. Its color varies from brick-red to light gray, and sometimes it is nearly white. The rock may be seen to good advantage at Cove and Evans' Mines, near the Meramec. At these places, we find about seventy feet exposed. The upper part consists of even layers, from a couple of inches to a foot thick, of a reddish color, often finely ripple-marked, and composed of moderately-fine grains of quartz, rather firmly cemented. The lower part consists of alternations of sandstone, magnesian limestone and chert. On Mr. Park's farm, near the Meramec, in Town. 42 N., R. 3 W., are fine exposures of this sandstone; the strata are in even layers, from three inches to a foot thick, and prettily variegated. On the ridges, between Indian Creek and the Meramec, it is frequently much indurated; and in the vicinity of Bredell's Copper Mine, it is an exceedingly hard quartz rock. On the Meramec, near Renick's Mill, it is a soft, brown, heavy-bedded, friable sandstone, scarcely distinguishable, lithologically, from the Saccharoidal Sandstone.

Lead Ore.—I have noticed the occurrence of lead in this sandstone at only one point in the county—at Skewes and Vallé's Mines, near the Meramec; for a detailed account of which, you are referred to the report of Dr. Litton.

For building, the sandstone of which we are speaking is a useful material, its texture being often quite uniform, and it usually contains but a small quantity of argillaceous matter. For paving and flagging stones, it is, also, well adapted; for, from the regularity of its stratification, slabs may often be obtained from six to eight feet square, and of a thickness varying from a couple of inches to a foot.

For *fire-stones*, this rock may be frequently employed to good advantage, taking care to select the purer varieties. The sandstone used for the hearths of Moselle Iron Furnace (now Franklin Mining Company) was obtained from a quarry in this rock, near Cove Mines, and it is said to have answered a good purpose. The hearths lasted about four months, when it was found necessary to substitute new

ones. The cost of getting these stones out, I understood, did not exceed fifty dollars each time.

Organic Remains.—The upper part of the mass, as far as I know, is destitute of organic remains, but the lower cherty portion sometimes yields them. At Cove Mines, and at Evans', fragments of *Straparollus*, *Pleurotomaria* and *Orthoceratites* have been observed, which apparently differ from those of the other groups of the Calciferous sandrock.

The formation, underlying the sandstone just described, is the 3*d Magnesian Limestone*, or "Lead-bearing Rock," and represents the Lower Magnesian Limestone of Iowa, Wisconsin and Minnesota. It is the oldest formation in the county, and is a mass of great importance, as it contains nearly all the productive deposits of lead and copper.

This rock is almost entirely confined to the southern half of the county. North of the line, between townships 42 and 43, we find it occupying merely a small space of three or four miles, along the valley of the Bourbeuse, in Town. 43 N, R. 1 E.

To the south of this line, it first appears at a point near the confluence of the Bourbeuse, and follows in a south-westerly course the valley of the Meramec, to the southern line of the county. At first it occurs in a narrow belt, scarcely a mile wide, but it soon expands to five or six miles, forming the spurs of all the hills, and entering largely into the composition of the hills themselves.

Along the shores of the river it is frequently exposed in bold escarpments, from two to three hundred feet high, traversed by deep vertical fissures, and sometimes presenting perpendicular faces, of two hundred feet, to the stream. Its characteristic features are well exhibited in the vicinity of Stanton Copper Mines, Bredell's Mines, Gallagher's Mill, Virginia Mines, and at various other points along the course of the Meramec.

This formation, also, prevails along the valley of Big and Little Indian Creeks, throughout their entire course in the county, forming a strip from a half to a mile wide on either side of these streams, and affording many interesting exposures for the study of its characters.

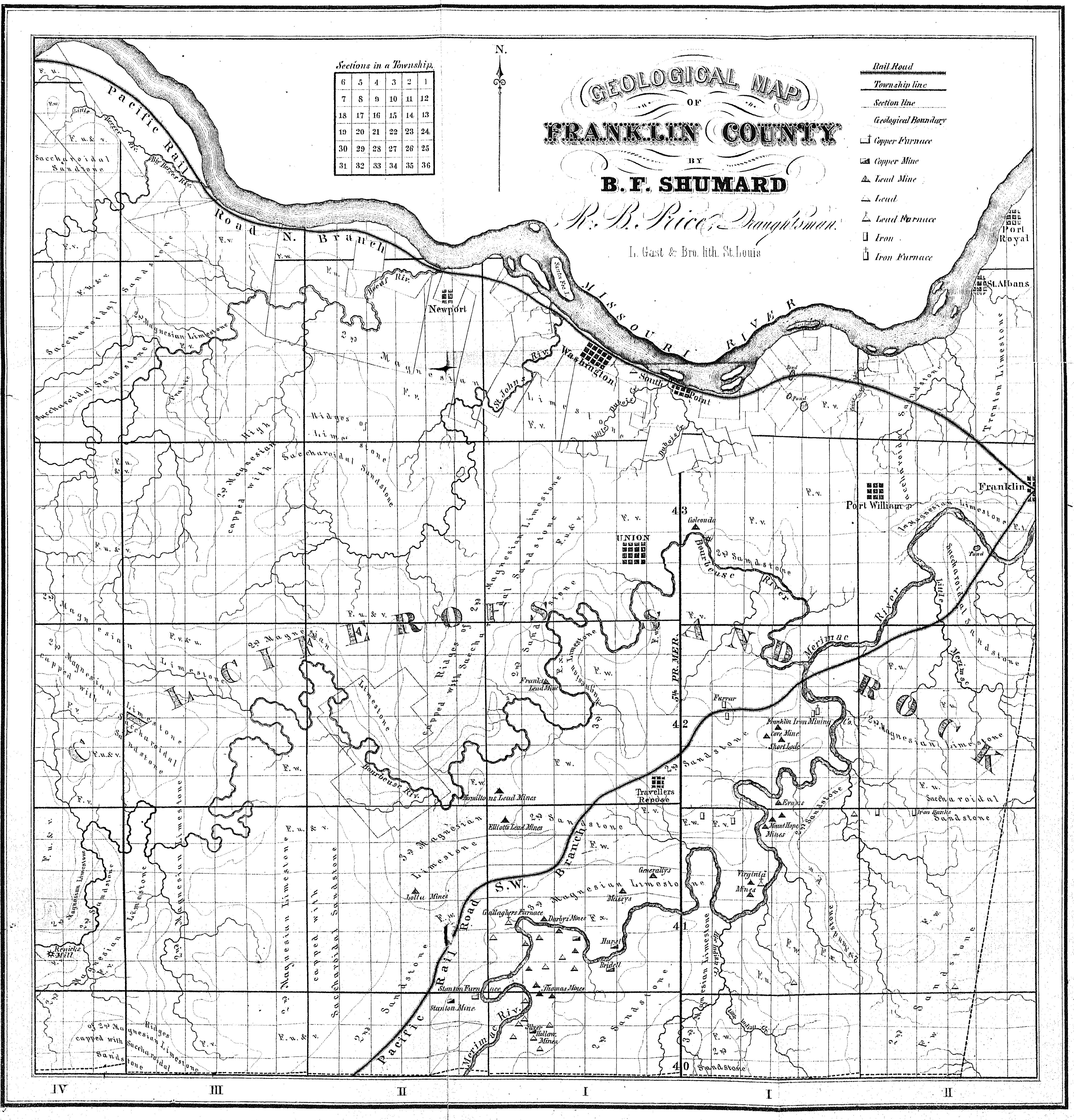
Again, it may be traced on the Bourbeuse in a continuous band, somewhat crescent-shaped, for nearly its entire course through Town. 42 N., Rs. 1 and 2 W. On the north side of the stream it occupies but a very narrow strip of country; but on the south side it is much wider, and passes into the north-east portion of Town. 41 N., R. 2 W., where it forms, for the most part, the surface rock, over an area of about ten square miles.

By inspecting the accompanying map, it will be at once seen, that within the districts underlaid by the 3d Magnesian Limestone, occur nearly all the important mines of lead and copper in the county. If we except the Golconda Mines, which are, as already stated, in the 2d Magnesian Limestone, no productive mines of lead have been found in the county out of this division of the Calciferous sandrock. I have, therefore, on the geological map, endeavored to lay down, with as much accuracy as possible, its general boundaries; and these, I think, will, in the main, be found correct. I refer you to the report of Dr. Litton, for detailed descriptions of its ores and associated minerals, and an account of the most important mines.

Lithological appearance. — The beds now under notice, near their junction with the 2d Sandstone, consist usually of alternations of buff and gray magnesian limestone, chert and indurated sandstone, but sometimes of a rough cherty mass, with irregular-shaped cavities, occasionally lined with crystals of quartz. The magnesian layers are chiefly of a fine granular, earthy texture, varying very much in hardness, being sometimes so soft that they can be cut with a knife, and at other times very compact and tough. Below these, we have beds of magnesian limestone, varying from a couple of inches to several feet in thickness, with bands of chert interstratified. The magnesian beds consist chiefly of two distinct varieties. One is a compact, sub-crystalline, even-bedded calcareo-magnesian rock, breaking with an angular fracture, and of a light gray or delicate flesh-color; the other is a buff, earthy-looking magnesian limestone, of a finely-granular texture. Both varieties are finely exhibited in the vicinity of Stanton and Bredell's Copper Mines, Virginia, Cove, Hamilton and Darby's Lead Mines, and at Gallagher's Mill.

Fossils. — I have only noticed the occurrence of organic remains in these beds, in a few localities in the county. At Cove and Evans' Mines, Dr. Litton and myself found *Orthoceras primigenium* (*Vanuxem*), a species very characteristic of the Calciferous Sandrock of New York, and which I have, also, observed in the Lower Magnesian Limestone of Wisconsin. We observed here, also, a *Turbo* and *Pleurotomaria.* On Mitchell's Creek, near Mr. Generally's house, in Town. 41 N., R. 1 W., Sec. 13, we found *Straparollus* (*Ophileta*) *complanata* and *S. levata* (*Vanuxem*), which are both characteristic of the Calciferous Sandrock of New York and the North-western States. We observed the same species, also, at Stanton Copper Mine.

The 3d Magnesian Limestone affords some excellent materials for construction. The light gray or flesh-colored varieties are, per-


GEOLOGICAL MAP
OF
FRANKLIN COUNTY
BY
B. F. SHUMARD
R. B. Rice Draughtsman
L. Gast & Bro. lith. St. Louis
N.
Sections in a Township.
6 5 4 3 2 1
7 8 9 10 11 12
18 17 16 15 14 13
19 20 21 22 23 24
30 29 28 27 26 25
31 32 33 34 35 36
Rail Road
Township line
Section line
Geological Boundary
Copper Furnace
Copper Mine
Lead Mine
Lead
Lead Furnace
Iron
Iron Furnace
MISSOURI RIVER
Pacific Rail Road N. Branch
Pacific Rail Road S.W. Branch
Newport
Washington
South Point
Port Royal
St. Albans
Franklin
Port William
UNION
Travellers Repose
Bourbeuse River
Merimac River
Little Merimac
St. Johns Riv.
Saccharoidal Sandstone
2nd Magnesian Limestone
Trenton Limestone
High Ridges of Limestone
2nd Sandstone
Ridges of 2nd Magnesian Limestone capped with Saccharoidal Sandstone
5th PR. MER.
43
42
41
40
Golconda
Franks Lead Mine
Farrar
Franklin Iron Mining Co.
Love Mine
Short Lode
Hamiltons Lead Mines
Elliotts Lead Mines
Evans
Mount Hope Mines
Virginia Mines
Generallys
Masseys
Gallaghers Furnace
Darbys Mines
Hurst
Bridell
Stanton Furnace
Stanton Mine
Thomas Mines
Silver Hollow Mines
Renicks Mill
Iron Banks
IV
III
II
I
I
II

haps, the best for this purpose. These beds contain a good deal of calcareous matter, and appear to be well calculated to withstand the influence of the weather. Structures in Europe, that have stood for centuries, with scarcely any perceptible alteration, were constructed of Calcareous Magnesian Limestone. Quarries of this rock may be opened at various points in the valleys of the Meramec and Bourbeuse. These beds may, also, be employed for burning into lime, if selected with care; the most crystalline varieties should, of course, be chosen.

ST. LOUIS COUNTY.

St. Louis county contains nearly fifteen townships, or an area of about 530 square miles; and, although not so large as the preceding, it embraces a much greater variety of geological formations. We find here, in addition to the Silurian rocks, the Chemung Group, Carboniferous Limestone, and Coal Measures.

I propose to commence my report on this county with a description of the geological section along the line of the Pacific Railroad. It begins at St. Louis, and, passing in a south-westerly direction, terminates in the south-west corner of the county. Along this route, excellent opportunities were afforded for studying the relative order and succession of the geological formations, at the numerous cuts that have been made through the rocks for the construction of the railroad.

The strata, underlying the Quaternary deposits, on which the city of St. Louis stands, belong to the superior division of the Carboniferous System, and is the St. Louis Limestone of western geologists. It is well characterized by its fossils, of which several are quite peculiar. These have been enumerated in my description of the Mississippi river section, where, also, the lithological characters of the mass have been minutely detailed.

On the line of our section, these rocks first appear at the eastern edge of Chouteau's Pond, near Poplar street, and they are again exposed at the quarries, a couple of hundred yards south of the railroad depôt, where they are overlaid by the Quaternary deposits, which here present a thickness of upwards of twenty feet. These deposits, or the Bluff Formation of your general vertical section, are also finely exhibited between Eleventh and Twelfth streets, at the cut recently made for the railroad.

The section at this place, from below, upwards, is —

No. 1. — Light, ash-colored, clay, with ferruginous bands, containing Lymnea, Physa and Helix, . . . 2 ft. 3 in.

No. 2. — Fine silicious sand, ... 6 in.
No. 3. — Ash-colored clay, ... 4 in.
No. 4. — Yellow and gray sandy clay, ... 2 ft. 9 in.
No. 5. — Fine sand, ... 5 ft.
No. 6. — Soil and sub-soil, ... 5 ft.

The St. Louis Limestone, overlaid by these deposits, prevails with a slight westerly dip, until we pass Rock Creek, when the Coal Measures succeed, and continue for a short distance beyond Cheltenham Sulphur Spring. At the spring, on the south side of the River des Peres, the hills are about seventy-five feet high, and consist chiefly of sandstone, with some beds of sandy shale. Just above the water level, we find a dark, ferruginous sandstone in thick beds; at forty feet, thin, shaly layers of argillaceous sandstone; and on the whole, rests fine-grained, soft, white sandstone. A hundred yards west of the spring, the St. Louis Limestone again appears underneath the Coal Measures, on the south side of the River des Peres, extending from the bed of the stream to the height of fourteen feet. It consists of light-colored, compact limestone, in layers, from an inch to a foot thick, with occasional bands of chert interstratified. These beds contain *Palaechinus* (*Melonites*) *multipora* and *Poteriocrinus longidactylus*, and other species of the upper beds of the St. Louis Limestone. The chert layers are highly fossiliferous, and contain *Avicula*, *Pecten*, *Arca* and *Cardiomorpha*.

The railroad now passes in gradual succession from the higher to the lower members of the St. Louis Limestone, and two miles beyond Kirkwood this group disappears altogether, and is succeeded by the Archimedes Limestone.

About a mile east of "Barrett's Station," is a cut through the Archimedes beds to the depth of twenty feet, and three hundred yards in length. The strata consist of bluish gray and buff limestone, in moderately thick beds, containing rounded masses of flint, which vary from an inch to a foot in diameter, and present often a concentric structure.

At the western extremity of the first tunnel ("Barrett's Station"), is an exposure of heavy-bedded, gray and blue, sub-crystalline and bluish argillaceous limestone. The section here, in the ascending order, is as follows: —

No. 1. — Dull, earthy-looking, argillaceous limestone, weathering in thin layers, ... 2 ft.

No. 2. — Heavy-bedded, compact, sub-crystalline limestone, highly charged with fossils. These strata have been chosen for the construction of the Custom-House, at St. Louis, and the selection appears to have been a good one; their texture being of a character to withstand the action of mois-

ture and frost. The rock possesses uniformity of composition, is free from cherty intermixture, and, as it contains a large proportion of carbonate of lime, the refuse material can be advantageously employed for making quicklime.* The following are a few of the most characteristic fossils of these beds: — *Pentremites florealis, P. laterniformis, Productus punctatus, Euomphalus planorbis, Archimedipora archimedes,* and *Psammodus.* In some of the layers the fossils are elegantly preserved, the original shells being converted into pure white lime, which retains their most delicate markings, ... 21 ft.

No. 3. — Blue, argillaceous limestone, similar to that at the base of the section (No. 1), ... 10 ft.

No. 4. — Heavy-bedded, blue and gray fossiliferous limestone, presenting nearly the same characters as No. 2, . . . 12 ft.

No. 5. — Loose chert, ... 2 ft.

The second tunnel is, also, through Archimedes Limestone, very similar in lithological characters to that of the first tunnel. We find, first, heavy-bedded, bluish gray limestone, twelve feet; above this, bluish gray, argillaceous limestone, ten feet; and then, gray, sub-crystalline limestone, abounding in fossils, thirty-four feet.

At the heavy cut, seventeen miles from St. Louis, the Encrinital Limestone of the general vertical section first appears. The strata are exposed to the height of forty-three feet, and present a very perceptible dip to the north-east. The Archimedes Limestone forms the top of the exposure, and, beneath, occurs the Encrinital beds, consisting, here, as elsewhere in the State, of alternations of light-colored, crystalline limestone and chert, the former very rich in remains of encrinites.

This formation extends along the railroad for nearly five miles, the mass being readily distinguished from the formation directly above and beneath, by its cherty character alone. At some points it is represented by a mass of broken chert and reddish clay, the debris resulting from the destruction of its strata; and this is well seen just beyond the seventeenth mile post, where is a cut of upwards of twenty feet, through material of this kind. The limestone, which is often in beds three or four feet thick, is of good quality for quicklime, and preferable to the Archimedes beds.

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* Dr. Litton's analysis of an average specimen gave—

Insoluble residue,	2.24
Alumina and peroxide of iron,	57
Carbonate of lime,	87.20
Carbonate of magnesia,	10.07
	100.08

Near the nineteenth mile post is a fine locality for its fossils. Besides many others, I observed *Platycrinus Burlingtonensis, P. discoideus, Megistocrinus Evansi, Actinocrinus unicornus, Pentremites Sayi* and *Spirifer Burlingtonensis*, species which I have found quite characteristic of the same group, in Iowa and Illinois.

At the Sulphur Springs, twenty-one miles from St. Louis, the hills attain the height of 127 feet above the railroad grade, and 154 feet above Meramec River. The upper seventy-seven feet consists of alternations of gray Encrinital Limestone and chert, below which is a slope down to the water level, in which the strata are hidden from view by soil and debris of rocks that have fallen from above.

