

Geological Explorations in Kansas Territory.

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As it is merely our purpose, on the present occasion, to give rather briefly, the results of some geological examinations made by us last summer in eastern Kansas, it will perhaps scarcely be expected that we should here enter into a historical review of the valuable labors of other explorers in that region. Hence we proceed at once to present such facts as came under our observation, and the conclusions they seem to warrant.

The route pursued by us while making these investigations, was first from Leavenworth city on the Missouri, across the country to Indianola, near the mouth of Soldier creek, on the Kansas; thence up the north side of Kansas and Smoky Hill rivers, to the mouth of Solomon's fork. Here we crossed the Smoky Hill, and followed it up on the south side to a point near the ninety-eighth degree of west longitude; from which point we struck across the country in a south east direction to the Santa Fe road, which we followed north eastward to the head of Cottonwood creek. Leaving the road here, we went down the Cottonwood valley some thirty miles, when we turned across the country nearly due northward to Council Grove. From the latter place we followed the Santa Fe road back southwestward about twenty-four miles to a watering place known as "Lost Spring;" here we again left the road and struck across the country in a northwest direction to Smoky Hill river, at a point nearly opposite the mouth of Solomon's fork. We then traveled down the south side of Smoky Hill and Kansas rivers to Lawrence, where we crossed the Kansas and proceeded in a northeast direction back to Leavenworth city.

The first outcrop of rocks examined by us during the expedition is at a point just below the steamboat landing at Leavenworth city. At this place and for some distance above on the river, the formation is well known to belong to the upper, but not the highest portions, of the great western coal measures.

The section here near the Leavenworth landing, presents the following beds, in descending order:

	Feet.
1. Bluish gray clay, exposing a thickness of about.....	3
2. Hard gray layer of <i>Fusulina</i> limestone.....	1½
3. Yellow laminated clay.....	7
4. Hard gray argillaceous limestone with <i>Fusulina</i>	1
5. Gray fine grained argillaceous sandstone with fucoidal markings, sometimes contains seams of limestone.....	1 to 3
6. Gray, green and blue, rather indurated clay, with sometimes near the base many compact concretions limestone.....	2
7. Hard light yellowish gray limestone, usually of bluish tinge far in beyond the effects of weathering. Contains <i>Spirifer cameratus</i> , <i>S. Kentuckensis</i> , <i>S. lineatus</i> , <i>Spirigera subtilita</i> , <i>Orthisina Missouriensis</i> , <i>Productus splendens</i> ? <i>P. semireticulatus</i> ? <i>P. pustulosus</i> and <i>Fusulina cylindrica</i> , together with columns of <i>Crinoids</i> , and spines and plates of <i>Archæocidaris</i> ; also jaws teeth of <i>Xystracanthus arcuatus</i>	15
8. Dark shale, passing up into gray less distinctly laminated clay.....	5
9. Hard dark bluish impure limestone, containing <i>Fusulina cylindrica</i> , <i>Spirigera subtilita</i> , <i>Productus Rogersi</i> , <i>P. Prattenianus</i> , <i>Arca carbonaria</i> ? an undetermined <i>Monotis</i> , <i>Allorisma</i> ? <i>Leavenworthensis</i> , <i>A. subcuneata</i> , <i>Myalina subquadrata</i> , <i>Leptodomus granosus</i> , and a large <i>Belerophon</i>	1½-2
10. Gray, more or less laminated clay, becoming darker near the upper part, rising above the river.....	11

Attached to the surfaces of bed No. 9 there is usually from one to two inches of soft dark argillo-calcareous matter containing great numbers of *Orthisina crassa*, with the undetermined species of *Pecten*, *Mytilus*, *Schizodus*, *Pleurotomaria*, &c.

All this section above No. 7 appears to vary considerably, at different places

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some of the beds, being entirely wanting, or presenting quite different lithological characters at other localities not far from here. Owing to the dip of the strata, and partly to the fall of the river, the bed of limestone No. 7, which is elevated eighteen feet above the river where this section was taken, rises as much as twenty-five feet above the level of the river, at a distance of one mile or less below; and on following the outcrop of these rocks along the shore above Leavenworth city, they were found to sink gradually beneath the water, so that at Fort Leavenworth landing, two miles above, (in a north direction from the exposure first examined) all of beds No. 8, 9 and 10, as well as two or three feet of No. 7, were submerged. Should this dip continue at the same rate, without local undulations, the whole of No. 7 must pass beneath the river in less than two miles above the Fort.

Immediately above No. 1 of this section, we saw no exposures of rock in place, but on a small stream about two and a half miles below Leavenworth city, and perhaps one and a half miles back from the river, there is an outcrop of soft fine grained yellow sandstone, showing a thickness of twenty-four feet, underlaid by a bed of blue clay of which a thickness of about four feet was exposed. We had no opportunity to determine the elevation of these beds above the river with sufficient accuracy to form a definite conclusion whether or not they hold a position above the section seen near the Leavenworth landing, though we incline to the opinion that they come in above it.