The Sulphur Spring issues from near the base of this slope, and only eight or ten feet above the bed of the river. The water, judging from its taste and the deposit formed in the bottom of the spring, appears to possess nearly the same properties as the Sulphur Spring on the Mississippi, in Jefferson county, mentioned in my description of the Mississippi river section, and it issues from beneath the same strata: *i. e.*, the argillaceous beds of the Chemung Group, which are seen in a short distance, and which, it is to be presumed, occupy the slope at this place.

The Chemung rocks are exposed, on the north side of the railroad, about a quarter of a mile west of Sulphur Spring.

The section here, in the ascending order, is: —

1. — Reddish brown and yellow limestone, in thick massive beds, 12 ft.
2. — Thin-bedded, reddish limestone and marl, . . . 15 ft.
3. — Yellow marly limestone, ... 12 ft.
4. — Compact, light gray limestone, in thin strata, . . 8 ft.

The uppermost strata of this section contain but few fossils, but in the reddish beds they are quite abundant. The most common species are *Chonetes ornata, Orthis* allied to *O. Michelini, Spirifer striatus? Cyathoxonia cynodon, Amplexus*, and several species of *Crinoidea.*

The reddish beds (No. 1) at the base of this section have been employed for the piers of the bridge at Sulphur Spring, for which purpose they seem to be well adapted. The rock has the appearance of durability, the color is agreeable to the eye, and, being in thick beds, is suitable for heavy masonry. It forms, in my opinion, an excellent and durable building material. The same strata again show themselves about a quarter of a mile further on, where they are exposed to the height of eleven feet. The lower five feet consist of yellow limestone, on which rests six feet of reddish sub-crystalline limestone. At this place there is a considerable local dip of the strata to the south-west.

Twenty-one miles from St. Louis, the hills rise to a height of 120 feet above the railroad grade. The lower seventy-five feet is a slope, probably underlaid by the Chemung rocks, from which rise perpendicular cliffs of Encrinital Limestone, forty-five feet high.

The hills now continue of about the same elevation, with constant escarpments near their summits, for the distance of about one mile.

About a quarter of a mile beyond the twenty-second mile post is an out-crop of Lower Silurian strata, referable to the age of the Trenton Limestone.

The section here, in the ascending series, is as follows: —

1. — Light gray, highly crystalline limestone, passing upwards into buff and gray cherty magnesian limestone, containing *Leptaena alternata*, *Leptaena sericea*, *Leptaena filitexta*, *Orthis testudinaria?* *Illaenus crassicanda*, *Lichas Trentonensis*, *Asaphus Iowensis* and *Chaetetes lycoperdon*, . 34 ft.
2. — Slope, no strata exposed, ... 30 ft.
3. — Buff, sandy calcareo-magnesian limestone, . . . 11 ft.

To these, succeed thin-bedded buff and argillaceous limestone, with crinoids and other fossils of the Chemung Group.

The crystalline beds at the base of this section contain the same assemblage of fossils, and are identical with the rocks that are quarried near the mouth of Rattlesnake Creek, in Jefferson county, for the columns of the Court House at St. Louis, and at Cape Girardeau, to furnish the well-known Cape Girardeau marble. This part of the Trenton Limestone has supplied some of our choicest building rock, and, in fact, wherever it crops out, we are liable to find good materials for construction. It is, therefore, probable that valuable quarries will be found in the vicinity of the point of which we are now speaking.

A few hundred yards further, we find the lower division of the Trenton Group emerging from beneath the crystalline beds just mentioned. It is here composed of drab, compact, close-textured limestone, in thick beds, with thin seams of chert interstratified, and, towards the base, perforated in every direction by vermiform cavities. These strata continue to be seen along the railroad for the distance of a third of a mile, forming precipitous cliffs, from thirty to forty feet high.

The railway now passes through nearly level land, and no rock exposures are to be seen in its immediate vicinity, until we get beyond the 24th mile post from St. Louis. Here we again find the lower Trenton rocks, at first in perpendicular walls, twenty feet high, but soon afterwards they attain to the height of from fifty to seventy feet, forming bold and isolated cliffs, near the tops of the hills.

A quarter of a mile before we reached Hamilton Creek, the following section was observed, counting from below upwards: —

1. — Blue argillaceous limestone, in moderately thick beds, . 15 ft.
2. — Heavy-bedded, buff magnesian limestone, passing upwards into cream-colored layers of the same, ... 55 ft.
3. — Compact, close-textured, brittle limestone, of drab color, some of the layers containing vermiform cavities, . . . 45 ft.

The lower seventy feet of this rock is the 1st Magnesian Limestone of your general section; and some of the beds towards the upper part contain, in great profusion, the casts of a small *Cythere*, which I have described in the Palæontology under the name of *Cythere sublaevis*. Some layers, four feet thick, are composed almost entirely of this little Crustacean. The superior strata of this section contain *Orthis, Leptaena* and an *Ormoceras*, very similar to, if not identical with, a species of the Black River Limestone of New York; but, until we have found a greater variety of fossils for examination, it would, perhaps, be unsafe to pronounce the beds we are now noticing identical with that group.

Just beyond Hamilton Creek, the 1st Magnesian Limestone is exposed to the height of forty-three feet. It consists of grayish, buff magnesian limestone, in thick layers, with intercalations of argillo-magnesian limestone, and continues along the north side of the railroad for the distance of three miles, forming perpendicular walls, from five to twenty-five feet high, and frequently presenting a remarkably banded appearance. Near the 27th mile post they exhibit an undulating character.

In a ravine, on the north side of the railroad, about three-quarters of a mile east of Allenton, we first encountered the Saccharoidal Sandstone of your general section. It occurs in massive beds, of a ferruginous brown color, and is composed of moderately fine quartz grains, rather loosely cemented.

Near Allenton, the 1st Magnesian Limestone is quarried in the adjacent hills,* and on the west side of Fox Creek it again appears in a ledge, sixteen feet high. At the latter locality, I observed *Cythere sublaevis* and elongated cylindrical bodies, which appear to be casts of the columns of *Encrinites*.

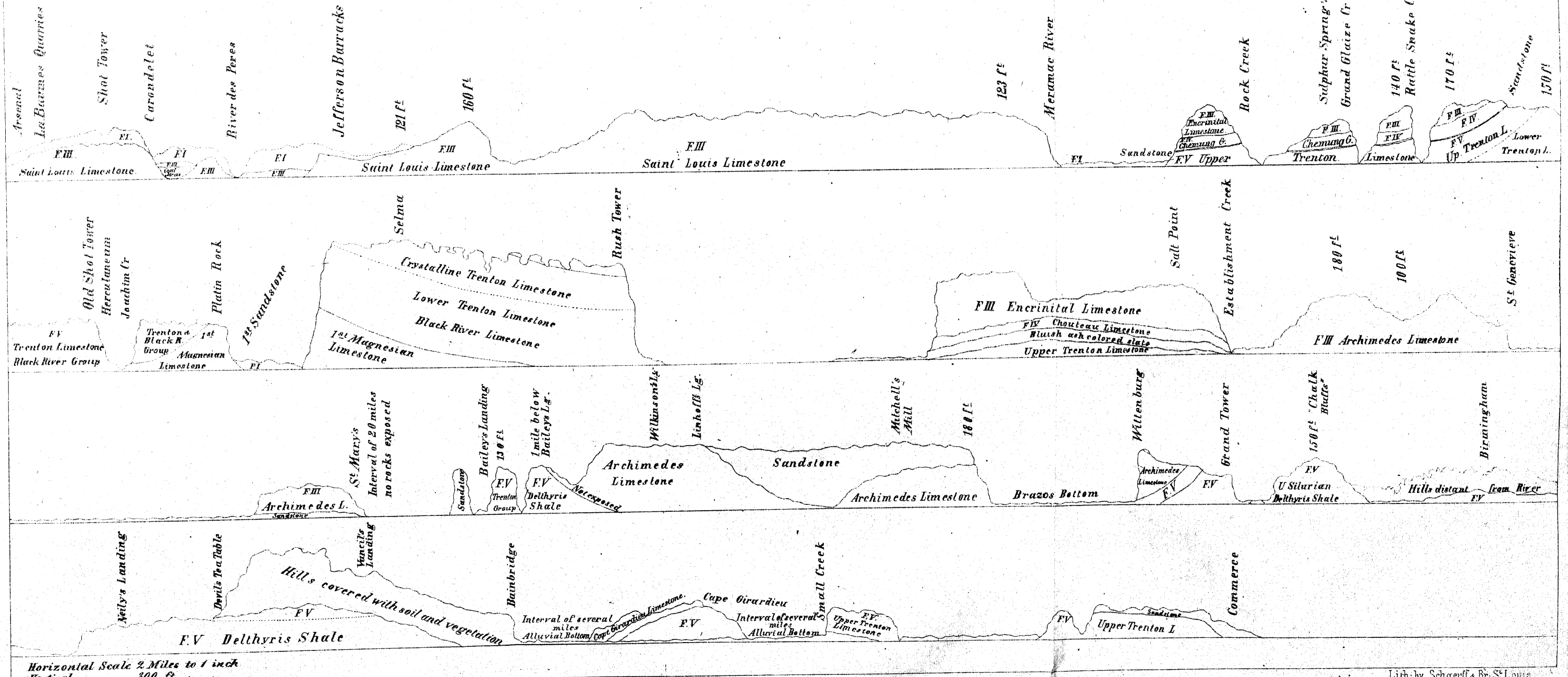
The next exposure, near the railroad, is about a mile north-east of Franklin, where we find a cut through the sandstone to the depth of twenty-five feet. The rock lies in heavy beds, and consists of fine grains of colorless quartz, usually so loosely cemented, that, when struck with the hammer, it falls to fine sand. It occupies the same geological position, and in its lithological character resembles the white sandrock of Ste. Genevieve county, large quantities of which are shipped annually to Pittsburgh and other points for the manufacture of glass.

A short distance beyond this place are perpendicular escarp-

* Through the politeness of Dr. H. King, of St. Louis, I have been permitted to examine fragments of a straight-chambered shell, of huge dimensions, probably belonging to the genus Endoceras of Prof. Hall, which, when perfect, must have exceeded ten feet in length. He informs me that it was obtained from the quarry, near Allenton.

GEOLOGICAL SECTION ON THE MISSISSIPPI RIVER FROM SAINT LOUIS TO COMMERCE

by B.F. SHUMARD



Horizontal Scale 2 Miles to 1 inch
Vertical " 300 ft. " "

Lith: by Schaerff & Br. St Louis.

ments of the Saccharoidal Sandstone, fifty feet high; then succeeds a talus of thirty-six feet, above which we find the 1st Magnesian Limestone, about twenty feet exposed, consisting of buff and gray magnesian rock, somewhat porous, and containing a good deal of calc spar. A large part of the sandstone at this place is colored with oxide of iron.

Within a quarter of a mile of Franklin, and a few hundred yards from the railroad, the hills are 250 feet high; and here we find the Saccharoidal Sandstone occupying their bases, above which is the 1st Magnesian Limestone, presenting the characters already noticed; and on the whole, rests the Black River and Trenton Limestones, with their characteristic fossils.

Having now completed an account of the geological formation along the line of the Pacific Railroad, I will next describe them as they appear in other parts of the county, beginning with the uppermost, and speaking of them in descending order.

Bluff, or Loess.—In sinking wells, and in excavations for roads and other purposes, we usually find between the soil and older stratified rocks of the county, the Bluff Formation of the general vertical section, varying in thickness from ten to forty feet, and consisting of clay, sand, sandy loam, and sometimes fine gravel. These deposits may, also, be frequently seen to good advantage along the courses of the streams, where they appear often in vertical cliffs.

At St. Louis, Carondelet, and other localities in the county, I have observed the characteristic terrestrial and fluviatile shells of the formation pertaining to the genera *Helix*, *Pupa*, *Physa*, *Limnea* and *Planorbis*. Fossil bones of the Mastodon (*M. giganteus*) have also recently been found in these deposits, at St. Louis, during an excavation for a sewer, near Flora Garden, in the southern part of the city. They were discovered at the depth of about sixteen feet beneath the surface, and consisted of two teeth, nearly perfect, and fragments of other bones, which crumbled on exposure to the air. This is the only locality in the county, known to me, where the remains of fossil quadrupeds have been encountered.

Referring to the section at the commencement of this report, and to your report, for further details with regard to the lithological character of this formation, I will here merely notice some points where it may be seen to the best advantage.

It is finely displayed at the Mound, in North St. Louis, where a cut has been made through it to the depth of nearly thirty feet. At the Bremen quarries, a thickness of twenty-five feet is exposed, passing downwards into a bed of gravel, about a foot thick, which rests on the St. Louis Limestone. Instructive sections of these deposits may also be seen in South St. Louis, near the Arsenal, in Carondelet, and at various points along the St. Charles and Bon Homme roads.

The clays of this formation are well fitted for the manufacture of bricks, for which purpose they are extensively employed in almost every part of the county. They, also, furnish materials for the coarser kinds of pottery.

CARBONIFEROUS SYSTEM.

This system is largely developed in St. Louis county. It forms

the underlying rock over nearly four-fifths of its entire extent, reaching from the Mississippi river westward, to within from six to ten miles of the western boundary. All the formations of the system given in the general vertical section, from the Middle Coal Series to the Encrinital Limestone inclusive, are here represented; and I will now describe them, commencing with the highest, and proceeding in the descending order.

Coal Measures. — This formation, so important in an economical point of view, occupies an area of about one hundred and sixty square miles, and lies chiefly in the north-east portion of the county. In the accompanying geological map, I have laid down its boundaries, from which you will obtain a better idea of its range and extent, than from a written description.

Although its limits are quite extensive, I think I may safely assert that only the middle and inferior portions, observed by yourself, on the Missouri river, occur in the district under notice. And the former, I have been able to identify only in a single locality: viz., at Charbonniere, on the Missouri river. The section here, in the descending order, is —

No. 1. — Slope, covered by soil and trees,	60 ft.
No. 2. — Rough, light gray, compact limestone, in masses, embedded in clay,	6 ft.
No. 3. — Light-colored, impure fire-clay?	6 ft.
No. 4. — Hard, compact, light bluish gray, hydraulic limestone, in uneven masses,	2 ft.
No. 5. — Yellow, argillaceous shale, with ochreous stains,	8 ft.
No. 6. — Purple, sandy shale, with fine micaceous particles disseminated,	13 ft.
No. 7. — Bluish, argillaceous shale,	46 ft.
No. 8. — Dark greenish and reddish fossiliferous shale,	6 ft.
No. 9. — Dark sandy shale,	8 ft.
No. 10. — Seam of coal,	

The compact limestones of the above sections (Nos. 2 and 4) abound in fossils, and they are usually well preserved. The most common species are *Chonetes mesoloba*, *Productus costatus*, *P. punctatus*, *P. splendens*, *P. Wabashensis*, *Spirifer lineatus*, *Fusulina cylindrica*, and remains of *Crinoidea*. The dark shale, at the base of the section (No. 8), is also filled with fossils, chiefly *Chonetes*, of the following species, recently described by Drs. Norwood and Pratten, of the Illinois Geological Survey: *C. Verneuiliana*, *C. Smithi* and *C. mesoloba*.

At the time of my visit to this locality, the coal seam was beneath the surface of the Missouri, and could not be seen. I was informed, however, that its thickness is about eighteen inches.

The next rock we meet with in the descending order, is the *Micaceous Sandstone*, which constitutes the superior part of our

Lower Coal Series. If we commence at a point on the Natural Bridge Plank-road, about six and a half miles from St. Louis, and draw a line in a direction nearly north, to within a short distance of Cold-Water Creek, such a line will pretty nearly represent the western boundary of the principal sandstone district in the county. Within this line, it forms the prevailing rock over a space of from thirty to thirty-five square miles, or to within a short distance of the eastern limit of the coal formation.

A fine exhibition of this sandstone may be seen on the North Missouri Railroad, between seven and eight miles from St. Louis, where is a cut through it, of about five hundred yards in length, and twenty-two feet in depth. It consists of soft, brown, fine-grained micaceous sandstone, thick-bedded, and crumbling readily on exposure to the air. Some of the layers contain imperfect impressions of *Calamites*, *Lepidodendron*, and dark stains of carbonaceous matter. At the south-western extremity of the cut, the sandstone is seen resting on a stratum of fire-clay, about five feet thick.

This sandstone may, also, be seen in the bluffs that skirt the bottom lands of the Mississippi, in Town. 46, R. 7 E.

On the top of a high ridge, about seven and a half miles from St. Louis, on Mr. Claire's land, near the Natural Bridge Plank-road, a well was excavated to the depth of eighty feet, the lower fifty or sixty feet being through the Micaceous Sandstone, filled with remains of fossil plants.

A couple of miles beyond this place, in the north-east quarter of Sec. 14, Town. 46, R. 6, is a quarry in this sandstone, whence is obtained the rock used in the construction of bridges and culverts on the North Missouri Railroad, between the fourth and ninth sections. It consists, at its upper part, of soft, fine-grained ferruginous sandstone, and below of bluish gray sandstone, with nodules of argillaceous sandstone embedded. The beds are easily wrought, blocks of large size being obtained without much difficulty. The upper layers are regarded as being the best.

Another quarry of this sandstone is situated near the Old Bon Homme road, in the south-east quarter of Sec. 5, Town. 45, R. 6 E. It is very similar to the last, but is of a darker color, rather more compact, and occurs in thinner beds. This rock has been quarried and conveyed to St. Louis, a distance of about eleven miles, for building purposes. Near the quarry, on the same quarter section, a well has been sunk to the depth of seventy-five feet, and, I am informed, they first passed through about thirty-four feet of Quaternary Deposits; then forty feet of sandstone, and reached a hard, dark bluish gray limestone, in which I found *Chonetes mesoloba* and *Productus splendens*.

The sandstone we are noticing always contains a considerable proportion of mica and traces of coal plants, by which it can readily be distinguished from the older sandstones. The fossils, however, owing to the loose and crumbling character of the rock, are always badly preserved. The same quality, also, renders it, in general, unfit as a material for construction.

On the Hall's Ferry Plank-road the piers of bridges and culverts, constructed of this rock, are rapidly crumbling away. The strata, at the two quarries above mentioned, are the best that I have seen, but even these, in my opinion, are far inferior to many of the limestones of the county.

I have not been able to observe the total thickness of this sand-

stone, at any locality in the county, but it may be estimated at from sixty to seventy feet.

Beneath the sandstone I have just described, and above the St. Louis Limestone, we find those members of the Lower Coal Series in which, probably, occur all the important deposits of coal in the county. These prevail over about two-thirds of the whole area occupied by the Coal Formation, and consist of beds of clay, fire-clay, limestone, shale and coal. They are perfectly characterized by the fossils, which, in the limestone and the clays directly in contact with it, are sometimes exceedingly abundant. The most frequently occurring forms are *Chonetes mesoloba*, *Chonetes Smithi*, *Productus costatus*, *P. splendens*, *Spirifer lineatus* and *Fusulina cylindrica;* and so characteristic are these species, that I have not failed to detect them at a single locality. The Formation is often concealed from view by an extensive layer of Quaternary Deposits, so that, in general, the best sections of the different beds are to be found in shafts at the coal-mines.

The subjoined sections, obtained at several different localities, are examples representing the order of superposition most frequently observed in this county.

At Gartside's Coal-Mines, near the City Farm, three and a half miles south-west of St. Louis, the section is: —

1. — Soil and bluff deposit,	20 ft.
2. — Blue clay,	12 ft.
3. — Bluish gray, compact, fine-grained hydraulic limestone with? *Productus*, *Chonetes* and *Fusulina*,	7 ft.
4. — Dark indurated shale,	4 ft.
5. — Coal,	4 to 5 ft.
6. — Fire-clay,	0 ft.

At Mr. B. F. Buchanan's, on the west side of the River Des Peres, six miles west of St. Louis, the order observed is: —

1. — Yellow clay,	5 ft.
2. — Light-colored sandy clay,	4 ft.
3. — Masses of limestone embedded in red clay ("tumbling rock"),	6 ft.
4. — Red clay,	6 ft.
5. — Blue clay,	7 ft.
6. — Light gray earthy limestone,	3½ ft.
7. — Very compact, hard, dark gray limestone,	2½ ft.
8. — Dark blue shale,	2 ft.
9. — Coal,	5 ft.
10. — Slope (rocks unexposed),	80 ft.
11. — St. Louis Limestone,	26 ft.

At Watkins' coal-bank, near the Mississippi, in the south-east corner of Town. 47, R. 7 E., the section commencing beneath the Bluff Formation is: —

1. — Yellow and ash-colored tough clay,	8 inches.
2. — Ash-colored fire-clay,	2 ft. 6 "
3. — Blue clay with masses of dark hydraulic limestone, containing *Productus*, *Chonetes*, etc.,	1 ft.
4. — Seam of coal,	18 "

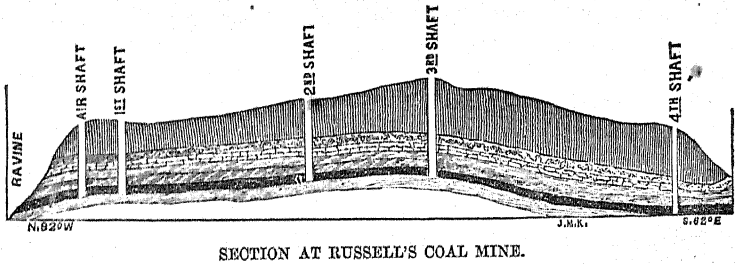
5.—Dark fire-clay, ...	2 ft.
6.—White fire-clay, ...	3 to 5 ft.
7.—White and brown, ferruginous, fine-grained sandstone, in thin layers,	10 to 15 ft.
8.—Archimedes Limestone, exposed in the bed of Watkins' Creek, .	0 ft.

At this place the St. Louis Limestone appears to be wanting, and the Coal Measures are separated from the Archimedes Limestone by merely a few feet of sandstone, which, doubtless, represents the Ferruginous Sandstone of the general section.

Coal.—This important mineral substance has been chiefly mined along the southern edge of the Formation. All the workings here are on the same stratum, which varies from two to five feet in thickness, and is nearly horizontal. At Gartside's Mines a number of shafts have been sunk, of an average depth of about forty feet, to the coal-bed. The latter consists of several layers, with thin partings of clay and iron pyrites interstratified, the aggregate thickness being about five feet. The average thickness of the workable coal is about three feet six inches. Sometimes it dwindles down, very suddenly, to two feet, for a few yards, and then as suddenly attains its usual thickness again.

On land belonging to Mr. Russell, a third of a mile south of Gartside's, coal crops out on the western slope of a hill fifty feet below the top. The bed is worked by Mr. Russell, by means of five shafts, sunk on the top of the hill.

The deepest of these is forty-five feet, the shallowest thirty feet, and the bed of coal varies from four feet eight inches to five feet in thickness. During the winter months about fifty hands are employed here in working the coal, and the average quantity extracted per day is about eighty bushels to the hand. The subjoined diagram exhibits a vertical section of the coal strata at this place. The first layer beneath the surface represents the Quaternary deposits, twenty-three feet; the second, "tumbling rock," consisting of masses of limestone embedded in clay; the third, main rock, or gray hydraulic limestone; the fourth, blue clay; the fifth, dark shale; the sixth, coal; and the seventh, gray fire-clay.



SECTION AT RUSSELL'S COAL MINE.

But the mines that have been, probably, worked most extensively in the county, are those of Messrs. Hunt & McDonald, situated in the Prairie des Noyers, on the west side of Grand Avenue, three miles from the Court-House. The land here is about of the same elevation as at Russell's Mines, and the coal is reached by a number of shafts, which vary from twenty-two to thirty-eight feet in depth. The bed is from three to six feet thick, but the common thickness of the workable coal is about five feet. Mr. Hunt informed me that, during the summer months, he employs about sixty hands, and, during the winter, one hundred and fifty. Messrs. Hunt & McDonald sunk an Artesian well on their land to the depth of one hundred feet, and, at twenty feet below the bed now being worked, struck another stratum of coal,

eighteen inches thick. This fact is of some importance, as showing the existence of more than one bed in this part of the coal district. It is very probable that this eighteen-inch stratum is coëxtensive with the thick bed above it.

South of Hunt's, are Morrow and McGreggor's coal mines, on the west side of the Gravois road; and a short distance further, in the same direction, is Peter Delore's, on the east side of the road. At both of these places, the bed of workable coal is about three and a half feet thick. I might mention numerous other points where coal is profitably mined in the southern part of the coal area; but, as all the workings are on the same bed, it would serve no good purpose.

About four miles west of the Court-House, on the Clayton road, a seam of impure coal, from eight to ten inches thick, shows itself at an elevation of fifty feet above the bed of the River des Peres. It is underlaid by fire-clay, beneath which is compact gray limestone, containing *Chonetes mesoloba*, *Productus Wabashensis*, and *Fusulina*. A third of a mile further west, on Chouteau's land, a bed of coal, thirty-one inches thick, is worked considerably below the level of the last-mentioned seam, the fossiliferous limestone being here about four feet above the coal. This bed is, doubtless, the same as that worked at Russell's, and other points in the Prairie des Noyers, while the eight-inch seam, seen in the road, is undoubtedly a distinct stratum lying above it. It is, therefore, pretty evident, that we have in St. Louis county, at least three beds of coal, beneath the ferruginous sandstone: viz., an eighteen-inch stratum below, and an eight-inch stratum above the main workable bed.

On land belonging to Mr. Shreve, four miles from the Court-House, a coal-bed, one foot thick, appears in the side of a hill, about ten feet above the bed of a small branch of Maline Creek.

On the St. Charles McAdamized road, a short distance beyond Prairie Place, I was informed that a thin seam of coal was struck in excavating a well.

South of the Clayton road, in Sec. 17 of Town. 45, R. 6 E., on Mrs. McCutchan's land, an eight-inch seam of coal crops out near the base of a hill. It is of inferior quality, and too light for blacksmiths' use. On Mr. Philip Litzinger's land, south-west quarter of north-west quarter, of Sec. 18, Town. 45, R. 6 E., in sinking a well on the top of a hill, the same bed was struck, thirty-eight feet below the surface. Coal, also, occurs on Mr. Fitzgerald's land, south of the Bon Homme road, about fifteen miles from St. Louis.

The coal of this county is all of the bituminous variety, burns with a good flame, and yields a gray ash. Sometimes it contains a good deal of sulphuret of iron, in the form of thin leaf-like laminæ, and at others, it is comparatively free from this substance. It, also, frequently contains very thin plates of crystalline carbonate of lime, generally vertical, but sometimes horizontal and oblique.

It is extremely rare to find fossil plants in the coal, sufficiently well preserved to enable one to make out, with any degree of satisfaction, even their generic characters. They are always converted into soft charcoal, that may frequently be seen along the planes of stratification. In a few instances, I have detected the structure of *Calamites* and *Equisetae*.

Fire-clay. — This highly useful substance may be said to occur in almost inexhaustible quantities in the Coal Measures of St. Louis county, as it forms the underlie of the workable coal-bed at nearly every locality that I have examined; and it, also, frequently exists between that bed and the thinner seams above and below it.

About four miles from the Court-House, between the Bellefontaine road and New Bremen Cemetery, it is extensively manufactured into fire-bricks, by Mr. Hambleton. The bank here presents the following section in descending order: —

1.—Yellow ferruginous impure fire-clay,	6 ft.
2.—Light gray fire-clay,	1 ft.
3.—Coarse ferruginous clay,	4 in.
4.—Variegated gray and purple fire-clay,	8 ft.

The bed at the base of the section is considered the purest variety;* that at the top does not answer a good purpose.† In the manufacture of fire-bricks, the former is generally mixed with a gray fire-clay that occurs directly under the coal-seam, on Mr. Shreve's land, a quarter of a mile west of the locality under notice. The mixture of the two clays makes an excellent quality of fire-bricks.

Hydraulic Lime. — The gray compact limestone, lying above the thick coal-bed, known at the coal-mines under the name of "Main Rock," exhibits frequently, the external characters of hydraulic limestone, and sometimes, also, the "Tumbling Rock," which lies above it. It will be necessary, however, to test them, to enable us to determine with certainty whether they are suitable for this purpose.

Ferruginous Sandstone. — This rock, which is the next below the Coal Measures, is to be seen only at a few points in the county. The best exhibition of it occurs at Emerson's quarry, near the Bon Homme road, about fourteen miles a little north of west from St. Louis. At this locality, it displays a thickness of twenty-five feet; and above it, we find the clays and limestones of the Coal Measures. It occurs in beds from four to five feet thick, and in its lithological appearance resembles very closely the Saccharoidal Sandstone. When first taken from the quarry it is quite soft, but it hardens somewhat after being exposed to the air. This sandstone, also, occurs at Cheltenham Sulphur Springs, where it is found directly above the St. Louis Limestone. Again, it is met with in the bed of a small branch of Maline Creek, near Hamilton's fire-clay bank. Here it is partly a white and partly a dirty ferruginous friable sandstone. The sandstone already mentioned as occurring beneath the coal-bed at Watkins', on the Mississippi river, also belongs to this formation. It here occurs in layers from a fourth to six inches in thickness, and is made up of fine quartzose particles, cemented with a silicious paste. Some of the beds are pure white, others are stained with oxide of iron.

The *St. Louis Limestone*, which in the descending series succeeds the Ferruginous Sandstone, is a highly important member of the Carboniferous System in St. Louis county, and its development here is greater than has been observed elsewhere in the State. Its lithological characters have been described at length in my account of the Mississippi river section. In the northern part of the county it forms a belt, estimated at from two to three miles in width, and about nine miles in length, lying be-

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* According to Dr. Litton's analysis, a specimen, dried at 212° Fah., yielded—

Silica,	53.94
Alumina, with some peroxide of iron,	33.73
Lime,	1.17
Magnesia,	trace.
Water,	10.94
	99.78

† Dr. Litton's analysis of this clay resulted as follows, dried at 212° Fah.:—

Silica,	56.25
Alumina, with very little peroxide of iron,	29.85
Lime,	1.03
Magnesia,	trace.
Water.	11-11
Alkalies and carbonic acid?	not determined.
	98.24

tween the Coal Measures and the Missouri. Just below Belle-Fontaine, the upper part of the formation is exposed on the shore of the river to the height of forty feet. Opposite the site of the old fort, and for some distance above, it forms perpendicular walls on the river, from ten to twenty feet high.

It shows itself in an irregular patch, in Sec. 33 and 34, of Town. 46 N., R. 6 E. In Sec. 33, it has been quarried somewhat extensively on land belonging to Mr. Underwood, for macadamizing the St. Charles road. At the base of the quarry, is five feet of thick-bedded, brittle, compact, pure limestone, of fine texture, above which is a foot of hard, bluish gray magnesian limestone, and the whole is surmounted by five feet of buff, earthy-looking magnesian limestone, in beds two and a half feet thick. Watson's quarry, a half mile west of this place, is also in the upper part of the St. Louis Limestone. The rock here is very compact, of a gray color, and contains a good deal of chert. In the township in which St. Louis is situated (Town. 45 N., R. 7 E.), it occupies all the space between the Mississippi and the eastern boundary of the Coal Measures; and south of this township, continues almost to the extremity of the county, forming a broad belt along the Mississippi, whose width from east to west is from six to nine miles. Again it skirts the south-western margin of the Coal Measures, in Town. 45 and 46, R. 5 and 6 E., appearing over a district from one to five miles in width; its greatest development here being in Town. 45, R. 6.

Excellent exposures of this formation are to be seen at the numerous quarries in and about St. Louis and Bremen, on the River des Peres and Gravois Creek.

The *Fossils* will be found in Catalogue No. III., and all the species there enumerated were found in this county.

It has not been possible to see its entire thickness at one point; but, from careful observation on the different beds, at a number of places, I estimate it at about 250 feet.

As a *material for construction*, the St. Louis Limestone is, in my opinion, not surpassed by any rock in the county. It is durable, dresses well, and, save some of the very uppermost layers, is remarkably free from chert. The compact beds, near the top of the formation, containing *Palaechinus multipora* and *Poteriocrinus longidactylus*, are, perhaps, the best. At the quarries, near the river, and in the vicinity of the new reservoir in St. Louis, slabs may be obtained from two or three inches to as many feet in thickness, and of any required length and breadth.

Lime. — The numerous lime-kilns around St. Louis, and, in fact, wherever the formation occurs, sufficiently prove its value for making quicklime. In my Mississippi river section I have indicated the beds that are to be preferred.

Archimedes Limestone. — This formation is so extensively covered with superficial deposits in this county, that it has not been possible to trace out its boundaries with as much precision as could have been desired. On the State road, it first makes its appearance about sixteen miles from St. Louis, and from thence extends westward for the distance of about ten miles. Good exposures may be seen in the neighborhood of Manchester, particularly on the south side of Grand Glaize Creek, where several quarries have been opened in it. The strata here consist chiefly of white limestone, with some layers of chert interstratified.

From the State road it extends beyond Creve Cœur Lake, decreasing in width as we proceed northward. It has been quarried on the Bon Homme road, a few rods west of Creve Cœur Creek, and used for constructing the bridge over that stream. The beds here are the same as are being wrought for the Custom-House, at St. Louis. The lower strata are from three to four feet thick, but at the top of the quarry they are thin-bedded. Along Creve Cœur Creek the Archimedes Limestone may be seen at several points, presenting the characters observed on the Pacific Railroad at the two tunnels.

At the Big Bend of the Meramec, south of Barrett's Station, the hills are about one hundred and fifty feet high, and are composed entirely of this formation, abounding in many of its usual fossils.

On the west bank of Meramec River, at Fenton, it appears in fissile layers of a gray color, separated by thin marly partings. In addition to many characteristic species of the mass, I found here a beautiful variety of *Pentremite*, which I have described under the name of *P. curtus*, and a new species of *Capulus*. To the Palæontologist, these strata are very interesting, but their schistose character detracts from their value as a building material. A short distance from the river, the hills attain a height of about a hundred and twenty feet; and near the top, is a quarry in the Archimedes Limestone, which has furnished some of the rock for macadamizing the road leading from St. Louis to Hillsboro'. This rock consists of brown and gray subcrystalline and earthy limestone, containing cavities, lined with calc spar. The beds are from one to three feet thick, and have the appearance of a good building stone. Fossils are not so abundant as in the inferior beds of the river shore. The most characteristic are *Productus punctatus*, *Orthis umbraculum* and *Spirifer striatus*.

Both east and west of Fenton, the Archimedes Limestone forms the surface rock for two or three miles, and it also passes southward from this place into Jefferson county, forming, on the Meramec, hills upwards of a hundred feet high.

The qualities of this rock, as a building material and lime-rock, have been already mentioned in my description of the section along the Pacific Railroad; and its fossils are enumerated in Catalogue No. IV.

Encrinital Limestone. — This formation, which underlies the preceding, occupies an area of about forty-five square miles in St. Louis county, lying chiefly in Town. 44 N., Rs. 4 and 5 E., and Town. 45 N., R. 4 E. If we draw a line diagonally through the latter township, from the middle of the north line of Sec. 2, to the south line of Sec. 33, we shall find that nearly all the land in the township, west of such a line, is underlaid by the formation under notice. In Town. 44, R. 4, it occupies a district from one and a half to two miles wide on the north and east sides, and in Town. 44, R. 5, prevails in the two western tiers of sections.

The best exhibition of the Encrinital Limestone that I have seen in the county, is on the sides of a deep ravine, known under the name of "Stony Hollow," in Sec. 7, of Town. 44, R. 4 E. Here it is displayed to the height of about 250 feet, and is composed of buff-colored, earthy, granular limestone, white sub-crystalline limestone and chert, in beds from an inch to five feet thick. The sub-crystalline beds are a good and durable building stone, and have been quarried at two or three points in the ravine for the foundations of houses in the neighborhood, and for bridges on the State road. They will make a first-rate article of quicklime, and may at once be recognized by the abundance of Crinoid remains they contain, some beds being almost entirely composed of these beautiful "Lillies of the Ocean." I obtained here some good examples of *Pentremites Sayi Platycrinus planus*, and *Actinocrinus rotundus*. And among the Brachiopods, *Spirifer Burlingtonensis* and *Orthis Michelini*. Near the foot of the ravine, the Encrinital beds are found resting upon a compact bluish gray limestone in thin strata, which resembles very much portions of the Chemung Group.

At the point where the Howell's Ferry plank-road crosses Bon Homme Creek, there is an exposure of about thirty feet of the Encrinital Limestone, containing large elliptical spines of Encrinites and the usual characteristic fossils of the formation. It again appears at several points on Caulk's Creek, a small tributary of Bon Homme Creek, and also on both sides of the Meramec.

CHEMUNG GROUP.

This formation is but little developed in St. Louis county, being confined to a narrow band, scarcely more than a third of a mile wide, and which I have only observed in Town. 44 N., R. 4 E. The best and only good exhibition of it is to be seen on the Pacific Railroad, and its characters there have been described at sufficient length in the earlier part of this report. The boundary of its out-crop is represented on the geological map of the county by the light green color.

LOWER SILURIAN SYSTEM.

In this county, the Chemung rocks appear to repose directly on the Trenton Limestone; the Hudson River Group, Upper Silurian and Devonian systems having no representatives.

By reference to the geological map, it will be seen that the Lower Silurian Rocks occupy the whole of the western tier of townships, and also extend over a considerable district of country in Town'ps 43 and 44, R. 4 E.