In ascending the hills back of Leavenworth city we observed no outcrops of rock along the slopes, until near the summit, where at an (estimated) elevation of about two hundred feet above the highest bed of the section at the river, there is an exposure of hard bluish-gray impure limestone, weathering to a yellowish tinge, the beds of which are separated at places, by partings of clay. Of this rock we saw a thickness of sixteen feet. It is much used for building purposes and quarried rather extensively back of Fort Leavenworth. At one of these quarries, amongst the loose material thrown out by the workmen we found specimens of *Spirifer cameratus*, *S. Kentuckensis*, *S. planoconvexa*, *S. hemipli-cata*, *Spirigera subtilita*, *Productus semireticulatus*, *P. Norwoodi*, *Leptodomus Topekaensis*, *Fusulina cylindrica*, *Terebratula millepunctata*, and fragments of *Crinoids*, with *Chonetes* and *Fenestella* of undetermined species.

Above the quarry there is a slope of some forty or more feet to the summit of the hills, apparently occupied by clays; and the quarrymen informed us that there is immediately under the bed of limestone an eight feet bed of clay, beneath which they had made no excavations.

West of this locality, the surface of the country soon descends gradually into a depression connected on the north with the valley of a small stream flowing into the Missouri above Fort Leavenworth. In this immediate neighborhood the face of the country is slightly inclined to be hilly, but the soil is rich, and the long gentle slopes are clothed in the spring and summer months with a luxuriant growth of prairie grass. From several points near here, we had a fine view of the broad rich valley, with its beautiful groves and scattering farm houses along the little stream to the north of us.

Beyond this, the road after passing over some undulations, ascends to the summit of the country, which is rich elevated prairie land. At several places near the upper part of the slopes some five or six miles from Leavenworth, we met with outcrops of light grey limestone, apparently in ten to twelve inch-layers, containing *Fusulina*, *Productus semireticulatus*, *Chonetes*, and small *Cyathophylloid* corals. These beds probably belong to the same horizon as the limestone near the top of the bluffs back of Leavenworth, or may even hold a higher position.

At Big Stranger creek, some fourteen or fifteen miles west of Leavenworth city, the following section was observed in descending order:

	Feet.
1. Slope, without any exposure of rocks,.....	60
2. Layers of limestone, weathering yellowish, containing <i>Spirifer came-ratus</i> and <i>Fusulina cylindrica</i>	8

3. Slope probably occupied by shale or clay.....	40
4. Grayish yellow limestone, with <i>Fusulina cylindrica</i> and <i>Spirigera subtilita</i>	5
5. Bluish gray soft shale, or laminated clay with occasional harder sandy seams.....	38
6. Coal immediately overlaid by one inch of <i>cone-in-cone</i>	4
7. Bluish gray laminated clay or soft shale, extending down to the creek	18

Again, on Little Stranger creek, some twelve miles south west of Leavenworth city, there is a somewhat similar exposure, containing a twenty inch bed of coal. This bed is worked to some extent on the land of Mr. Charles Stone, where the following section may be seen in the descending order :

1. Light gray, or bluish gray, soft calcareous sandstone with harder layers containing much argillaceous matter, with <i>Productus splendens?</i> <i>Myalina subquadrata</i> , an undetermined <i>Monotis</i> , and many fucoidal markings; exposing a thickness of.....	15
2. Blue laminated clays more or less arenaceous above.....	26
3. Coal.....	1½
4. Bluish gray somewhat ferruginous clay rising above the creek....	4

We have no means of determining what relations the rocks composing these two sections bear to the exposure at Leavenworth, but we think they hold a position between the bed of limestone seen near the top of the hills back of Leavenworth city, and the upper bed of the section near the Leavenworth landing.

Between Big Stranger and Grasshopper creeks, the road passes over a beautiful rich prairie, elevated about 350 or 400 feet above the Missouri. In crossing this prairie we met with no exposures of rock, the whole being covered by heavy Quaternary deposits, into which wells have been sunk at several places, from thirty to seventy feet without striking solid rock *in situ*. At one or two places, however, we saw masses of limestone which had been quarried for building purposes along a little stream two or three miles north of the road. These contained amongst other fossils *Spirifer cameratus*, *Orthisina umbraculum?* *Fusulina cylindrica*, and fragments of *Fenestella*, with spines and plates of *Archaeoidaris*. We had no opportunity to examine the quarry from which this rock was obtained, but were informed that the bed is some sixty or seventy feet below the summit of the higher portions of the surrounding country.

In descending from this elevated prairie into the valley of Grasshopper creek, at Osawkee village, we observed,

1. A bed of hard gray limestone near the summit of the slopes, containing great numbers of <i>Fusulina</i>	8
2. Slope, no rocks exposed, about.....	55
3. Outcrop of <i>Fusulina</i> limestone, apparently.....	3
4. Slope, no rocks exposed.....	50
5. Gray or bluish gray limestone, weathering yellowish, containing <i>Pleurotomaria humerosa</i> , <i>P. subturbinata</i> , and a large undetermined species of <i>Bellerophon</i> ; also <i>Allorisma?</i> <i>Leavenworthensis</i> , <i>Myalina subquadrata</i> , <i>Pinna</i> undt., <i>Spirifer cameratus</i> , <i>S. planiconvexa</i> and <i>Productus æquicostatus</i> , with great numbers of <i>Fusulina cylindrica</i>	3
6. Dark gray indurated clay.....	2
7. Rather soft argillaceous limestone.....	4

The fact that several of the fossils seen here in bed No. 4 are the same species found in No. 5, of the section at Leavenworth landing, would seem to indicate that these beds occupy the same geological horizon. It is very difficult, however, to identify the same beds at different localities amongst these formations, in consequence of the fact that the fossils found in them usually have a great vertical range, and exactly similar strata are often repeated in various parts of the series. Should it prove to be the case that they do occupy the same geological horizon, it would show that there is here a gentle eastward

dip; for the lowest bed of this section on Grasshopper creek, cannot be less than 100 feet higher than the base of the section at Leavenworth city.

Still we incline to the opinion that the strata near here, if not almost horizontal, or merely undulating, have a general inclination towards the west, or somewhat north of west, and that the exposure on Grasshopper creek, is composed of much more modern beds than those near the landing at Leavenworth city. At any rate we saw an exposure at Lawrence landing, on the Kansas, composed of ledges of limestone, overlaid by clay, and having a decided dip to the west or north of west, at a rate of not less than fifty feet to the mile. This limestone consists of an upper hard gray layer, about three feet in thickness, resting on a soft gray arenaceous bed, of which some one or two feet were visible above the surface of the river when examined by us. In these beds we saw *Spirigera subtilita*, *Productus splendens?* and *Myalina subquadrata*. Above these, about eleven feet of gray laminated clay were exposed, the upper part of the bed having a more yellowish tinge, and containing more arenaceous matter than the lower.

If these beds continue to rise at the same rate towards the east, they must of course run out on the summit of the highest part of the country not far east of Lawrence; and the same inclination to the west or north west, would take them far beneath the horizon of the base of the section seen on Grasshopper creek.

Above this exposure at Lawrence landing, there is a space of about 160 feet in which no outcrops were seen excepting some red and blue clays near the upper part of the hills, back of the town. Just above these clays, some ledges of gray limestone were seen, apparently altogether about eight feet in thickness, containing *Fusulina cylindrica*, *Spirigera subtilita*, and *Spirifer cameratus*.

West of Grasshopper creek, on both sides of the Kansas, the country becomes lower near the river, but at a distance of some ten or twelve miles back, on the north side, it appears to be nearly as elevated as on the east of Grasshopper creek. Between this higher country and the Kansas, there is a plateau, apparently elevated not more than sixty feet above the broad level prairie bottoms along the river; while on the south of the Kansas, some five or six miles south west of Topeka, there are some isolated hills apparently of the same elevation as the high country north of the Kansas.

At several places soon after crossing Grasshopper creek, we met with some highly fossiliferous beds along the small streams, at an elevation of apparently about eighty feet above the Kansas. Below we give a section of these beds seen at a locality some eight miles south west of the point where the exposures mentioned on Grasshopper creek were observed :

	Feet.
1. Rough seams and layers of concretionary limestone of bluish tinge with partings of clay, containing <i>Terebratula millepunctata</i> , <i>Spirigera subtilita</i> , <i>Spirifer cameratus</i> , <i>S. Kentuckensis</i> , <i>Retzia Mormonii</i> , <i>Rhynchonella Uta</i> , <i>Productus Norwoodii</i> , <i>P. splendens?</i> <i>P. semireticulatus</i> , <i>P. Prattenianus</i> , <i>Orthisina</i> , similar to <i>O. umbraculum</i> , also <i>Fenestella</i> and <i>Chetetes</i> of undetermined species.....	4
2. Black shale, shading upwards gradually into laminated blue clay.....	2½
3. Hard blue or gray limestone, with <i>Spirifer cameratus</i> , <i>Spirigera subtilita</i> , <i>Myalina</i> , <i>Pecten</i> , &c.....	1
4. Bluish gray soft clay, with seams of hard limestone.....	3
5. Light gray, somewhat granular limestone with a few round grains, and very small pebbles of quartz.....	2

At another place on the south side of the Kansas, about twelve miles south west of the point where the last section was seen, there is an abrupt bluff near the old Baptist Mission, composed of the following beds in the descending order :

	Feet,
1. Slope, no rocks exposed.....	20
2. Hard yellowish gray limestone, with fragments of fossils.....	4
3. Slope, no rock exposed.....	18

4. Light gray, rather hard fine grained sandstone.....	3
5. Slope.....	20
6. Fine grained sandstone, in thin layers, not well exposed—apparently	2
7. Slope, with occasional outcrops hard gray limestone	16
8. Yellowish and dark gray laminated clay, or soft shale, with layers and nodular concretions of argillaceous carbonate of iron, near base*.....	90
9. Hard bluish argillaceous limestone, of which there was exposed in the bed of a small stream, not more than 13 or 15 feet above the river, a thickness of	1

After passing this locality, we heard of a coal mine some three or four miles south of here, near the base of an isolated hill, known as Shunganunga Mound. We did not visit this mine, but were informed that it is considerably above the summit of the last section, and that the bed is about 18 inches in thickness. The coal is said to be of good quality.

Above here on both sides of the Kansas, the country continues to be rather low, no part of it being apparently more than two hundred feet above the river. For a long distance above this, there is a beautiful broad, level bottom prairie, on the north side of the Kansas, extending back from four to six miles, and as much as eighteen or twenty miles along the river. Bounding this on the north, the country rises by a gentle grassy slope to an elevation of from sixty to about one hundred feet, furnishing the most beautiful sites for dwelling houses.

For a considerable distance above the locality where the exposure near the old Baptist Mission was examined, the hills especially near the river on the south side, appear to be mainly composed of rather heavy deposits of laminated clays and shales, with soft sandstones and occasional thin beds of limestone, containing the usual fossils of the upper carboniferous series. At the crossing of Mission creek, at an elevation of perhaps not more than twenty-five or thirty feet above the Kansas, exposures were observed consisting first above of five feet of light gray laminated clay, resting upon two or three feet of soft yellow sandstone, which passes down into laminated arenaceous clays, of which some eight or ten feet were exposed above the creek.