The Trenton Limestone here, as on the Mississippi, may be separated into two well-marked divisions, an upper white sub-crystalline, and a lower bluish gray compact limestone. Both varieties have been already noticed to some extent in the description of the railroad section. The white limestone may be well seen along the valley of Hamilton Creek, between the railroad and State road, and about a mile and a half from the former. Here it exists in thick and thin layers, forming abrupt cliffs from forty to fifty feet high, and might be quarried to excellent advantage. It appears to me to be equal, if not superior, as a building rock, to that used for the columns of the Court-House. The bluish gray compact beds are exposed on the State road, where it crosses Fox Creek. They contain *Orthis disparilis, O. subacquata, Illaenus crassicanda* and an *Ambonychia.* These layers are near the top of the hill; at the base, the rock is perforated in all directions by vermiform cavities, sometimes lined with yellow argillaceous matter. At Melrose, similar beds occur on the declivities of the hills, and contain a great number of fossils.

Throughout the whole course of Wild-Horse Creek, the lower Trenton Limestone constitutes the entire mass of the hills, which are from one hundred to two hundred and fifty feet high. Near their bases, the limestone strata are occasionally separated by beds of blue and gray marl, abounding in fossils.

The 1*st Magnesian Limestone* and *Saccharoidal Sandstone* have been spoken of at sufficient length in my description of the railroad section.


GEOLOGICAL MAP
OF
ST. LOUIS COUNTY.
BY
B. F. SHUMARD.
R. B. PRICE, DRAUGHTSMAN.
Lith. by Schaerff & Bro. St. Louis
Sections in a Township.
6 5 4 3 2 1
7 8 9 10 11 12
18 17 16 15 14 13
19 20 21 22 23 24
30 29 28 27 26 25
31 32 33 34 35 36
Quaternary
Coal Measures
Carboniferous L.
Chemung Group.
Silurian
Geological Boundary
Coal
MISSOURI
RIVER
MISSISSIPPI
ILLINOIS
COAL MEASURES
CARBONIFEROUS LIMESTONE
LOWER SILURIAN
Carboniferous Limestone
Archimedes Limestone
Encrinital L.
Meramec Encrinital Limestone
Chemung Group
St. Louis Limestone
Quaternary
Swamp
St. Charles
Ferry
North Missouri R.R.
Pacific R.R.
St. Louis & Iron Mountain R.R.
Bridgeton
Florisant
St. Ferdinand Common Field
Charbonniere
Halls Ferry
Jamestown
Belle Fontaine
Columbia
Glaize au Biche
Spanish Lake
Cold Water Cr.
Watkins Cr.
Maline Cr.
Bremen
Gingras Cr.
Grand Prairie
St. Louis
Cheltenham
Laclede
Kirkwood
Manchester
Ballwin
Tippets
Melrose
Allenton
Fenton
Ferry
Carondelet
Carondelet Common
U.S. Jefferson Barracks
Gravois Cr.
Riv. des Peres
Meramec River
Grand Glaize
Kiefer Cr.
Hamilton Cr.
Bonhomme Cr.
Wild Horse Cr.
Caulk's Cr.
Fee Fee Cr.
Creve Coeur Lake
Big River
Negro Fork
Mattice Cr.
Cove's Salt Lick
Fishestown
JEFFERSON COUNTY.
47
46
45
44
43
3
4
5
6
7

PALÆONTOLOGY.

DESCRIPTION OF NEW SPECIES OF ORGANIC REMAINS.

The following descriptions and figures of new organic remains from the rocks of our State, embrace only such species as are characteristic of the formations in which they occur, none of them having been found to pass from one into another. The illustrations have been drawn with great care, by Mr. F. B. Meek, one of the principal assistants in the Survey, and are true portraits of the objects they are intended to represent. The examples we have selected form but a very small part of the new and interesting fossil forms that have been discovered in the strata of our State. Already, more than two hundred species, unknown to science, have been brought to light, and there is every reason to believe that many more will be added to the list, after our rocks have been more fully explored. The collections made by Professor Swallow from the upper palæozoic rocks, in North Missouri, would alone, if properly illustrated, occupy a large-sized volume; and such a volume would not only be an important contribution to science, but in the highest degree creditable to the State. I need not speak here of the value of fossil remains in the identification of strata, as this will, doubtless, be sufficiently dwelt upon by Professor Swallow.

CRINOIDEA.

GENUS PENTREMITES—SAY.

PENTREMITES SAYI*—SHUMARD.

Pl. B—Fig. 1—*a, b, c. d.*

Body subglobose; *base* (*pelvis*, Miller) small, concave, eight-sided, with five angles salient and three retreating; two of the pieces are broad pentagonal, and one is lozenge-shaped. *Fork pieces* short, forming rather more than one-fourth the length of the body, wider than long, enlarging rapidly from below upwards; upper edges arched on either side of the pseud-ambulacral fields; inferior edges of three, truncated and resting on the straight edges of the pentagonal plates of the base; the others terminating in obtuse angles, which rest in the retreating angles of the base, with their points corresponding to the basal sutures. These pieces are highest in the middle, and form five small projections around the base of the body. *Deltoid pieces* thicker than the fork-pieces, sub-triangular forming three fourths the

* In designating the shell pieces of this and the following species of Pentremites, I have, with some exceptions, availed myself of the terms employed by Dr. F. Roemer, in his valuable Monograph on the Blastoidea.

entire length of the body; lateral edges widely beveled, each beveled surface about as wide as one of the pseud-ambulacral fields; inferior edges excavated on each side of the median line, so as to form on every piece three obtusely salient angles. The surface at the summit bears a small deep pit, bounded below by a transverse ridge, and from the latter proceeds a distinct carina down the middle of the pieces to the base; a well-defined carina, also, surrounds the borders. The *pseud-ambulacral fields* are narrow, reach down to the base of the body, and their sides are nearly parallel. They consist of pore pieces, supplementary pore pieces, and lanceolate pieces. The pore pieces amount to about eighty in each field; they are transverse and wedge-shaped; supplementary pore pieces, small, triangular; lancet piece narrow, linear, forming not quite one-third the width of the field, and minutely crenulated. The ovarial apertures are very small, and situated on the sides of the deltoid pieces, which are notched at each of the openings. The anal opening is rather large, ovate, and situated on the upper extremity of one of the deltoid pieces. The central opening is closed by minute, usually pentagonal and hexagonal plates, arranged in a manner somewhat similar to those of *Pentremites* (*Elaeacrinus*) *Verneuili* (Roemer).

Dimensions. — Length, 7 lines; width, 7 lines; diameter of pelvis, 1⅔ lines; length of fork-pieces, 3 lines; length of deltoid pieces, 6 lines.

This fossil presents all the essential characters of the genus *Elaeacrinus*, founded by Dr. F. Roemer, on a species from the Devonian strata of the Falls of the Ohio. It possesses a circle of five pairs of ovarial apertures around the summit, and one large anal opening. A central opening is not visible in perfect specimens, this being perfectly closed by minute angular plates. The same structure occurs in *Pentremites Norwoodi* and *P. melo* (*Owen and Shumard*), of which I have fully satisfied myself from an attentive examination of many specimens. And I have but little hesitation in advancing the opinion, that all the *Pentremites* included at present in the group *Elliptici* of Dr. Roemer, will be found, like *Elaeacrinus*, deficient in a central summit opening.

Formation and Localities. — It occurs near the base of the Encrinital Limestone, in Boone, Marion, Jefferson, St. Louis and Ste. Genevieve counties.

Named in honor of Thomas Say, the founder of the family Blastoidea.

PENTREMITES ROEMERI. — SHUMARD.

Pl. B — Fig. 2 — *a, b, c, d.*

Body small, elliptical, a little flattened on the summit. *Base* small, pentagonal, slightly elongated, flattened convex or plane; edges slightly arcuated, composed of three pieces, two wide pentagonal and one quadrangular. *Fork pieces* (*radials*) subhexagonal, widest above, length a third greater than the width, and occupying about three-fourths the whole length of the body. Their branches are ornamented with crenulated ridges, longitudinal and transverse, the latter being usually most prominent towards the extremities of the pieces. Deltoid pieces rather small, a little longer than wide and sub-quadrangular. The pseud-ambulacral fields extend nearly to the base of the body. They are narrow, with sides nearly parallel. The disposition and form of the pore pieces cannot be seen.

The ovarial apertures are small, circular, and lie on either side of the extremity of the deltoid pieces. The *anal aperture* is large, and of an elliptical form. The central part of the summit, like the preceding species, is covered with small plates, but owing to the worn condition of the specimens, their form has not been ascertained.

Dimensions. — Length, 3½ lines; greatest width, 2¾ lines; long diameter of base, 1½ lines.

The place of this handsome little Pentremite is in the group *Elliptici* of Dr. F. Roemer, and it is at once distinguished from all the species of this section, by its convex base.

Geological Position and Locality. — It occurs in the Chemung group, at Providence, Boone county, where it is associated with *Chonetes ornata* and *Rhynconella obscura-plicata.* It is very rare, only two examples having been discovered.

I am glad to be able to dedicate this species to Dr. Ferd. Roemer, of Bonn, Prussia, whose recent valuable researches have added so much to our knowledge of this interesting family.

PENTREMITES CURTUS. — SHUMARD.

Pl. B — Fig. 3 — *a, b.*

Body short, sub-globose. *Basal* pieces small, concave, not visible from a side view. *Fork pieces* hexagonal, arched, occupying nearly the entire height of the body; length and breadth about equal; bent inwards and upwards below to join the basal pieces; sides sub-parallel; upper edges oblique and slightly arcuated. Surface beautifully marked with granulose ridges, several of them uniting to form a broad band around the borders, within which the granules are not so distinctly collected in regular lines, but are diffused over the surface. Deltoid pieces sub-rhombic, about half as long as the fork pieces; a large portion of them lying on the summit plane; inferior edges rounded; surface granulose. The pseud-ambulacral fields are narrow, linear, and extend nearly the whole length of the body. The pore pieces are convex, and project beyond the edge of the fork pieces; they are moderately large, and very finely striated. The supplementary pore pieces, and lancet pieces cannot be made out. The structure of the summit, and characters of the ovarial and anal apertures, are, also, unknown.

Dimensions. — Height, about three lines; width, about four lines.

Formation and Locality. — I found this species at Fenton, on the Meramec River, in St. Louis county; where it occurs in the Archimedes Limestone, associated with *Pentremites florealis, Productus punctatus* and *Productus elegans.* The specimen figured is the only example we have found of this elegant *Pentremite.* It is considerably distorted, so that the figure represents it as being more transverse than natural.

PENTREMITES ELONGATUS. — SHUMARD.

Pl. B — Fig. 4.

Body much elongated, elliptical, usually more than twice as long as broad. *Base* small, short, truncated, sub-conical. *Fork pieces* much elongated, about one and a half times longer than wide, and occupying rather more than two-thirds the total length; their branches are long, narrow, and very obliquely truncated above; the surface is marked with very fine striæ, the direction of which is nearly parallel with the borders. *Deltoid* pieces elongate, quadrangular, the inferior edges being considerably shorter than the superior ones; surface striated in the same manner as the fork pieces. The *pseud-ambulacral fields* extend almost the entire length of the body, and gradually increase in width from below upwards. The pore and lanceolate pieces do not vary much from those of *P. floeralis,* except that the first are more numerous, and the second considerably longer.

Dimensions. — Length, 15½ lines; width, about 9 lines; diameter of base (*pelvis*), 8 lines; height of base, 1 line; length of fork pieces, 9 lines; width of ditto, 5 lines; length of deltoid pieces, 4 lines; greatest width of ditto, 1½ lines.

This *Pentremite* appertains to the section *Floreales* of Roemer, and is very nearly allied to *Pentremites florealis* and *P. pyriformis* of Say, and *P. sulcatus* (Roemer), from which species ours is distinguished by its greater proportionate length, and, consequently, increased number of plates in the pseud-ambulacral fields. Its form is, also, more regularly elliptical, and it invariably occupies a lower geological position.

Geological Formation and Localities. — We have found this species, but not abundantly, in the Encrinital Limestone, on the Mississippi, at Clarksville, Pike county. Professor Swallow found it near Columbia; and Dr. Litton showed me specimens of it from the same formation at Rocheport.

POTERIOCRINUS MEEKIANUS.* — SHUMARD.

Pl. A — Fig. 7 — *a, b.*

Calyx inverted conical, expanding rapidly from below upwards; plates thick, smooth; sutures strongly defined. Basal plates five, pentagonal, as wide again as high, forming, united, a low cup, its under side deeply excavated, and presenting a wide funnel-shaped cavity to receive the last columnar joint. This facet is covered with numerous fine, radiating striæ, and contains a large pentagonal central perforation. The sub-radial pieces are hexagonal, their length and breadth about equal, and they are twice as high as the basal pieces. First radials (*Scapulae, Miller*) as wide again as high; upper edges excavated about one-third the length of the plates, and bearing a finely striated facet for articulating with the succeeding radial piece. This facet occupies about two-thirds the width of the piece. Of the second radial pieces, only one remains; this is very short, and scarcely fills one-third of the excavation of the large first radial. The upper radials, brachials and the column are unknown.

This encrinite is remarkable for the thickness of its shell pieces and its general robust appearance. It is distinguished from *Poteriocrinus impressus* (*Phillips*), to which it is most nearly related, by its more depressed form, the shortness of the basal pieces, and the greater proportionate width of the first radials. It cannot be mistaken for any other described species.

Dimensions. — Length of calyx, 8 lines; width of base, 5 lines; greatest width at summit, 14 lines; height of basal pieces, 2 lines; height of sub-radials, 4½ lines; height of radials, 4 lines.

A single specimen, only, has come under our observation. It was found by Mr. F. B. Meek, at Mount Vernon, in Moniteau county, and to him we have dedicated the species. Its geological position is probably near the base of the Encrinital Limestone, though this is somewhat doubtful, as Mr. Meek found it among loose debris, at the foot of bluffs, composed of both Chouteau and Encrinital Limestone.

POTERIOCRINUS LONGIDACTYLUS.— SHUMARD.

Pl. B — Fig. 5 — *a, b, c.*

Body elongate-conical, surface of plates smooth. *Basal pieces* five, pentagonal, length and breadth nearly equal, uniting to form a little cup with a wide surface beneath, for the supra-columnar joint, and with sides expanding very gradually from below upwards; sutures not very apparent. *Sub-radial* pieces very slightly convex; three of them, regular, hexagonal, as broad as long; the two others, which are situated on the anal side of the body, are irregularly heptagonal, about equal in size, and a fourth larger than the regular pieces. *First radial pieces*, wider than long; articular surfaces occupying the whole width; four of them pentagonal, alternating with the sub-radials; the fifth is irregularly hexagonal, projects above the others, and rests on the upper straight edge of one of the large sub-radials; one of

* In the description of this and the following species of Crinoids, I have adopted the nomenclature recently submitted by MM. De Konninck and Le Hon, in their excellent work on the Crinoids of Belgium. (*Recherches sur les Crinoides des Terrain Carbonifere de la Belgique.*) By it each piece can be readily designated; and it appears to me to be founded on a more correct appreciation of the structure of these animals, than any hitherto offered by authors who have written on the subject.

its sides joins a regular radial, and three unite with the anal pieces; the upper edge is truncated obliquely. The *second radial pieces* are quadrangular, and rather wider than long. The remaining plates of the arms consist of rather short wedge-shaped pieces, obtusely angulated in the middle, of which the number to the first bifurcation varies from eight to twelve. Each arm appears to be thrice bifurcated. Of the *anal pieces*, the specimens under examination permit us to count eight, disposed as follows: one is pentagonal, and rests by its inferior angle between the two irregular sub-radials; a second is hexagonal, of the same size as the last, and rests on the upper truncated edge of an irregular sub-radial; above these, are three smaller hexagonal pieces, one with sides equal, the others unequal, and to these succeed three still smaller hexagonals, from which arises the proboscis. The *proboscis* (*trompe, Koninck*) is about two lines wide, and, in the specimen figured, about one inch remains, the upper part being, unfortunately, not preserved. The fragment preserved is composed of several longitudinal rows of small, transverse, invariably hexagonal plates. Five of these rows are to be seen in the specimen, each one consisting of about twenty-five pieces, which alternate with those of the adjoining rows. At the sutures of junction, between every two rows of plates, we may observe, with the aid of a strong lens, a series of minute pores extending their whole length, which remind one somewhat of the apertures in the ambulacral fields of Palæchinus. The *column* is cylindrical, very long and slender, and enlarges just before joining the body. It consists of short, alternate thin and thicker joints, and has a central opening of a pentagonal form; the exterior surface of each joint is surrounded by a line of small granules, which frequently coalesce and form a central carina.

Dimensions. — The column of this Poteriocrinus is upwards of two feet in length. Width of body at junction of free arms, 4½ lines; width at base, 2½ lines; height of anal side, 5¼ lines; height of opposite side, 4½ lines; height of base, 2 lines; width of summit of base, 3 lines.

The remains of this *Poteriocrinus* are very common in the upper part of the St. Louis Limestone, in St. Louis county. It is associated with *Palaechinus* (*Melonites*) *multipora*. (Owen and Norwood.) The specimens figured, are from the Bremen quarries.

ACTINOCRINUS CONCINNUS.—SHUMARD.

Pl. A—Fig. 5.

The portion of the body of this species situated above the second radial pieces is unknown.

The inferior part of the calyx is nearly hemispherical, and the plates moderately thick. *Basal pieces*, three, nearly equal in size, forming a low cup with a nine-sided border, and presenting beneath a wide, circular, shallow depression for the column. *First radials*, moderately convex, length and breadth nearly equal, three hexagonal and two heptagonal; inferior angle of heptagonal pieces, corresponding with a basal suture. *Second radials*, wider than long, with the articular facets for third radials nearly perpendicular, large, reniform, occupying nearly half the length and two-thirds the width of each piece. *First interradials*, hexagonal, a little longer than wide, and rather larger than the second radials. *First anal pieces*, hexagonal, longer than wide, its inferior angle corresponding to a basal suture. Second anals, heptagonal, surface of the plates ornamented with prominent radiating ridges, which rise from near the center of the plates, and cross the sutures, so as to form several sets of double triangles around the body.

Dimensions. — Diameter at base, 4 lines; superior diameter, 13 lines; height of basal pieces, 1 line.

The specimen figured, is all that has been found of this beautiful species of Actinocrinus. It was discovered by Professor Swallow, in the Encrinital Limestone, on North River, in Marion county.

ACTINOCRINUS MISSOURIENSIS. — SHUMARD.

Pl. A — Fig. 4 — *a*, *b*, *c*.