Some fifteen or sixteen miles west of the point where the road crosses Mission creek, at a locality six or seven miles south of the Kansas, there is a high elevation known by the name of Buffalo mound, rising as much as four hundred and fifty or sixty feet above the river. At one place a large creek called on the maps, Upper Mill creek, sweeps close along the northern base of this elevation, and has carried away the loose debris so as to leave the lower strata well exposed. The section here beginning at the summit of this hill is,

Feet.

1. A slope of about 160 feet, along the lower forty feet of which we found loose specimens of <i>Spirifer cameratus</i> , <i>S. planoconvexa</i> , <i>Retzia Morrisonii</i> , <i>Productus splendens?</i> <i>Chonetes Verneuiliana</i> , <i>C. mucronata</i> , and <i>Fusulina cylindrica</i> , var. <i>ventricosa</i> , with fragments of <i>Chonetes</i> , <i>Crinoids</i> , &c., of undetermined species.....	3
2. Bluish gray limestone in two layers, the upper of which contains columns of <i>Crinoids</i> , <i>Productus Culhounianus</i> , &c., while <i>Myalina subquadrata</i> , <i>Orthisina Missouriensis</i> , <i>Allorisma</i> , <i>Pinna</i> , <i>Monotis</i> , &c., of undetermined species, occur in the lower	3
3. Slope with no exposures of rock.....	96
4. Rather hard mottled brown and light gray compact limestone, with a few <i>Crinoid</i> columns; may be thicker, but only showing a thickness of....	3
5. Brown, whitish and green clays, with rugged white calcareous concretions	4
6. Fine argillaceous sandstone, with streaks of yellow and brown colors..	1½
7. Ash colored clay.....	10

*There may be some thin beds of limestone in this portion of the section, as every part of this ninety foot bed was not well exposed,

8. Clays of red or brownish colors above; blue and green below.....	3½
9. Deep brown clay, with rugged concretions of same color	3
10. Hard light bluish limestone, with some rather large columns of <i>Crinoids</i> , <i>Chonetes</i> , <i>Verneuiliana</i> , &c.....	2½
11. Brown, ash colored, and blue laminated clays, which are more or less arenaceous, with near the middle some 5 or 6 inches black shale.....	46
12. Gray and purple argillaceous limestone, with <i>Pinna</i> , <i>Productus</i> , and a few <i>Fusulina</i>	1¼
13. Green laminated clay.....	4
14. Two or three layers of soft fine grained sandstone, more or less argil- laceous, and separated by seams of clay.....	2
15. Bluish and ash colored clays.....	21
16. Alternate layers of hard bluish gray limestone, and seams of clay with sandy concretions.....	3
17. Rather hard yellowish limestone, with <i>Fusulina</i>	2½
18. Ash colored clay, not very well exposed.....	15
19. Yellowish impure limestone with <i>Fusulina</i>	2
20. Ash colored laminated clays—above the creek.....	5

About three hundred yards below where this section was taken, the creek was observed to fall nearly a foot, over a ledge of hard limestone; and one mile further down, the bed of the creek is composed of a hard yellow limestone containing great numbers of *Fusulina*. At these localities Mill creek is probably not elevated more than thirty feet above the Kansas.

Near half a mile east, or south east, of the point where the *Fusulina* limestone was seen in the bed of Mill creek, and at a somewhat higher elevation, we saw apparently the same bed of *Fusulina* limestone showing a thickness of three feet. Under this there was at one place exposed a thickness of some four or five feet of very fine yellow sandstone with minute specks of Mica. These exposures indicate a moderate dip of the strata towards the west or north west.

On the north side of Kansas, in a direction a little west of north, and about sixteen miles from the last mentioned localities, we observed an outcrop on a small stream marked "Last Creek" on the maps, presenting the following section, descending:—

	Feet.
1. Seams yellow magnesian limestone, alternating with clay, showing a thickness of about.....	8
2. Yellow soft granular magnesian limestone, containing <i>Productus Nor-</i> <i>woodi</i> , and an undetermined species of <i>Myalina</i>	4
3. Fine laminated black shale.....	1
4. Gray rather soft argillaceous limestone.....	1
5. Blue somewhat indurated very fine calcareous clay containing at its junction with the next bed below, <i>Chonetes</i> , <i>Synocladia biserialis</i> , <i>Chaetetes</i> , and fragments of <i>Crinoids</i>	9
6. Seams hard, compact gray limestone, alternating with softer argillo- calcareous matter, and containing casts of many small <i>Cypricardia</i> -like shells, small <i>Murchisonia</i> , <i>Pleurotomaria</i> , <i>Macrocheilus</i> , <i>Naticopsis</i> , <i>Bellero-</i> <i>phon</i> , &c.....	2
7. Bluish laminated clays weathering to drab color.....	4
8. Yellow rather soft granular magnesian limestone, with embedded fragments of harder more compact do.....	5¼
9. Bluish indurated calcareous clays.....	3

The base of this section is evidently not elevated much above the Kansas, as it extends down to the bottom of a deep ravine formed by the creek, while its top appeared to be nearly on a level with the surface of the bottom prairie in the Kansas valley. These beds dip a little to the north west, and are very similar, especially the magnesian limestones, to some of the Permian strata holding a position far above this in the series, some considerable distance west of

here. Only about three miles further west, we saw the following exposure on Vermilion creek:—