The body of this fine species has the form of an inverted truncated cone, with the truncated apex resting on a widened base. The plates are rather thick, many of them garnished with a central prominence, while others are plane or slightly convex. *Base* massive, moderately high, inferior border surrounded by a thick rim, which is notched at the sutures; articular facet for the column circular, slightly concave, occupying about one-third the diameter of the base, and usually surrounded by a shallow, but well-marked depression; two of the pieces are irregularly hexagonal, the third is sub-quadrangular. *Radial pieces* large, rather wider than long, three hexagonal and two heptagonal; upper oblique edges short, superior edges concave. The surface of each plate is marked with a prominent transverse ridge. The *second radials* are small, not more than a fourth as large as the first radials, quadrangular, as wide again as long, and raised in their centers. *The axillary pieces* (*third radials*) are pentagonal, twice as wide as high, and flattened convex; they usually support, on each of their oblique superior edges, two brachials; the first (sometimes not present) is small, short and often irregular in form; the second is comparatively large; its length and breadth being about equal, and in the upper edge is a small notch for the passage of the brachial vessels. The *first interradials* are rather large, as wide as long, and the number of their sides varies from six to nine; their surfaces bear a central mammillary projection. The *second interradials* are small, elongated, and irregular. The *anal pieces* are eight in number; the inferior one, a little longer and narrower than the *first radials*, is heptagonal, and bears on its upper edges three smaller anals, the middle one hexagonal and the others heptagonal; these again support the other and smallest anal pieces.

The pieces composing the vault have the following arrangement: Over every pair of second brachials is a rather large pentagonal piece, whose inferior angle corresponds to the axis of the radial pieces; and, on either side of this, is an elongated plate of an irregular form, which is situated over the interradials; these three form the inferior segment of a circle of seven pieces, in the center of which is a large wart-shaped plate, bearing a round articular facet; five such circles of plates surround the vertex, each enclosing wart-shaped platea. Near the center of the vault, but closer to the anal side, is a large tumid piece, encircled by eight or nine polygonal plates.

The *proboscis* is short and lies below the level of the vault-plane, and between two of the wart-shaped pieces that are wider apart than the others. It is of a semi-ovoid form, made up of small plates of various shapes; the aperture is heptagonal.

Dimensions. — Height of body, 1½ inches; diameter at vertex, 15 lines; inferior diameter of base, 9 lines; superior diameter of base, 7 lines; height of base, 8½ lines; height of first radials, 3 lines; width of base, about 4 lines.

This species, in the general arrangement of the plates, is very analagous to *Actiocrinus* (*Dorycrinus*), *Mississippiensis* of Dr. Roemer, but the general form of the body and pieces are quite different. Its summit, like that of *A. Mississippiensis*, was, doubtless, provided with spines or long thorns, since articular facets for such appendages are perfectly plain on our specimens; and detached spines, more than an inch long, occur in the strata which have yielded them.

Geological Position and Locality. — Found by Professor Swallow in the 6th Division of the Encrinital Limestone, on North River, near Palmyra, Marion county.

ACTINOCRINUS ROTUNDUS — YANDELL AND SHUMARD.

Pl. A — Fig. 2 — *a, b.*

Synonym — *Actinocriniles*, Christy, 1848. — Letters on Geology, Pl. 1, fig. 3, 4.

General form ovate, sub-globose, surface of all the plates smooth. *Basal* pieces similar in form, rather small, pentagonal, forming united a low saucer, with a hexagonal rim; articular facet large, concave, central perforation very small. 1*st radial pieces* hexagonal, as wide again as long; 2*d radials* small, quadrangular, about half as wide as the 1st radials, width rather more than double the length; axillary pieces rather larger than the last, irregularly pentagonal, supporting on each of their oblique upper edges two brachials, and the upper ones of these, being axillary pieces, bear also two secondary brachials, from which arise the free arms. The interradial pieces, of which there are three between every two of the radial rows, are nearly equal in size; those of the first order are octagonal, moderately large, and their length and breadth is about equal; the pieces of the second order are elongated and irregular in form. The *anal* pieces amount to eight or ten in number; the first, which rests on the base, is regularly hexagonal; it is longer than the 1st radial, and bears three smaller pieces, one pentagonal, and two heptagonal.

The vault is elevated, regularly convex, and consists of numerous polygonal pieces, which are large at the summit and diminish in size as they approach the orifices of the arms. The proboscis is sub-central, and situated nearest the anal side of the body.

Arms. — The example we have figured, exhibits twenty-one arm openings.

Dimensions. — Height, 9 lines; greatest width, 9 lines.

Formation and Localities. — It occurs at Rocheport, in Boone county, and near Palmyra, in Marion county, near the base of the Encrinital Limestone, and is one of the most characteristic fossils of that formation.

ACTINOCRINUS CHRISTYI.

Pl. A — Fig. 3.

Synonym — *Actinocriniles*, Christy, 1848. — Letters on Geology, Pl. 1, Nos. 1, 2.

Body large, bell-shaped, plates thick, very slightly convex, surface smooth. *Base* cup-shaped, as wide again as high, pieces nearly equal in size; 1*st radials* large, increasing slightly in width from below upwards, length and breadth about equal; 2*d radials* small, short, quadrangular; *axillary* pieces pentagonal, as wide again as high; 1*st brachials* much wider than long, irregular in form, and larger than the axillary radial pieces; 2*d brachials* considerably larger than the 1st brachials, and, being axillary pieces, they support on their upper edges two large secondary brachials of an irregular form, each of which again bears a short sub-quadrangular piece, furnished with a facet for the articulation of the free arms. The *interradial* pieces amount to four in number, and are very variable in form. The first are large, longer than wide, and usually of an irregular octagonal form; the others are small. The *anal pieces* amount to seven; the first, which rests on the base, is of large size, heptagonal, longer than wide, and its sides are nearly parallel. It supports three small pieces: one, central, slightly elongated, and hexagonal; and two, heptagonal. These again are succeeded by three still smaller pieces, pentagonal and hexagonal. The proboscis is nearly central, but only the base of it is preserved in our specimen. In a specimen from Oquawka, Illinois, figured by Mr. D. Christy,

in his letters on Geology, about one inch of the proboscis remains attached to the fossil. It is represented as being of a curved cylindrical form.

The *dimensions* of the specimen figured, are as follows: whole height, 14 lines; height from base to vault, 12 lines; greatest diameter, 17 lines; inferior diameter of base, 3 lines; superior diameter of base, 5 lines; height of base, 2½ lines.

I have dedicated this interesting species to Mr. David Christy, to whom we are indebted for the first notice of it. It was very properly placed by him in the genus *Actinocrinus*, but the figures were unaccompanied by either a description or a specific name.

This species was found by Professor Swallow, near Palmyra, Marion county, who regards it as being very characteristic of his division No. 6, of the Encrinital Limestone. It was, also, discovered by Dr. Litton, in similar geological position, at Rocheport, in Boone county.

ACTINOCRINUS PYRIFORMIS.—SHUMARD.

Pl. A—Fig. 6—*a*, *b*.

Body large, pyriform, plates moderately thick, often prominent in their centers; surface smooth, sutures not very evident.

Base sub-cylindrical; width greater than the length; inferior border slightly thickened, articular facet small, round, concave, central perforation minute, its form unknown; plates equal. *First radial pieces* large, elongated, about half as long again as wide, sides sub-parallel, upper edges very short. *Second radials* nearly square, very small, their length being only a fraction over a line, while the length of the first radials is four lines; third radials (axillary pieces) hexagonal, length and breadth about the same, and more than double the size of the second radials. *Brachial pieces* wide, hexagonal, and about equal in size to the axillary radials; their upper edges are nearly straight, and they are, also, longer than the others, and support a wide, pentagonal piece, on whose oblique upper edges rest the arm-bearing pieces; these are a little wider than long, and sometimes are hexagonal, and sometimes heptagonal. The upper edges are furnished with a semi-circular notch, which occupies about one-fourth the width of the piece, and leads into the interior of the body. The *interradials* are six in number; the first and largest heptagonal, on which rests two nearly regular pentagonal pieces; these are succeeded by one smaller pentagonal piece, which is surmounted by a larger piece of a heptagonal shape. *Anal pieces.* In neither of the specimens figured, can the number and form of these plates be made out.

The *vault* is very convex, and consists of rather large pieces, chiefly of hexagonal and heptagonal figures, of which the former are the most common.

Of the *proboscis*, only the base is preserved. Its position is sub-central and nearest the anal side. The number of arms vary in different specimens. In the larger specimen figured (Pl. A — Fig. 6, — *a*), the number of arms are indicated by nineteen apertures. In the smaller example (Pl. A — Fig. 6 — *b*), there are twenty apertures.

The *dimensions* of the largest example we have figured, are as follows: Height, 23 lines; greatest diameter, about 15 lines; height, from base to arm openings, 13½ lines; height of base, 3½ lines; inferior diameter of base, 5½ lines; superior diameter of base, 5 lines.

Geological Position and Locality. — This is one of the finest species of Crinoids as yet found in the strata of our State, and is very characteristic of the Encrinital

Limestone. Both the specimens we have illustrated were discovered by Professor Swallow, near Palmyra, Marion county, associated with the preceding species.

ACTINOCRINUS PARVUS.—SHUMARD.

Pl. A—Fig. 9.

Of this elegant little Actinocrinus we possess only a fragment of the body, from which, however, we are able to characterize the species, so as to permit of its being easily identified. Its general form is globose; the surface is ornamented with very fine, somewhat flexuous striæ, which radiate from the center of each piece to the sides, where they unite with striæ from the adjacent pieces in such a manner as to form several series of isosceles triangles around the body; the plates are thick and very finely serrated at the sutures.

The *base* is moderately convex, and has nine angles, six of which are salient and three retreating; articular facet for the column small, concave, its border finely crenulated; central perforation, extremely small and pentalobate. *First radial pieces* wider than long, three of them hexagonal, and two pentagonal. *Second radial pieces* hexagonal, nearly as wide again as long, their superior lateral edges very short. *Axillary pieces* pentagonal, about as long as the second radials, but not as wide. Each row of radial pieces exhibits a slightly prominent longitudinal ridge, which becomes obsolete as it approaches the base. *First Brachial pieces* quadrangular, short, widest above, and crenulated on the superior articular border. The number of interradial pieces amounts to three, between every two radial rows. The first and largest is hexagonal, with sides nearly equal, the others are chiefly hexagonal, with sides unequal. *Anal pieces* unknown.

The vault consists of many small pieces, irregular in form. The situation of the proboscis is unknown.

Dimensions.—Length, 5 lines; greatest width, 5 lines; height from base to arm-openings, 3 lines; diameter of base, 2 lines.

Formation and Locality.—It was found at St. Louis, in the upper part of the St. Louis Limestone, associated with *Palaechinus multipora*, and *Poteriocrinus longidactylus*. It is very rare.

ACTINOCRINUS VERNEUILIANUS.—SHUMARD.

Pl. A—Fig. 1—*a*, *b*.

General form obovate, surface of plates smooth.

Base, a low cup, widest above, slightly thickened at the inferior border, under surface gently convex; articular facet of moderate width, deeply concave; central perforation small. *First radials* large, as wide as long, three hexagonal, two heptagonal, all of them exhibiting a central prominence, which in some specimens is quite distinct, and in others obscure. *Second radial pieces* very small, quadrangular, about as wide again as long, their surfaces nearly plane. *Axillary pieces* wide pentagonal, supporting on each side a short first brachial, which on the same specimen is sometimes an axillary piece, and sometimes not; the form of the *second* and *third brachials* is very variable. Of the *interradials*, there usually exists but one between every two rows of regular radials; sometimes, however, there are two, in which case the second is quite small and irregular in form. The number of *anal pieces* amounts to seven or eight; the one resting on the base is hexagonal, equals in size the first radials, and bears on its oblique upper edges two hexagonal pieces, one wider than long, the other about as long as wide; these again, support three or four still smaller pieces.

The *vault* consists of numerous small pieces, united so as to form a nearly

smooth convex surface. *Proboscis* sub-central. *Arms* unknown; the number of arm-openings in the specimens under examination varies from fourteen to fifteen.

Dimensions. — This species presents some variety in form, dependent on differences in age. The adult specimen we have figured (Pl. A, fig. 1, b), exhibits the following proportions: — Length, 9 lines; greatest diameter, 8½ lines; height of vault, 3 lines; inferior diameter of base, 3 lines; superior diameter of same, 3½ lines; height of same, 1 line. The young example (Pl. A, fig. 1, a) has the following dimensions: — Length, 8 lines; greatest diameter, 6 lines; height of vault, 3½ lines; inferior diameter of base, 2½ lines.

Geological Formation and Locality. — Dr. Litton found this species abundantly at Rocheport; and Prof. Swallow also obtained specimens of it in the Encrinital Limestone, near Palmyra, Marion county, associated with *Actinocrinus Missouriensis* and *A. pyriformis*.

ACTINOCRINUS KONINCKI. — SHUMARD.

Pl. A — Fig. 8 — *a, b, c.*

Synonym — *Actinocrinites*, Christy, 1848. — Letters on Geology, Pl. 1, Figs. 5, 6.

The calyx of this elegant little species has somewhat the form of an ancient urn; the plates are thick, and nearly all of them are furnished with a central tubercle, which is very prominent on the pieces composing the inferior half of the calyx. *Base* about as wide again as high, decreasing rapidly in width from below upwards; inferior border trilobate; under surface nearly plane, articular facet small, deeply excavated, and circumscribed by a very slight prominence; central perforation very minute, round (?). *1st radial pieces*, three hexagonal and two heptagonal, rather higher than the base, length and breadth about equal, each one bearing a very prominent tubercle, the base of which is generally circular, but sometimes elliptical. *2d radial pieces*, small, quadrangular, rather wider than long, with or without a central tubercle. *Axillary pieces*, pentagonal as high as the first radials, and wider than long. *1st brachials* irregularly hexagonal and heptagonal, each supporting a 2d brachial of a transverse sub-hexagonal form, from which commences the free arms. The *interradial pieces* amount to only one between every two of the radial rows; this is of an octagonal shape. The *anal pieces* amount to ten; the first, which rests directly on the base, is heptagonal, longer than wide, and bears, like the 1st radials, a very large tubercle; on its upper edges rest three small pieces, the middle one hexagonal and the lateral ones heptagonal; these support three smaller pieces, one heptagonal and two pentagonal, to which succeed the remaining and still smaller pieces. The *vault* is of a depressed conical form, and consists of small polygonal plates. The *proboscis* is sub-central, and always situated nearest the anal side.

Dimensions. — Length, 7 lines; length, from base to arm openings, 5 lines; greatest diameter at summit, about 4 lines; height of base, about 1 line; inferior diameter of same, 3 lines; superior diameter of same, 2 lines.

Formation and Locality. — Occurs in the Encrinital Limestone, at Rocheport, Boone county, and near Palmyra, Marion county, where it is associated with the preceding species. Its vertical range in the strata is very limited.

GLYPTOCRINUS FIMBRIATUS. — SHUMARD.

Pl. A — Fig. 10 — *a, b.*

The body of this little Crinoid, when the delicate arms, tentaculæ and column are attached, has the form of a broom.

The *column* is round, long, slender, and composed of thin joints, every third or fourth joint being enlarged; its surface is very finely crenulated. *Calyx* conical, expanding rapidly from base to summit. *Basal pieces* pentagonal; length and

breadth about equal. *First radial pieces* hexagonal, alternating with and a little larger than the basals. To these succeed the second and third radials; and the latter, being axillary pieces, support the free arms. The remaining pieces comprising the cup are so worn, that their form and arrangement cannot be accurately made out. The *arms* are slender, twice or thrice bifurcated, and composed of numerous quadrangular joints, furnished with delicate tentaculæ; arms and tentaculæ, very finely and beautifully crenulated.

This little species, in its general appearance, and in the structure of the lower part of the cup, bears a strong resemblance to some of the species of Glyptocrinus of Professor Hall. I have, therefore, placed it in that genus, although the examination of more perfect specimens than we have at present may render it necessary to transfer it to some other.

Geological Position and Locality. — This species occurs in the Cape Girardeau Limestone, associated with *Tentaculites incurvus*, *Cyphaspis Girardeauensis*, and *Acidaspis Halli*, on the Mississippi river, in Cape Girardeau county.

TENTACULITES INCURVUS. — SHUMARD.

Pl. B — Fig. 6 — *a*, *b*.

Tube attenuated, curved, with prominent sharp annulations extending to the tip; at the large extremity there are from five to six rings in the space of an eighth of an inch, and the intervening spaces are about double the width; but near the tip the rings are much closer together, and there are from eighteen to twenty in the eighth of an inch; the whole number of rings amounts to about thirty-five. The surface is covered with fine longitudinal striæ, which cross the rings, as well as the spaces. In well-preserved specimens very fine transverse striæ can be perceived. The length of the tube varies from six to eight lines.

These little bodies occur on the Mississippi, two miles above Cape Girardeau, in Cape Girardeau Limestone. They occur in the greatest profusion, associated with *Encrinurus deltoideus*, *Cyphaspis Girardeauensis*, and *Proetus depressus*.

CRUSTACEA.

CYTHERE SUBLAEVIS. — SHUMARD.

Pl. B — Fig. 15.

Carapace small, sub-ovate, smooth, nearly as long again as high, moderately tumid, most prominent posteriorly; posterior end a little wider than the anterior, rounded; ventral margin straight, its anterior extremity extended into a minute pointed process. Just within the borders a faintly impressed line may be traced entirely around the valves. The surface is highly polished.

This little species is very analagous to *Cythere Phillipsiana*, Koninck, from the Carboniferous System of Belgium and Yorkshire. It differs in being proportionally longer, and the process on the ventral margin is much smaller and more acute.

Dimensions. — Length, two lines; height, 1½ lines.

It occurs in the 1st Magnesian Limestone, near its junction with the Saccharoidal Sandstone, near Hamilton Creek, St. Louis county, and in Ste. Genevieve county. It is very abundant, beds several feet thick being composed almost entirely of the remains of this little crustacean. At these localities the fossil is always divested of its shell. Professor Swallow has, however, discovered some individuals on Spencer's Creek, Ralls county, in which the outer crust still remains, and from these the above description has been drawn.

TRILOBITES.

PROETUS SWALLOWI.*—SHUMARD.

Pl. B—Fig. 12—*a, b.*

Head semicircular, swelled, exterior border narrow, slightly elevated and marked with four or five thread-like striæ; sinus of the border shallow and indistinct; posterior border of cheeks rather wide, and limited internally by a shallow, but distinct groove; genal angle short and rounded?; *glabella* tumid, elevated above the plane of the cheeks, occupying about four-fifths the entire length of the head, rather more than half as wide as long; front rounded; sides convex, in advance of the eyes; slightly concave in the middle, and expanding again posteriorly; lobation indistinctly marked by three very shallow depressions on each side, the anterior and middle ones being nearly obsolete; occipital segment wider than the base of the glabella; convex, and as high as the glabella; occipital furrow slightly arched towards the front, narrow, rather deeply impressed, widest at the extremities; the furrow which separates the globella from the cheeks (dorsal sinus) is narrow, flexuous and slightly impressed; *cheeks* elevated in the middle, declining rapidly towards the borders; *eyes* reniform, moderately developed, not as high as the glabella, palpebral lobes semi-oval, visual surface very minutely reticulated. *Thorax* with nine segments; axal lobe very elevated, width greater than the lateral lobes, rings rather wide, flattened in the direction of the axis; separated from each other by straight, narrow, but well-defined grooves; segments of lateral lobes flattened between the knee and axis; the two bands are of nearly equal width; extremities rounded. Pygidium parabolic, moderately convex; length about equal to the head, border rather wide; axal lobe elevated, as wide as lateral lobes; segments eleven, flattened, separated by straight and feebly-impressed grooves; lateral lobes about seven, indistinct.

The whole surface is minutely punctate; the punctæ sometimes disposed in quincunx and sometimes irregularly.

Dimensions. — Length of head, 3½ lines; greatest width, 6 lines.

Formation and Locality. — This pretty little species was found by Professor Swallow, in the lithographic limestone of the Chemung Group at Chouteau Springs, Cooper county; and by Mr. F. B. Meek, in Moniteau county.

Dedicated to its discoverer, Professor G. C. Swallow.

PROETUS MISSOURIENSIS.—SHUMARD.

Pl. B—Fig. 13.—*a, b.*

Glabella tumid, greatest height about the center, ovoid, obtusely rounded in front, truncated posteriorly, length a little greater than the width, widest behind, three furrows on either side, posterior pair strongly marked: these commence at the dorsal sinus, about one-third the distance from base to front, pass in a curve backwards, and bifurcate about midway between the center and sides of the glabella; one branch, very shallow, is continued for a short distance almost transversely; the other bends backwards nearly to the occipital sinus, and with the main branch partially encloses a large oval lobe on each side, the lobes separated by a space about half the width of the glabella; middle pair of furrows, shallow, curving backwards in a direction nearly parallel with the posterior ones, but considerably shorter; anterior pair feebly impressed, a little oblique; occipital sinus a little convex towards

* In the following description of Trilobites I have followed, with but little alteration, the nomenclature of Barrande.

the front, shallowest in the middle; occipital ring wide, flattened, much lower than the plane of the glabella. *Pygidium* semi-circular, flattened convex, width double the length, margin broad and slightly concave; axal lobe almost as wide as the lateral lobes, rounded at the extremity, segments ten, separated by strongly-marked furrows; lateral lobes flattened, with six or seven segments, separated by shallow, but well-marked furrows; surface thickly studded with granulæ, which are rather smaller than those of the glabella.

Dimensions. — Length of head, 8½ lines; greatest width of glabella, 7½ lines; length of pygidium, 6½ lines; width of ditto, 1 inch.

Cheeks and thorax unknown.

This is one of the most beautiful species found in our rocks. The test is of a light chesnut brown color.

Locality. — It was obtained by Prof. Swallow, from the Lithographic Limestone, at Hannibal, Louisiana and Chouteau Springs, Missouri, associated with *Productus Murchisonianus*, *Spirifer cuspidatus* and *Chonetes ornata*.

CYPHASPIS GIRARDEAUENSIS. — SHUMARD.

Pl. B — Fig. 11 — *a*, *b*.

Body ovate, depressed; *head* nearly semicircular, forming more than one-third the length of the body, very moderately convex, exterior border raised, narrow, prolonged posteriorly into slender, arched spines, which extend to the seventh thoracic articulation; within the border is a narrow well-defined groove, and between this and the furrow which passes round the front of the glabella is a slightly-raised surface. *Glabella* subovate, rounded before, truncated behind, occupying rather more than two-thirds the length of the head, greatest width a little in advance of the middle, surface moderately convex and but little elevated above the cheeks, when compared with other species of the genus; at the base on either side is a small ovate lobe, about half the length of the glabella, and entirely separated from it by a narrow, deeply-impressed groove; longitudinal furrows narrow, profound, uniting in front of the glabella; occipital furrow straight, narrow, deep; occipital ring about as high as the glabella, wide in the middle, narrowing towards the extremities, garnished with a minute central granule; cheeks depressed convex; eyes small, nearly circular, situated very near the glabella, and opposite the anterior half of its lateral lobes. *Thorax* with ten segments, trilobation strongly marked by the longitudinal furrows; *axal lobe* wider than the lateral lobes, slightly flattened in the middle, rings slightly arched towards the front, separated by strong furrows; seventh ring provided with a slender spine, a little flattened on the sides; it extends directly backwards, nearly two lines beyond the extremity of the pygidium. The entire length of this appendage is about four lines; it rises by a thickened base, and terminates in an acute point. *Pleuræ* rounded at extremities, each with a deep groove running nearly the entire length, bend of the knee nearest the axal extremities. *Pygidium* semicircular, twice as wide as long, border narrow, axal lobe about as wide as one lateral lobe, rings from five to eight (varying in different specimens), segments of lateral lobes tolerably distinct, grooved throughout their entire length. The surface of the crust appears perfectly smooth to the naked eye, but when examined with a strong lens, numerous minute granulæ are to be seen.

Dimensions. — Length, 7 lines; greatest breadth, 6 lines; length of head, 2½ lines.

The species described, as far as my observation extends, is the only example of the genus hitherto observed in American strata. The depressed form of the glabella

and the large size of its basal lobes will distinguish it from its European congeners, with one exception, *Cyphaspis depressa* of Barrande, from the Upper Silurian strata of Bohemia, which, also, possesses these characters. In other respects, however, our fossil is widely different, and cannot be mistaken for that species.

The only perfect example of this trilobite we have found, is represented in plate B, Fig. 11, *a*. An interesting feature in this specimen is the remarkable spinal appendage, which rises from the seventh axal ring of the thorax, and which, notwithstanding its extreme delicacy, is beautifully preserved in nearly a normal position. Barrande has observed a similar appendage in a number of Bohemian species of Cyphaspis, and Salter figures a fine example from the Silurian rocks of Britain. In all the specimens mentioned by these authors, however, the spine arises from the sixth axal ring of the thorax, instead of from the seventh, as *Cyphaspis Girardeauensis*.

Formation and Locality. — It occurs in the Upper Silurian strata (Cape Girardeau Limestone), on the Mississippi river, two miles above Cape Girardeau, Missouri, where it is associated with *Proetus depressus*, *Encrinurus deltoideus*, and Homocrinus.

ENCRINURUS DELTOIDEUS. — SHUMARD.

Pl. B — Fig 10.

Head and *Thorax* unknown.

Pygidium subtriangular, width greater than the length, moderately convex, arched before, extremity rounded and bent slightly upward; *axal lobe* flattened convex, a little elevated above the convexity of the lateral lobes, from which it is well defined by the longitudinal furrows; rings about twenty-four, narrow; the first four or five only are entire, the others are interrupted by a longitudinal space, which runs down the middle of the axis, and bears several very small granules, which are indistinct, and, in the specimens before us, are only apparent on the anterior third of its length; on each side of this interval, the rings are separated by strong transverse furrows, nearly as wide as the rings; *lateral lobes*, each about one and a half times the width of axal lobe; ribs eight on each side, narrow at their origin, and becoming wider as they approach the border, curved downward and backwards, the last two or three being nearly parallel with a line drawn through the length of the axis; furrows deep, smooth, and about half as wide as the ribs. The surface of the test appears perfectly smooth to the unassisted eye, excepting the annulations of the axis, which show traces of granules. With the magnifier, minute granulæ are to be seen, particularly near the borders and posterior extremity. The shell is of a beautiful chestnut brown color.

Dimensions of largest specimen of the pygidium: length, 9 lines; width, 10½ lines.

It is nearly related to *Encrinurus sex-costatus*, Salter, from which it differs in the greater number of ribs of the axal and lateral lobes of the pygidium, and in its axis, which is longer and narrower. From the pygidium of *Encrinurus punctatus*, as figured by Murchison, McCoy and Hall, ours may be readily distinguished by its greater width, rounded posterior extremity, and the greater width of its ribs. It cannot be confounded with any other species of the genus.

Formation and Locality. — It occurs with the preceding species in the Cape Girardeau Limestone, on the Mississippi river, about two miles above Cape Girardeau. We have found several specimens of the pygidium, but, up to this time, no portions of the head or thorax have been discovered.

PHILLIPSIA MERAMECENSIS.—SHUMARD.

Pl. B—Fig. 9.

Pygidium semi-elliptical, rather wider than long, very convex; border moderately narrow; *axal lobe* not quite as wide as the lateral lobes, and considerably elevated above them; anterior extremity arched; posterior extremity obtusely rounded; rings thirteen, convex on the dorsum, flattened on the sides; transverse furrows rather deeply impressed on the dorsum, but shallow and narrow on the flattened sides; *lateral lobes* strongly arched downwards; ribs about twelve, distinct, except the two or three last, which are obscure; the first four from the thoracic margin marked with a shallow but distinct furrow, which is situated very near the posterior edge; furrows between the ribs rather deeply impressed. Surface very finely granulose.

Dimensions. — Length, 6 lines; greatest width, 6½ lines.

Geological Position and Locality. — Occurs in the Archimedes Limestone, on the Meramec River, at Fenton, St. Louis county.

DALMANIA TRIDENTIFERA.—SHUMARD.

Pl. B—Fig. 8—*a*, *b*, *c*.

Head sub-semicircular, but little elevated, granulose; external border wide, slightly raised, and with a broad shallow groove extending nearly the entire length; front extended into a remarkable three-lobed process, about four lines wide at the base, and three and a half lines long; the lobes angulated and bent slightly upwards; one, a little the largest, projects forward from the middle of the process, and occupies about half its length; the others arise from behind the central lobe, and project laterally one on either side, their extremities being about five lines apart. On each side of the process the border is notched about half its width. The genal angles are broad, flattened convex and slightly curved at the tip; their length about equal to the head, exclusive of the frontal process. *Glabella* very moderately convex; frontal lobe transverse, somewhat lozenge-shaped, with the angles rounded, occupying more than one-half the length of the glabella, including the occipital ring, and separated from the cheeks by a well-defined dorsal furrow, which becomes obsolete in front; lateral furrows well impressed, and extending rather more than one-third the distance across the glabella; anterior pair directed obliquely backwards, forming, with the axis, an angle of about seventy degrees; second pair directed forwards; posterior pair transverse. Eyes large, lunate, very close to the glabella, and extending from the occipital to the anterior lateral furrows. The visual surface of each eye contains about thirty-eight vertical rows of lenses, the maximum number in a row being ten, the whole number about 350. The cheeks are very slightly convex.

Pygidium sub-triangular, flattened convex; border from a half to a line wide, prolonged posteriorly into a pointed spine from one to two lines long. *Axis* but little raised above the lateral lobes, forming about one-fourth the entire width, tapering gradually, rounded and slightly prominent at the extremity, from which an obscure carina extends to the caudal spine; rings fourteen, flattened convex, separated by narrow grooves; *lateral lobes*, with nine or ten segments, gently curved, and their extremities coalescing with the border; furrows rather wide but shallow, each with two shallow pits near the border, separated by a slightly-raised carina.

Formation and Locality. — This species is quite characteristic of the Delthyris Shaly Limestone, on the Mississippi river, below Bailey's Landing, in Perry county, and at Birmingham, in Cape Girardeau county.

CALYMENE RUGOSA.—SHUMARD.

Pl. B—Fig. 14.

Of this handsome species we have found only the pygidium. It is much wider than long, and the posterior border is moderately rounded. The surface is thickly studded with granules, which are most numerous on the borders. *Axis* not as wide as one lateral lobe; rings eight, separated by rather deep furrows, scarcely half as wide as the rings; *lateral lobes* with about five segments, which continue to the exterior edge, each one divided into two nearly equal parts by a slight furrow, which extends nearly to the extremity; furrows between the ribs becoming nearly obsolete before attaining the edges.

Dimensions. — Length, 6½ lines; width, 10 lines.

The pygidium here described is very similar to that of *Calymene incerta*, Barrande, but the axis is narrower, and the lateral lobes wider.

Formation and Locality. — This species occurs on the Mississippi river, one mile below Birmingham, in the Delthyris Shaly Limestone.

ACIDASPIS HALLI.—SHUMARD.

Pl. B—Fig. 7—*a, b, c.*

This is, perhaps, the most beautiful of the American species of Acidaspis, and the only one known to me from western localities. We have not yet succeeded in obtaining an entire individual, but the specimens in the State collection are sufficient to enable us to illustrate most of the essential characters of the species.

The *glabella* is very moderately convex; its length is 2¼ lines, and its width, between the eyes, is about 3 lines; frontal border elevated, garnished with a row of closely-set granules, and limited internally by a deep furrow; dorsal sinuses rather deep and nearly parallel with each other; false sinuses well defined from their commencement at the middle lateral furrows, to the occipital furrow; mesial lobe of glabella slightly elevated above the lateral lobes, and bearing a wide frontal lobe, forming a little more than a fourth of its length, and behind which the sides are slightly arched; of the lateral lobes the middle one is nearly circular, the posterior one oval; no antero-lateral sinuses, the middle and posterior ones neatly defined and deep; occipital sinus distinctly marked, but rather shallow in its middle third; occipital ring very slightly elevated above the plane of the median lobe, rather wide in the middle, constricted at the extremities, posterior edge of constricted portion bearing a prominent granule on either side; area between the groove of the occular thread and dorsal sinus narrow, triangular, and ornamented with a double row of granules; occular thread very slender, bearing a single series of granules; eyes situated directly opposite the posterior lateral lobes; *movable cheeks* as wide as the median lobe of the glabella is long; border well defined, and terminating posteriorly in a slightly-curved acute spine, about two lines in length; exterior edge ornamented with about fourteen spines, increasing in length as they recede from the front, and two of them situated on the genal spine; the forward ones are blunt at their extremities, the others are drawn to a sharp point.

Thorax. — The number of segments composing the thorax is unknown. In the specimen figured, which is the most perfect one in our possession, eight are preserved; *axis* not so wide as one of the lateral lobes; *lateral segments* each bearing a *bourrelet* of a semi-cylindrical form, occupying about half its width, and garnished with a row of granules; posterior band very narrow and difficult to be seen; anterior band very slightly convex, narrow and granulose.

Pygidium minute, sub-semicircular; axal lobe occupying about one-third the

entire width, consisting of two rings; lateral lobes very slightly convex; the single segment which arises from the first axal ring is narrow at its origin, but becomes rather broad before attaining the margin; it is prolonged into a primary spine, one on each side, about one and a half lines long, and between these are two secondary spines, about half as long as the former; the lateral borders are also furnished with two, and sometimes three secondary spines on either side.

Dimensions. — Length, about 7 lines; width of eighth rib of thorax, exclusive of spines, 6¼ lines; length of pygidium, 1 line.

Formation and Locality. — Fragments of this elegant little trilobite are quite common in the Cape Girardeau Limestone, on the Mississippi river, in Cape Girardeau county.

Dedicated to Prof. James Hall.

PRODUCTUS AEQUICOSTATUS.— SHUMARD.

Pl C — Fig. 10.

Synonyms — *Productus* — Christy, 1848, Letters on Geology, Pl. 5, Fig. 1. *Productus cora* — D. D. Owen, Geol. Rep., Iowa, Wisconsin and Minnesota, Tab. V., Fig. 1 (not *P. cora* of D'Orbigny).

Shell large, broad, hinge-line equal to the greatest width of the shell. Dorsal valve much elevated, arched, visceral portion slightly flattened on the middle, sides falling rather abruptly to the ears. Ears large, triangular, with three or four broad folds, which are not continued across the visceral portion. Just within the cardinal border is a range of four or five small tubes on either side of the beak. The beak is moderately obtuse, and passes a little beyond the cardinal border. The surface is covered with longitudinal rounded ribs, which, at about one-fourth of the distance from the beak, preserve nearly an uniform width to the front margin. Some of the ribs bifurcate near the beak, and then continue without further division, the spaces between being occasionally supplied with new ones; they are nearly straight on the back of the shell; on the sides, they are curved towards the lateral borders, and rendered flexuous by the folds. At ten lines from the beak there are fifteen ribs in the space of five lines; the whole number is from 150 to 160. The surface is studded with slender tubes, which in some specimens are separated from each other by pretty regular intervals, and arranged in oblique lines across the shell; in others, they are scattered promiscuously over the surface. In a specimen before us, we can count six ranges of these tubes separated from each other by regular distances of about four lines. In another example, they are more numerous and nearer together. They occupy rather more space than the width of the ribs. Ventral valve concave, visceral portion nearly plane, subquadrilateral, with several folds which continue across the shell; these are prominent on the ears and side, but as they approach the middle they become obscure.

Dr. Owen refers this species to *Productus cora*, D'Orbigny, from which, however, it differs in many respects. The cardinal line is much wider, ears larger, ribs coarser and fewer, and the spaces between the ribs are not more than half their width, the reverse of which is the case in the Productus Cora.

This fine species was found very abundantly by Professor Swallow, in the upper Coal Measures, on the Missouri river, at Iowa Point, Bondtown, Dallas, mouth of Platte river and Weston.

CHONETES PARVA.— SHUMARD.

Shell small, sub-semicircular, cardinal line straight, front and sides regularly rounded. Dorsal value convex, most prominent near the beak, sinus very shallow; ears short, slightly concave; surface marked with rounded, dichotomous ribs, sepa-

rated by spaces not as wide as the ribs; the number on the border amounts to about forty-five. On the ears the ribs are not so prominent as on the vaulted portion of the shell. Ventral valve with a slight elevation in front, corresponding to the sinus of the dorsal valve. Area and spines unknown.

The specimens we have of this species are somewhat worn, so that all the characters cannot be determined. It is believed, however, that the above description will identify the species.

Locality.—Found by Professor Swallow, in the Coal Measures, in Boone county.

CHONETES ORNATA.—SHUMARD.

Pl. C—Fig. 1.—*a, b, c.*

Shell small, sub-semicircular, transverse, greatest width at the cardinal border. Dorsal valve moderately convex, hinge-line prolonged into small acute ears, which are smooth, slightly deflected and convex; cardinal border, with three or four minute spines on each side of the beak; surface, with from thirty to forty rounded ribs, separated by sulci not quite as wide as the ribs; some of the latter bifurcate twice or thrice, and others proceed from the beak to the border without division. They are crossed by fine concentric undulating lines of growth, which are barely visible to the naked eye. Ventral valve moderately concave, with a shallow transverse depression on the ears, corresponding to the convexity of the opposite valve.

Dimensions.—Length, 2½ lines; breadth, 5 lines. In the number and character of the ribs, the *C. ornata* is analagous to *C. nana*, but it differs in being proportionally wider and more depressed. From *C. convoluta* (Phillips' sp.), to which it, also, bears considerable resemblance, it may be readily distinguished by the ribs, many of which are dichotomous, whereas they are always simple in the former species.