	Fect.
1. Slope of about fifteen feet, with near the base some ledges of gray limestone, amongst loose fragments of which we picked up specimens of <i>Spirifer subtilita</i> , <i>Spirifer hemiplicata</i> , <i>Productus Norwoodi</i> , and <i>P. splendens?</i> ...	15
2. Slope, no rock seen.....	26
3. Soft bluish and gray more or less laminated clays with irregular sandy seams and concretions.....	12
4. Irregular hard blue calcareous seam one to six inches.....	$\frac{1}{2}$
5. Blue clay.....	2
6. Soft decomposing more or less laminated sandstone.....	4
7. Blue clay one foot above the creek.....	1

Almost directly opposite these localities, on the south side of the Kansas, some three or four miles back from the river, and nearly on a line between the locality where we saw the exposures on "Last Creek" and Buffalo mound,—but considerably below the level of the summit of the latter, we examined some exposures presenting beneath a slope of about eighty feet, in descending order:

	Fect.
1. Hard bluish gray limestone of which there was exposed.....	1
2. Rough yellowish magnesian limestone with cavities lined with chalcodony.....	3
3. Bluish and ash colored clays.....	5
4. Layer much like No. 2.....	1
5. Yellowish green clay.....	20
6. Bluish gray limestone in two layers, the upper of which contains columns of <i>Crinoids</i> , <i>Productus Calhounianus</i> , &c., while <i>Myalina subquadrata</i> , <i>Orthisina Missouriensis</i> , <i>Allorisma</i> , <i>Pinna</i> , <i>Monotus</i> , &c., occur in the lower.....	3
7. Bluish and ash colored clays exposing a thickness of.....	5

The bed No. 6 of this section is evidently the same as No. 2 of the section at Buffalo mound (page 12), though here the dip of the strata has brought it lower. Its elevation above the Kansas at Buffalo mound must be about two hundred and fifty feet. We had no means of estimating very accurately its elevation where the last section was taken, though we do not think it as much as one hundred and seventy-five feet above the Kansas.

Ten miles farther west, on the same side of the river, along a small stream marked "Deep creek" on the maps, at a point some four or five miles back from the Kansas, and elevated perhaps as much as forty feet above it, some outcrops were examined near Zeandale, presenting the following section, descending:—

	Fect.
1. Long slope of about one hundred feet, no rocks seen.....	100
2. Dark argillaceous limestone, stained with iron, and containing fragments of <i>Crinoids</i>	4
3. Soft decomposing argillaceous limestone.....	2
4. Very hard light yellow compact limestone in one massive bed,—containing great numbers of <i>Fusulina</i> , also <i>Productus Calhounianus</i> , &c.....	6
5. Ash-colored laminated clay.....	22
6. Hard decomposing argillaceous limestone with <i>Fusulina</i>	3
7. Blue, green, and ash-colored clay.....	18
8. Gray argillaceous limestone, with more or less ferruginous matter...	3
9. Light bluish clay somewhat laminated.....	7
10. White decomposing argillaceous limestone with <i>Productus Calhounianus</i>	1

We heard of a bed of coal some four or five miles above this on the same creek, but were unsuccessful in an attempt to find the locality where it crops out. We were informed, however, by Mr. Pillsbury, an intelligent gentleman

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living at Zeandale, that the bed is from four to six inches in thickness, and overlaid by about three and a half feet of blue shale, strongly impregnated with alum. Above the latter, he said there is an eight or ten inch layer of dark argillaceous material, weathering to an iron rust color, and containing many nodular concretions,—perhaps of carbonate of iron. From the information obtained in regard to the location and elevation of this coal bed, we are inclined to believe it must hold a position a little below the horizon of the middle of the slope at the top of the foregoing section. It is probably the highest bed of coal in the whole series of this region,—at any rate we saw no indications of coal above it.

About a mile or a mile and a half north of the locality where this coal bed has been seen, the dividing ridge between the Kansas and Deep creek, rises to an elevation of near three hundred and twenty feet above the latter stream at the nearest point. Here at the summit of this ridge there are some thin outcrops of gray and whitish argillaceous limestone, showing on weathered surfaces a somewhat laminated structure, and containing at places large spines of a species of *Archæocidaris*; beneath this there is about two feet of gray fragmentary limestone reposing on a more compact bed of hard gray limestone near three feet in thickness, and often cellular in the middle. Along the slope about one hundred and twenty feet below the horizon of these beds, we found loose specimens of *Spirifer cameratus*, *Orthisina umbraculum?* *Rhynchonella Uta*, *Al-lorisma*, *Synocladia biserialis*, &c. Just below these, there were many loose slabs of light yellowish fine grained calcareous sandstone, containing *Productus*, *Pecten*, and *Fucoidal* markings. About forty-seven feet lower down the slope, and near one hundred and fifteen feet above the level of the Kansas, there is an exposure of light grayish granular limestone, showing a thickness of three feet, in which we only saw fragments of a *Chonetes*, and *Crinoid* columns: large tabular masses of this rock were strewed along the slope for some distance below.