This pretty Chonetes is one of the most characteristic fossils of the Chemung Group of Missouri. It was obtained by Professor Swallow, at Vandever's Falls, Cooper county, Louisiana and Hannibal, and by Mr. Meek, in Moniteau county. It is quite common, particularly in the Lithographic Limestone.

SPIRIFER PLANO-CONVEXA.—SHUMARD.

Shell small, plano-convex, semi-elliptical, greatest width near the middle, surface of valves smooth. Ventral valve nearly plane, presenting only a slight convexity near the beak, no mesial ridge; cardinal line straight, short, less than the width of the shell; lateral borders and front regularly rounded; area short, triangular, having a rather wide foramen, with the lateral edges raised. Dorsal valve gibbous, greatest convexity at the middle, a faint mesial sinus running from the beak to the front; beak produced and rather strongly incurved; deltoid foramen moderately wide, edges slightly raised; no deltidium in any of the specimens examined.

Dimensions.—Width, 3½ lines; length, 3 lines; height, 2 lines. The surface of this shell, to the naked eye, appears smooth, but some specimens under the magnifier exhibit faint longitudinal striæ and fine concentric lines of growth.

This species was found abundantly in the Upper Coal Measures, on the Missouri, near the mouth of Platte River, associated with *Productus Wabashensis, Chonetes granulifera*, etc. For other localities, refer to Prof. Swallow's Report, p. 79.

SPIRIFER? PECULIARIS.—SHUMARD.

Pl. C—Fig. 7—*a, b.*

Shell transverse, gibbous, length and breadth nearly equal, cardinal angles rounded. *Dorsal valve* more inflated than the ventral, greatest convexity near the

beak; beak large, prolonged, elevated, incurved; hinge-line shorter than the width of the shell, flexuous; sinus shallow and narrow, extending from beak to front, not plicated; *ribs*, six or seven on each side of the sinus, simple, convex, rather broad, separated by narrow, slightly-impressed furrows; area very small, triangular, not very distinctly marked, equal to about one-third the width of the shell, aperture triangular, longer than wide; *ventral valve* convex, mesial ridge moderately elevated above the general convexity, simple, sometimes with a very slight linear longitudinal furrow; beak obtusely rounded, slightly incurved; area narrow; surface of the valves marked by very fine concentric undulating lines of growth.

Dimensions. — Length, 7½ lines; width, 9 lines.

This shell is placed with doubt in the genus Spirifer, as it presents some characters at variance with the species now included in that genus. In some of its characters it resembles the species for which the genus *Martinia* has been proposed by Prof. McCoy.

Formation and Locality. — This species is characteristic of the Chemung Group, at Chouteau Springs, Cooper county.

SPIRIFER KENTUCKENSIS. — SHUMARD.

Synonym — *Spirifer octoplicatus?* Hall, Stansb. Exped. to Salt Lake, p. 409 — Pl. XI. — Fig. 4 — *a*, *b* (not S. octoplicatus of Sowerby).

Mr. Hall refers with doubt the shell we have named as above, to *Spir. octoplicatus* of Sowerby, from which it differs in several respects. Mr. Sowerby's description, in the sixth volume of his Mineral Conchology, reads thus: "Transversely elongated, gibbous, semicircular, plaited; plaits eight or ten, deep and angular; central elevation, plain; beaks remote, incurved; area triangular curved." In some specimens procured by Professor Swallow, on the Missouri river, not far from Weston, we notice the following characters: Transversely elongate, gibbous, sub-semicircular, with from six to nine plaits on each side of the mesial sinus (the number varying with the age of the shell); plaits rounded, crossed by concentric, undulating, sharp lines of growth, thickly studded with minute granulae.

I found this shell, several years since, in the Coal Measures of Grayson county, Kentucky, and retain for it the name by which I have ever since known it. It is associated with *Terebratula subtilita*, *Productus splendens*, and *Chonetes mesoloba*.

SPIRIFER MARIONENSIS. — SHUMARD.

Pl. C — Fig. 8 — *a*, *b*, *c*, *d*.

Shell transverse, sub-semicircular, rather gibbous; hinge-line extended into acute ears, and equal to twice the length of the shell. Area narrow; borders subparallel, marked with very fine transverse striæ, and more apparent longitudinal striæ. Dorsal valve more gibbous than the ventral valve; aperture rather broadly triangular, and not closed by a deltidium; beak pointed, incurved; sinus commencing at apex of the beak, narrow, shallow, with three or four plications, which do not vary in size from those on the sides of the valve. Ventral valve regularly convex; mesial ridge scarcely elevated above the general convexity of the shell, being only a little prominent towards the front. The surface of the shell is marked with about fifty rounded ribs, mostly simple, except on the mesial fold and sinus, which are dichotomous; ribs crossed by fine undulating lines of growth.

This beautiful shell is easily recognized by its narrow area, and the slight elevation of its mesial fold, which, in young examples, is sometimes even concave. In young specimens, the cardinal border is produced into long mucronate points.

One of the most characteristic and abundant fossils of the Chemung rocks of our State. It was found by Professor Swallow, at Chouteau Springs, Cooper county; at Hannibal, Marion county, and Louisiana, Pike county. Mr. Meek, also, observed it in Moniteau county.

CYRTIA ACUTIROSTRIS.—SHUMARD.

Pl. C—Fig. 3—*a, b, c.*

Shell small; area very high, nearly an equilateral triangle; greatest width at the cardinal margin. Beak of dorsal valve very slightly incurved in most specimens, sometimes straight; deltoid aperture narrow, becoming abruptly dilated near the base; lateral edges slightly elevated; the elevation most prominent at the dilated portion; mesial sinus commencing at the tip of the beak, rather deeply impressed and destitute of ribs. Ventral valve semi-elliptical, flattened convex; mesial ridge elevated above the general convexity of the valve, and well defined by a wide concave space on either side. Some specimens exhibit a faint longitudinal sinus running the whole length of the mesial fold. Valves with four or five simple rounded ribs on each side of the mesial fold and sinus, crossed by fine undulating subimbricating lines of growth.

This shell is very nearly related to *Cyrtia (Spirifer) pyramidalis, Hall,* from the Niagara Group of New York; but it differs in the form of the aperture, which is wider, the ventral valve is more convex, and the mesial ridge and sinus, larger.

Occurs in the Lithographic Limestone of the Chemung Group on the Mississippi, at Hannibal and Louisiana.

RHYNCONELLA MISSOURIENSIS.—SHUMARD.

Pl. C—Fig. 5—*a, b, c.*

Shell gibbous, subtriangular; beaks sharp; greatest width usually near the front, but very variable in different ages of the shell. *Ventral valve* much more elevated than the dorsal valve; degree of elevation varying according to the age of the shell; beak incurved, pointed; mesial ridge obscure, with from two to three obscure rounded folds, commencing a short distance in advance of the beak, and becoming more prominent towards the front, where the valve is emarginate, and presents two or three deep indentations. Dorsal valve slightly convex near the beak, nearly plane anteriorly; sinus broad and shallow in young examples, becoming deeper in the more advanced ages of the shell; it has two or three wide obscure plaits, sometimes reaching the beak. Tongue of sinus quadrangular, bent upwards at nearly right angles to the plane of the valve, and in most specimens equal in length to one-third the length of the shell. The cardinal line is sinuous. The surface of the valves is covered with very fine, concentric, imbricating, waved lines of growth.

Professor Swallow found this species quite common in the Chouteau Limestone of the Chemung Group, at Vandever's Falls, Cooper county. It also occurs at Providence, Boone county.

RHYNCONELLA COOPERENSIS.—SHUMARD.

Pl. C—Fig. 4—*a, b, c, d.*

Shell sub-pentagonal, transverse; surface covered by prominent, simple ribs, increasing in size from beak to front. Dorsal valve moderately convex near the beak and on the lateral lobes; sinus shallow at first, but profound and very wide at the front, with seven rounded equal ribs, the last somewhat angular; lateral lobes with seven ribs, rounded at their origin, but becoming angular at the front; tongue of the sinus very wide, equal to nearly one-third the length of the shell.

Ventral valve more convex than the dorsal valve, and more regularly rounded; median ridge corresponding in width to the sinus, and very moderately elevated. Beak of dorsal valve pointed and entire; cardinal border longer than sides; anterior and lateral commissure denticulated; surface covered with numerous fine filiform striæ.

This shell is very variable in its proportions; some specimens are very gibbous; the tongue of the sinus is quadrangular and bent at nearly right angles to the plane of the ventral valve, while the opposite valve is profoundly emarginate.

This species was discovered by Professor Swallow, in the Chouteau Limestone, associated with the preceding.

It resembles very closely some of the varieties of *Rhynconella* (*Terebratula*) *pentatoma*.

RHYNCONELLA BOONENSIS.—SHUMARD.

Pl. C—Fig. 6—*a*, *b*.

Shell sub-triangular, length and breadth about equal, greatest width at the cardinal border, and diminishing rapidly to the front, where it terminates in an obtuse angle; cardinal border sinuous, terminating exteriorly in small salient ears; dorsal valve longitudinally convex, concave from side to side, furnished with two folds which are very obscure at the beak, but become rather prominent and broadly angular as they approach the front; sinus indistinct near the beak, large and moderately deep in front; tongue of sinus triangular; beak rather obtuse and strongly incurved; hinge-line sinuous and situated some distance within the cardinal border; ventral valve shorter than dorsal valve, convex on the middle, sides nearly perpendicular; mesial fold indistinct near the beak, becoming broad and somewhat prominent in front.

Dimensions. — Length, 11 lines; height, 6 lines.

Formation and Locality. — This shell occurs in the middle division of the Encrinital Limestone, near Columbia, Boone county. It is rare, only one specimen having been found.

ORTHIS MISSOURIENSIS.— SHUMARD.

Pl. C—Fig. 9—*a*, *b*.

Shell transverse, semi-elliptical, depressed convex; cardinal margin equal to the greatest width of the shell; dorsal valve very gently convex, with a broad and very shallow sinus; beak pointed, flattened, and not extending beyond the cardinal border; surface covered with fine, sharp, rounded, simple ribs, with interstitial ribs often planted between, which, before reaching the border, attain the same size as the regular ones; the number on the border amounts to fifty or sixty. With the assistance of the lens we can perceive numerous very fine concentric striæ, which give to the surface a very elegant appearance.

Formation and Locality. — Occurs in the Cape Girardeau Limestone, on the Mississippi river, two miles above Cape Girardeau.

LEPTAENA MESACOSTA. — SHUMARD.

Pl. C—Fig. 2.

Shell small, subquadrangular, transverse; greatest width at the cardinal border, which is extended into small triangular ears; dorsal valve gently convex; beak pointed, slightly prominent, and passing slightly beyond the cardinal border; a single longitudinal rib extends from beak to front, on either side of which the surface is thickly covered with fine dichotomous longitudinal striæ, of which the number,

two lines from the beak, is about twelve in the space of one line; longitudinal striæ, crossed by very fine concentric striæ of growth.

Ventral valve and area unknown.

Dimensions. — Length, 4 lines; greatest width, 6 lines.

Formation and Locality. — This species is characteristic of the Cape Girardeau Limestone, on the Mississippi river, in Cape Girardeau county.

AVICULA CIRCULUS.—SHUMARD.

Pl. C—Fig. 14.—*a b.*

Shell suborbicular, slightly convex; cardinal line about equal to two-thirds the width of the shell; length and width about equal; ears small and angulated; beak rather pointed, elevated slightly above the cardinal line; posterio-superior edge of visceral portion gently concave; sides and front regularly rounded; surface marked with sharp concentric striæ, crossed by longitudinal undulating striæ; near the beak two or three obscure folds are occasionally seen.

The *Avicula circulus* is very nearly related to *Avicula* (*Pecten*) *dolabraeformis*, from the Chemung Group in New York, described by Professor Hall in the Geological Report of the 4th District. Our specimens, however, are constantly more orbicular, and less oblique.

Geological Position and Locality. — It was found very abundantly by Professor Swallow, in the Chouteau Limestone of the Chemung Group at Vandever's Falls, Cooper county, and by Mr. Meek, in Moniteau county.

AVICULA COOPERENSIS.—SHUMARD.

Pl. C—Fig. 15.

Shell flattened, convex, sub-orbicular, slightly oblique, length and width about equal; beak pointed; hinge-line short, equal to about one-third the length of the shell; wings small, subrectangular; surface of the shell covered with fine, concentric, crowded striæ, crossed by six or seven slightly elevated longitudinal ribs.

Dimensions. — Length and width, about nine lines.

In its surface markings, this shell resembles *Avicula Kanzanensis, Verneuil* (*Geol. de la Russie et Ural Mont.*, Tome 2, page 320, pl. xx., fig. 14), but it is neither so gibbous or oblique, and the longitudinal ribs are not spinous, as in that species.

Formation and Locality. — Very abundant and characteristic of the Chouteau Limestone at Vandever's Falls, Cooper county.

ALLORISMA HANNIBALENSIS.—SHUMARD.

Pl. C—Fig. 19.

Shell transverse, subovate, rather depressed; anterior extremity rounded, posterior extremity obliquely truncated and obtusely angulated; basal margin gently rounded; hinge margin slightly concave; beaks obtuse, situated at about one-third the distance from the anterior to the posterior extremity; surface marked with about eighteen concentric ribs, the lower ones broad and angulated, those near the beak rounded and very close together.

Dimensions. — Length, 18 lines; height, 9 lines.

It is associated with *Chonetes ornata, Cyrtia* (*Spirifer*) *cuspidatus*, and *Proetus Missouriensis*, in the Lithographic Limestone of the Chemung Group at Hannibal, in Marion county.

PECTEN MISSOURIENSIS.

Pl. C — Fig. 16.

Shell small, inequilateral, oval, regularly convex, sides falling rather abruptly to the ears; surface with numerous fine, radiating, unequal, rounded ribs, which usually bifurcate once or twice before reaching the border, intervening spaces not as wide as the ribs; posterior wing triangular, pointed; lateral border arcuated; anterior wing larger than the posterior; posterior border sinuous, surface with nine or ten ribs, beak projecting slightly beyond the cardinal border, its angle about 65°. The specimens we have seen of this species are all casts.

Formation and Locality. — This species is characteristic of the upper cherty portion of the St. Louis Limestone, in St. Louis county.

PECTEN OCCIDENTALIS. — SHUMARD.

Pl. C — Fig. 18.

Shell inequilateral, rather large, ovate, subtrigonal, length and breadth nearly equal; valves convex; surface marked with radiating, slender, rounded, bifurcating and somewhat flexuous ribs, separated by spaces double their width; ribs and spaces crossed by numerous very fine concentric striæ, and several imbricating lines of growth; wings triangular, ribbed; anterior one larger than the posterior and separated from the body of the shell by a broad groove, border sinuous; posterior wing terminating in a point, its border arcuated; beak projecting slightly beyond the cardinal edge; apicial angle about 80°. It was found by Mr. Hawn, in the Coal Measures, near Plattsburg, in Clinton county.

MYALINA SUB-QUADRATA. — SHUMARD.

Pl. C — Fig. 17.

Shell very large, inequilateral, thick, elongated, subquadrate, cardinal border very slightly arched, posterior border a little sinuous, anterior border deeply excavated; beaks terminal, pointed, a little incurved; umbones rather prominent, from which there is a gradual slope to the posterior border; anterior umbonial slope nearly perpendicular to the plane of the surface of the valves; surface covered with numerous imbricating lamellæ, marked with fine concentric striæ. The facet for the ligament is very broad and covered with numerous fine grooves, parallel and extending its whole length.

Dimensions. — Length, 3 inches; width at cardinal border, 21 lines; greatest width, about 2 inches.

Formation and Locality. — Discovered by Professor Swallow, in the Upper Coal Measures, of which it is quite characteristic. Its locality is on the Missouri river, two miles below the month of the Little Nemaha.

CHEMNITZIA TENUILINEATA. — SHUMARD.

Pl. C — Fig. 12.

Shell elongate, conical; spiral angle about 26°; aperture longer than wide, volutions regularly rounded, covered with numerous fine longitudinal thread-like striæ, slightly arched posteriorly, which again are crossed by rather obscure, revolving carinæ, of which about fifteen can be counted on the body volution. The specimen we have of this shell is a fragment, consisting of about four volutions.

Formation and Locality. — This species was found in the Chouteau Limestone, in Cooper county.

MURCHISONIA MELANIAFORMIS.—SHUMARD.

Pl. C—Fig. 13.

Shell slender, elongated; volutions about nine, slightly convex, flattened, the last one obtusely carinated and angulated beneath; sutures distinct; form of aperture unknown; spiral angle, about 18°; length, 8½ lines; width of body whorl, 3 lines. The specimens of this shell that we have seen are all casts, and the surface markings gone.

It occurs in the silicious oolitic strata of the 2d Magnesian Limestone (*Calciferous Sandstone*), in Franklin county, near the junction of the Bourbeuse with the Meramec river.

GONIATITES PLANORBIFORMIS.—SHUMARD.

Pl. C—Fig. 11—*a*, *b*.

Shell small; umbilicus broad and profound; whorls about six, transverse, moderately convex on the dorsum; surface covered with narrow, transverse, small, sub-imbricating bands, bearing very minute transverse striæ; bands flexuous on the dorsum; aperture transverse, and constricted just within the edge; dorsal lobe wider than high, bifurcated, superior lateral lobes wider than long, angulated at their extremities, and about as long as the dorsal lobe; dorsal saddle somewhat linguæform, and about equal in length and width to the dorsal lobe.

Dimensions. — Greatest diameter, 3 lines; width at aperture, 2½ lines.

Formation and Locality. — Found by Prof. Swallow, in the Coal Measures, on the Missouri river, above Dover Landing.

FILICITES GRACILIS.—SHUMARD.

Pl. A—Fig. 11.