At the mouth of Big Blue river, on the south side of the Kansas, there is an abrupt bluff, along which several slides have exposed many of the beds composing the high ridge mentioned six or seven miles below here. The dip, however, of the strata towards the west, or north west, is so great that the limestone containing spines of *Archæocidaris*, seen on the summit of the ridge below this, at an elevation of about 320 feet above the Kansas, is here, opposite the mouth of Big Blue river, only elevated about 214 feet above the Kansas; consequently the three feet of grayish yellow limestone cropping out 115 feet above the Kansas along the slope of the ridge above mentioned, at the mouth of Blue river, has sunk beneath the level of the Kansas.

This far we have scarcely attempted to draw parallels between the various beds seen by us at different places, in consequence of the fact that our observations were isolated, as must necessarily be the case in a mere reconnaissance, extended over a large area in a short space of time. In addition to this, the group of rocks examined presents no extensive beds of limestone or other hard material, forming well marked horizons, or continuous lines of outcrop, by which the relations between strata seen at different localities could be traced out. This difficulty is also greatly increased by the frequent repetition of precisely similar beds at different horizons in the series, and above all by the great vertical range of the organic remains. Consequently we have preferred to present separately the local sections examined, instead of attempting to construct a continuous general vertical section showing the order of superposition of the various strata. To do this successfully throughout all the various rocks of the whole Kansas valley, would require much more time than we had at our command.

As our examinations along the Kansas and Smoky Hill rivers above this point were made in more detail, where the outcrops were more frequent and continuous, we have, as we believe, been able to trace out the connections and order of succession of the various strata with considerable accuracy. Hence, we give below a general section of the rocks in this region, commencing with 1859.]

the Cretaceous sandstones on the summits of the Smoky Hills, lat. 38° 30' N., long. 98° W., and descending through the various intermediate formations seen along the Smoky Hill and Kansas rivers, to the base of the bluff already mentioned, opposite the mouth of Big Blue river, on the Kansas. It is true, there are a few gaps in this section, where we were unable to see the beds along some of the slopes, but as we know the position in the series, as well as the extent of these gaps, it will be easy to determine, when a greater number of exposures have been examined, the nature of the beds occupying them.

General section of the Rocks of Kansas Valley from the Cretaceous down, so as to include portions of the upper Coal measures.

	Feet.
1. Red, brown, and yellowish, rather coarse grained sandstone, often obliquely laminated, and containing many ferruginous concretions; also, fossil wood and many leaves of dicotyledonous trees, some of which belong to existing genera, and others to genera peculiar to the Cretaceous epoch. <i>Locality, summit of Smoky Hills</i>	60
2. Whitish, very fine grained argillaceous sandstone, underlaid by bluish purple and ash colored clays. <i>Locality same as preceding</i>	15
3. Long, gentle slope, with occasional outcrops of ash colored red, blue, and whitish, more or less laminated clays, with thin beds of sandstone. <i>Locality same as preceding, and extending down at places nearly or quite to the bluffs of Smoky Hill river; thickness about</i>	200
4. Red sandstone, with some layers of hard, light gray calcareous, do., and both containing ferruginous concretions. <i>Locality, bluffs Smoky Hill river, five or six miles above Grand Saline river. Probably local, thickness seen about</i>	15
5. Bluish, red, light yellow, and gray clays, and soft claystones, with sometimes a few thin layers of magnesian limestone. In many places these clays have been traversed in every direction by cracks, into which calcareous and argillaceous matter have found their way, and subsequently become consolidated so as to form thin seams of impure yellowish limestone, which cross and intersect each other at every angle. The red clays are usually less distinctly laminated, contain more arenaceous matter, and often show ripple marks on the surfaces. <i>Locality, Bluffs along Smoky Hill river, above the mouth of the Grand Saline</i>	60
6. Light gray, ash colored, and red clays, sometimes arenaceous, and often traversed by cracks, filled with calcareous matter as in the bed above,—alternating with thin layers and seams of gypsum. <i>Locality, near mouth Smoky Hill river</i>	40
7. Rather compact amorphous white gypsum, with near the base disseminated crystals, dark colored do. <i>Locality same as last</i>	4½ to 5
8. Alternations of ash colored, more or less arenaceous clays, with thin beds and seams of gypsum above; towards lower part, thin layers of claystone, and at some places soft magnesian limestone. <i>Locality same as last</i> ..	50
9. Rough conglomerated mass, composed of fragments magnesian limestone and sandstone, with sometimes a few quartz pebbles, cemented by calcareous and arenaceous matter; variable in the thickness and probably local. <i>Locality, south side Smoky Hill river, ten or twelve miles below Solomon's Fork</i>	seen 18
10. Bluish, light gray, and red laminated clays, with seams and beds of yellowish magnesian limestone, containing <i>Monotis Hawni, Myalina peratenuata, Pleurophorus? subcuneata, Edmondia? Calhouni, Peeten</i> undt. and <i>Spirigera</i> near <i>S. subtilita</i> ; also <i>Nautilus eccentricus, Bakevella parva, Leda subscitula, Azinus rotundatus</i> , and undetermined species of <i>Bellerophon, Murchisonia, &c.</i> <i>Locality, near Smoky Hill river, on high country south of Fort Riley, as well as on Cottonwood creek</i>	90
11. Light grayish and yellow magnesian limestone, in layers and beds sometimes alternating with bluish and other colored clays, and containing	

- Solemya*, a *Myalina* near *M. squamosa*, *Pleurophorus?* *subcuneata*, *Bakevellia parva*, *Pecten* undt., and a *Euomphalus* near *E. rugosus*; also, a *Spirigera* allied to *S. subtilita*, but more gibbous, *Orthisina umbraculum?* *O. Shumardiana*, &c. Locality, summit of the hills, near Fort Riley and above there; also seen on Cottonwood creek..... 25 to 35
12. Light grayish yellow, rather granular magnesian limestone, containing spines and plates of *Archæocidaris*; a few fragments of small *Crinoid* columns, *Spirifer* similar to *S. lineatus*, but perhaps distinct; also same *Spirigera* seen in beds above, *Orthisina Shumardiana*, *O. umbraculum?* and *Productus Calhounianus*. Forms distinct horizon near summit of hills in vicinity of Fort Riley, also seen on Cottonwood creek..... 7 to 8
13. Soft argillo-calcareous bed, apparently local. *Kansas Falls*..... 5
14. Light grayish and yellowish magnesian limestone, containing many concretions of flint, also the same *Spirigera* found in beds above, and *Productus Norwoodi* *P. Calhounianus*, with *Discina tenuilineata* and an undetermined *Monotis*. *Fort Riley* and below, also at *Kansas Falls* and on *Cottonwood creek*..... 38
15. Alternations, bluish, yellowish and brown clays, with a few thin seams of limestone. *Fort Riley, Kansas Falls*; also below *Fort Riley*, and on *Cottonwood creek*..... 35
16. Light yellowish magnesian limestone, containing *fucoidal* markings, fragments of small *Crinoid* columns, *Pecten*, *Allorisma*, *Spirigera*, *Orthisina umbraculum?* *O. Shumardiana*, *Discina tenuilineata*, &c. Lower quarry at *Fort Riley*, and at other places above and below *Fort R.*, as well as on *Cottonwood creek*..... 4 to
17. Alternations of blue, red, and light gray clays, with sometimes thin layers and seams of magnesian limestone. *Fort Riley*..... 28
18. Light gray and whitish magnesian limestone, containing *Spirigera*, *Orthisina umbraculum?* *O. Shumardiana*, *Productus Calhounianus*, *Acanthocladia Americana*, and undt. *sp. Cyathocrinus*. Lower part containing many concretions of flint. *Fort Riley* and on *Cottonwood creek*. Whole thickness about..... 40
19. Brown, green, and very light gray clays, alternating; contains near the upper part fragments of *Crinoid* columns, *Synocladia biserialis*, *spirigera*, *Productus Norwoodi*, *Chonetes mucronata*, *Orthisina Shumardiana*, *Orthisina umbraculum*, &c., with teeth of *Petalodus Alleghaniensis*. *Fort Riley*..... 14
20. Alternations of rather thin layers light yellowish magnesian limestone, and various colored clays; the limestone layers containing *Monotis*, *Synocladia biserialis*, &c. Locality same as last..... 33
21. Slope, no rocks seen. *Below Fort Riley*..... 25
22. Whitish, or very light gray magnesian limestone, rendered porous by cavities left by the weathering out of numerous *Fusulina*. This is the highest horizon at which any remains of *Fusulina* were met with. *Some four miles below Fort Riley*, along a creek on the south side of the *Kansas*, and apparently not more than ten feet above it..... 2
23. Bluish, light gray, and brown clays, with occasional layers of magnesian limestone. *Chonetes mucronata*, *Orthisina umbraculum?* *Monotis*, *Fusulina*, &c. *Ten miles below Fort Riley*..... 35
24. Hard, very light yellowish gray magnesian limestone, with *Fusulina*, and spines of *Archæocidaris*. Forms a marked horizon near the same locality as last..... 6
25. Slope, with occasional exposures, thin layers of *Fusulina*, limestone, and seams of gray limestone containing *Myalina*, *Monotis*, *Pecten* and fragments of *Synocladia biserialis*. *Near same locality as last*..... 36
26. Light gray argillaceous limestone, showing on weathered surfaces a somewhat laminated structure; contains large spines of *Archæocidaris*. *Near Ogden Ferry, and Manhattan*..... 9
27. Gray limestone, often fragmentary, with much clay above; lower part hard, and more or less cellular in middle. *Locality, same as last*..... 5