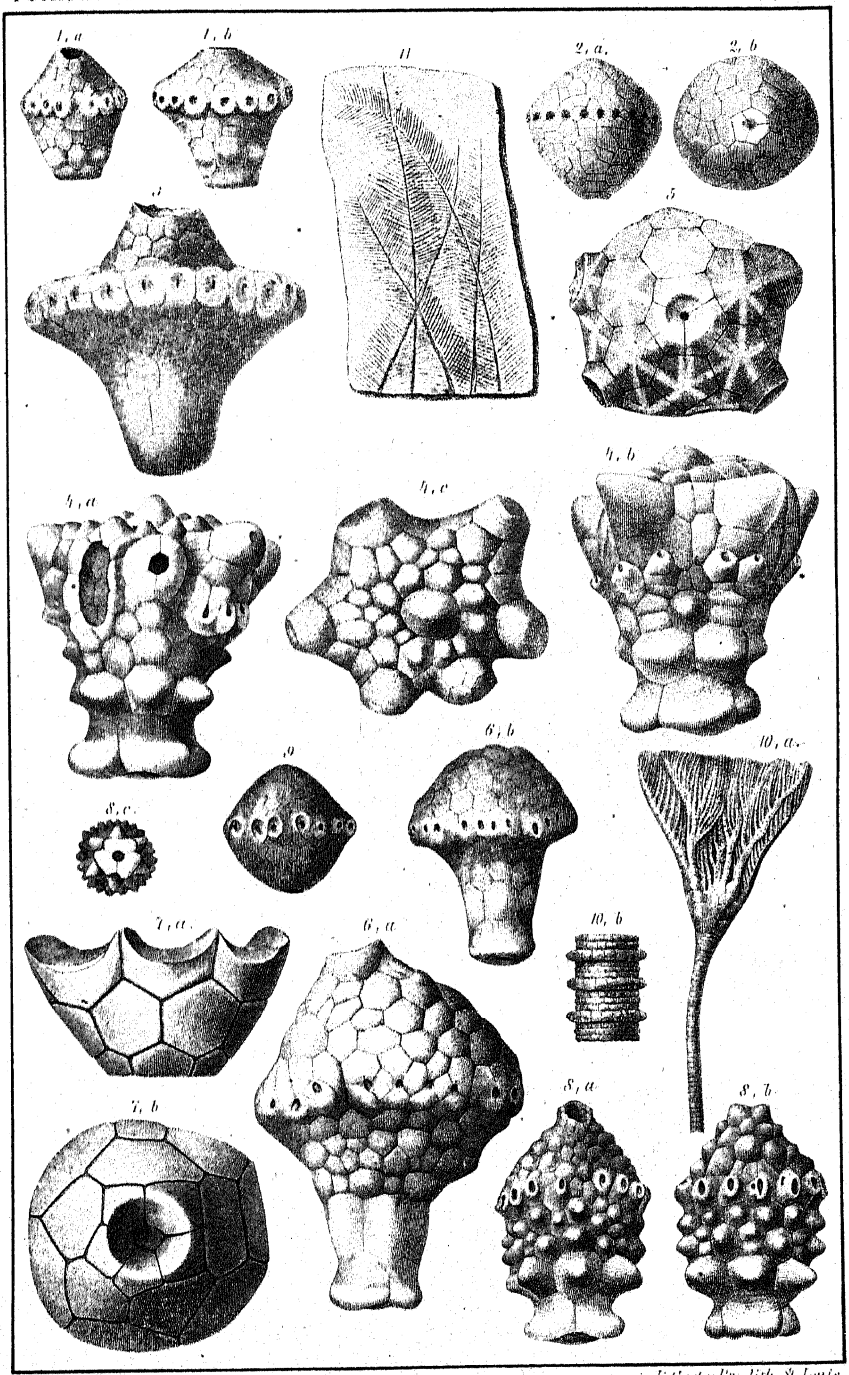
This curious fossil, in its general appearance, bears considerable resemblance to the fimbriated tentaculæ of some of the Crinoids. As it appears on the surface of the rock it consists of a central bifurcating axis, very slender, from which proceeds, at nearly right angles on either side, a series of very thin leaf-like plates, about four lines in length; these laminæ rise directly opposite each other, and they appear to be directed obliquely backwards and downwards.

It has a more slender and delicate appearance than the species figured by Prof. Hall.

Formation and Locality. — It was found by Prof. Swallow, in the Lithographic Limestone, at Louisiana and Elk Spring, Pike county; and on North River, in Marion county.

EXPLANATIONS OF PLATE A.

Fig. 1. — ACTINOCRINUS VERNEUILIANUS, *Shumard.* Part II., p. 193.
a and *b*. — Side view of two extreme varieties.
Fig. 2. — ACTINOCRINUS ROTUNDUS, *Yandell* and *Shumard.* Part II., p. 191.
a. — Side view of a specimen from Boone county; natural size.
b. — Basal view of the same individual.
Fig. 3. — ACTINOCRINUS CHRISTYI, *Shumard.* Part II., p. 191.
Fig. 4. — ACTINOCRINUS MISSOURIENSIS, *Shumard.* Part II., p. 190.
a. — Specimen, natural size; view of the anal side.
b. — Another individual; view of the opposite side.
c. — View of the summit, representing the spines restored.
Fig. 5. — ACTINOCRINUS CONCINNUS, *Shumard.* Part II., p. 189.
Basal view.
Fig. 6. — ACTINOCRINUS PYRIFORMIS, *Shumard.* Part II., p. 192.
a. — An adult individual; natural size.
b. — A young individual.
Fig. 7. — POTERIOCRINUS MEEKIANUS, *Shumard.* Part II., p. 188.
a. — Specimen, natural size; view of the side.
b. — The same; basal view.
Fig. 8. — ACTINOCRINUS KONINCKI, *Shumard.* Part II., p. 194.
a. — View of the anal side of a specimen, four times enlarged.
b. — View of the opposite side.
c. — Basal view of the same; natural size.
Fig. 9. — ACTINOCRINUS PARVUS; specimen, four times enlarged. Part II., p. 193.
Fig. 10. — GLYPTOCRINUS FIMBRIATUS, *Shumard.* Part II., p. 194.
a. — A specimen, with the arms and column attached to the body; four times enlarged.
b. — Fragment of the column; much enlarged.
Fig. 11. — FILICITES GRACILIS, *Shumard.* Part II., p. 208.



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EXPLANATIONS OF PLATE B.

Fig. 1. — PENTREMITES SAYI, *Shumard.* Part II., p. 185.
a. — Side view of a specimen; natural size.
b. — Basal view of the same.
c. — View of the vertex, very much enlarged, showing the form and arrangement of the small plates which close the central opening.
d. — Part of pseudo-ambulacral field, greatly enlarged, exhibiting the form of the lancet and pore pieces.

Fig. 2. — PENTREMITES ROEMERI, *Shumard.* Part II., p. 186.
a. — Side view of a specimen exhibiting a convex base; four times enlarged.
b. — Another individual, view of the side; four times enlarged.
c. — The same; basal view.
d. — The same, summit view; nine times enlarged.

Fig. 3. — PENTREMITES CURTUS, *Shumard.* Part II., p. 187.
a. — Side view of a specimen; four times enlarged, distorted from lateral pressure.
b. — Detached fork-piece; enlarged to show the surface markings.

Fig. 4. — PENTREMITES ELONGATUS, natural size. Part II., p. 187.

Fig. 5. — POTERIOCRINUS LONGIDACTYLUS, *Shumard.* Part II., p. 188.
a. — View of a specimen, natural size, a portion of the arms and column remaining attached to the body.
b. — View of the anal side of a specimen, exhibiting a portion of the proboscis and slender column attached to the body.
c. — Portion of the proboscis enlarged, showing the rows of pores at the lateral sutures.

Fig. 6. — TENTACULITES INCURVUS, *Shumard.* Part II., p. 195.
a. — Specimen, natural size.
b. — A fragment, enlarged to show the character of the striæ.

Fig. 7. — ACIDASPIS HALLI, *Shumard.* Part II., p. 200.
a. — Glabella, four times enlarged.
b. — Movable cheek, four times enlarged.
c. — Specimen showing eight segments of the thorax and the pygidium; nine times enlarged.

Fig. 8. — DALMANIA TRIDENTIFERA, *Shumard.* Part II., p. 199.
a. — Specimen of the head, natural size.
b. — Pygidium of a smaller individual.
c. — A portion of the eye magnified.

Fig. 9. — PHILLIPSIA MERAMECENSIS, *Shumard.* Part II., p. 199.

Fig. 10. — ENCRINURUS DELTOIDEUS. Part II., p. 198.

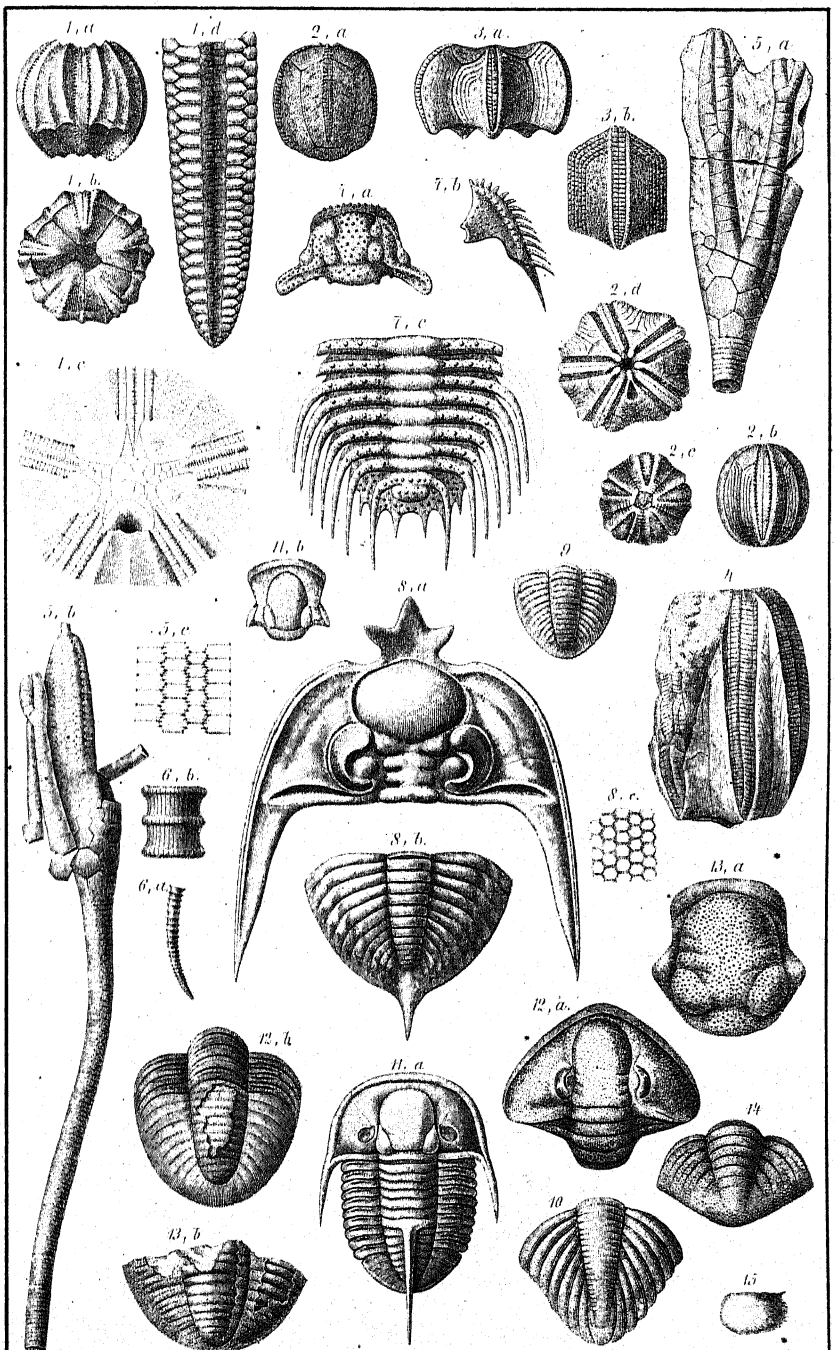
Fig. 11. — CYPHASPIS GIRARDEAUENSIS, *Shumard,* Part II., p. 197.
a. — Specimen, four times enlarged, exhibiting the thoracic spine, projecting backwards from the seventh axal ring of the thorax.
b. — Glabella of another specimen; four times enlarged.

Fig. 12. — PROETUS SWALLOWI, *Shumard.* Part II., p. 196.
a. — Specimen enrolled, exhibiting the head and a portion of the thorax.
b. — The same; view of the pygidium and part of the thorax.

Fig. 13. — PROETUS MISSOURIENSIS, *Shumard.* Part II., p. 196.
a. — Glabella, natural size.
b. — Pygidium.

Fig. 14. — CALYMENE RUGOSA, *Shumard;* natural size. Part II., p. 200.

Fig. 15. — CYTHERE SUBLAEVIS, *Shumard;* four times enlarged. Part II., p. 195.



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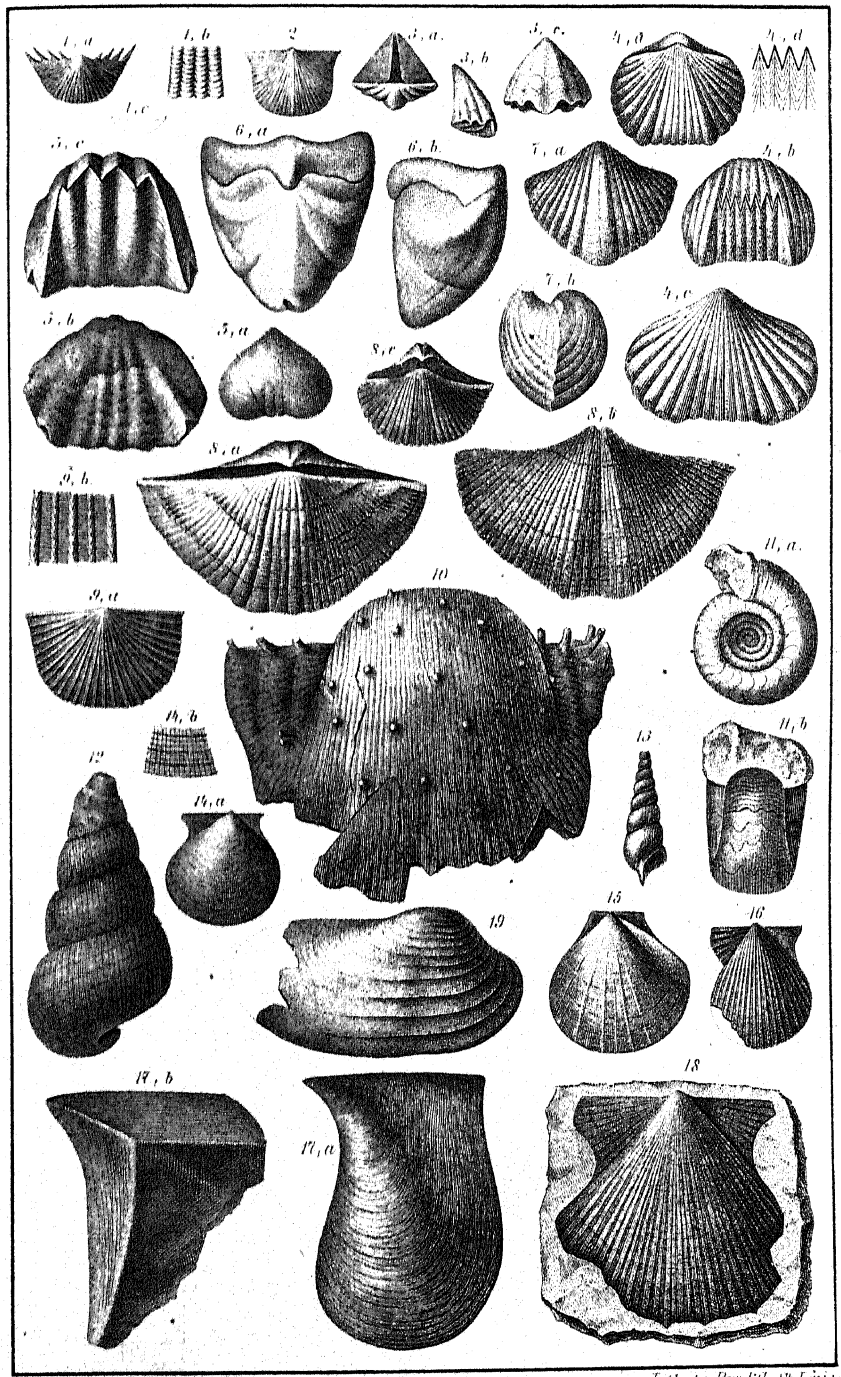
EXPLANATIONS OF PLATE C.

Fig. 1. — CHONETES ORNATA, *Shumard.* Part II., p. 202.
a. — Dorsal valve. The spines on the cardinal border are larger than natural.
b. — Surface enlarged.
c. — Profile view.
Fig. 2. — LEPTÆNA MESACOSTA, *Shumard.* Part II., p. 205.
Fig. 3. — CYRTIA ACUTIROSTRIS, *Shumard.* Part II., p. 204.
a. — Specimen nat. size view of the area.
b. — The same, profile view.
c. — View of the dorsal valve.
Fig. 4. — RHYNCONELLA COOPERENSIS, *Shumard.* Part II., p. 204.
a. — Gibbous variety; view of the ventral valve.
b. — The same; view of the front.
c. — Flattened variety; view of the dorsal valve.
d. — Tongue of sinus enlarged, showing the character of the striæ.
Fig. 5. — RHYNCONELLA MISSOURIENSIS, *Shumard.* Part II., p. 204.
a. — Young individual; view of dorsal valve.
b. — Adult specimen; view of dorsal valve.
c. — The same; view of the front, showing the large quadrangular tongue of the sinus.
Fig. 6. — RHYNCONELLA BOONENSIS, *Shumard.* Part II., p. 205.
a. — Ventral valve.
b. — Profile view.
Fig. 7. — SPIRIFER? PECULIARIS, *Shumard.* Part II., p. 202.
a. — View of the ventral valve.
b. — Profile view.
Fig. 8. — SPIRIFER MARIONENSIS, *Shumard.* Part II., p. 203.
a. — Ventral valve.
b. — Dorsal valve.
c. — Young example, showing a mesian sinus in the ventral valve.
Fig. 9. — ORTHIS MISSOURIENSIS, *Shumard.* Part II., p. 205.
a. — Specimen, natural size.
b. — Surface enlarged.
Fig. 10. — PRODUCTUS AEQUICOSTATUS, *Shumard.* Part II., p. 201.
Fig. 11. — GONIATITES PLANORBIFORMIS, *Shumard.* Part II., p. 208.
a. — Specimen, about sixteen times enlarged; view of the side.
b. — The same; ventral view.
Fig. 12. — CHEMNITZIA TENUILINEATA, *Shumard.* Part II., p. 207.
Fig. 13. — MURCHISONIA MELANIAFORMIS, *Shumard.* Part II., p. 208.
Fig. 14. — AVICULA CIRCULUS, *Shumard.* Part II., p. 206.
a. — Specimen enlarged.
b. — Surface very much enlarged, showing the character of the striæ.
Fig. 15. — AVICULA COOPERENSIS, *Shumard.* Part II., p. 206.
Fig. 16. — PECTEN MISSOURIENSIS, *Shumard.* Part II., p. 207.
Fig. 17. — MYALINA SUBQUADRATA, *Shumard.* Part II., p. 207.
a. — Specimen reduced four times.
b. — Fragment, showing a part of the hinge.
Fig. 18. — PECTEN OCCIDENTALIS, *Shumard.* Part II., p. 207.
Fig. 19. — ALLORISMA HANNIBALENSIS, *Shumard.* Part II., p. 206.



F. B. Meek del.

L. Gast & Bro. lith. St. Louis.