28. Whitish clays and claystones, with a thin layer of hard compact gray limestone near the middle. <i>Locality same as last</i>	10
29. Light greenish indurated clays. <i>Same locality</i>	3
30. Hard, heavy bedded, white argillaceous limestone, containing <i>Monotis</i> and <i>Aricula</i> . <i>Ogden Ferry, and below there</i>	5
31. Very thinly laminated dark green shale. <i>Three miles nearly east of Ogden Ferry, on McDowell's creek; also at Manhattan, on the Kansas</i>	1
32. Light greenish and flesh-colored hard argillaceous limestone, with <i>Spirifer cameratus</i> . This is the highest horizon at which we found this species. <i>Same localities</i>	3
33. Alternations of bluish, green, and red more or less calcareous laminated clays, light gray limestones and claystones, with <i>Pecten</i> , <i>Monotis</i> and fragments of <i>Crinoid</i> columnus. <i>Same localities</i>	30
34. Alternations bluish, purple, and ash colored calcareous clays, passing at places into claystones, and containing in a thin bed near the middle, <i>Spirifer planoconvexa</i> , <i>Spirigera subtilita</i> , <i>Productus splendens?</i> <i>Rhynchonella Uta</i> , &c. <i>Locality same as preceding</i>	12
35. Blue, light gray, and greenish clays, with occasional harder seams and layers of claystone and limestone. <i>Same locality</i>	33
36. Somewhat laminated claystone of light gray color, with more or less calc spar near lower part. <i>Manhattan</i>	19
37. Alternations of dark gray and blue, soft decomposing argillaceous limestone, with dark laminated clays, or soft shale, containing great quantities of <i>Fusulina cylindrica</i> , <i>F. cylindrica</i> , var. <i>ventricosa</i> , <i>Discina Manhattanensis</i> , <i>Chaetetes</i> , and fragments <i>Crinoids</i> ; also, <i>Chonetes</i> , <i>Vernuculianc</i> , <i>C. mucronata</i> , <i>Productus splendens?</i> <i>Retzia Mormonii</i> , <i>Rhynchonella Uta</i> , <i>Spirigera subtilita</i> , <i>Spirifer cameratus</i> , <i>S. planoconvexa</i> , <i>Euomphalus</i> , near <i>E. rugosus</i> and <i>Synoeludia biserialis</i> ; also <i>Cladodus occidentalis</i> . <i>Locality, same as last</i>	18
38. Soft bluish shale, with yellow laminated arenaceous seams below, containing Fucoidal markings. <i>Same locality</i>	25
39. Two layers gray argillo-calcareous rock, separated by two feet of dark green and ash colored clays. The calcareous beds contain fragments of <i>Crinoids</i> , <i>Chonetes</i> , and <i>Myalina</i> of undt. species. <i>Same locality as last</i>	4½
40. Light greenish, yellow, and gray clays and claystones, extending down nearly to high water mark of the Kansas, opposite the mouth of Blue River.....	27

The foregoing general section of the strata seen along the valley of Kansas and Smoky Hill rivers, from the mouth of Blue river to the 98th degree of west longitude, is presented in its present form more with a view of illustrating the vertical range of the organic remains found in these rocks, than as an attempt to group the beds into formations that may be expected to preserve their distinctive lithological characters throughout areas of any great extent. As this has necessarily been done from a knowledge of only a portion of the fossils characterizing these strata, it is quite probable, when more extensive collections are obtained, that it may be found necessary even on this principle, to classify and group the beds somewhat differently. We are also aware that some of these beds probably increase or diminish greatly in thickness, or may even entirely thin out, at no very great distances from the localities where we saw them.

Among the more peculiar features of the series of rocks represented by this general section, and in part by the preceding local sections, may be mentioned first, the great number of thin layers and beds; and secondly, the frequent repetition of similar beds at various horizons. Again, the almost entire absence of heavy massive strata of limestone, or other hard material possessing sufficient durability to form perpendicular escarpments of much extent, is worthy of note. As a general thing, the limestones vary from only a few inches in thickness, to from one to three or four feet, and rarely, as in Nos. 14 and 18, attain a thickness of from thirty-eight to forty feet. Although various light colored laminated clays, and soft argillaceous shaly beds predominate, and

arenaceous material is not unfrequently present, it is somewhat remarkable, that dark bituminous shales and beds of coal are rarely met with, even among the outcrops seen along the Kansas, below the mouth of Blue river, belonging to the upper coal measures, and holding a position below the base of the foregoing general section; while through a considerable thickness of beds belonging to higher portions of the coal measures included in the lower part of this section, as well as through the strata containing Permian fossils above, beds of coal and dark carbonaceous shales appear to be almost, if not entirely wanting.

It will be observed we have in this general section, without attempting to draw lines between the systems or great primary divisions, presented in regular succession the various beds with the fossils found in each, from the Cretaceous sandstone on the summits of the Smoky Hills, down through several hundred feet of intermediate doubtful strata, so as to include the beds containing Permian types of fossils, and a considerable thickness of rocks in which we find great numbers of upper coal measure forms. We have preferred to give the section in this form because, in the first place, the upper Coal measures of this region pass by such imperceptible gradations into the Permian above, that it is very difficult to determine, with our present information, at what particular horizon we should draw the line between them, while on the other hand, it is equally difficult to define the limits between the Permian and beds above, in which we find no fossils.

Beginning near the base of this section, we find we have in great numbers the following well known and widely distributed Coal measure fossils, viz.: *Fusulina cylindrica*,* *Chonetes Verneuiliana*, *Productus splendens*, (or a closely allied species,) *Retzia Mormonii*, *Rhynchonella Uta*, *Spirigera subtilita*, *Spirifer cameratus*, *S. planoconvexa*, and a *Euomphalus* similar to *E. rugosus* of the Coal measures, while the few new and undetermined species associated with these, are, for the most part, also decidedly more nearly allied to Carboniferous than Permian forms. We should here remark, however, that we occasionally met with a species of *Monotis*, allied to the Permian species *M. Speluncaria* and *Synocladia biserialis*, also regarded in the old world as a Permian genus, at horizons far beneath the base of this section, between Manhattan and the Missouri. We even found a single specimen of this *Monotis* as low down as bed No. 9, of the section taken near the landing at Leavenworth City, which must occupy a position several hundred feet below the lowest beds of the above section. Still as this shell is very rare in these lower rocks, and the *Synocladia* is a distinct species from the well known Permian form of the old world, while they are both, at these horizons, associated with great numbers of the common well known Coal measure species we can only regard their presence in these beds as establishing the existence of these genera at an earlier period in this country, than in the old world. This, it seems to us, is more philosophical than it would be to place all this great thickness of strata, with their vast numbers of well known Coal measure species, in the Permian, merely because we also find with these occasionally a few forms which would in the old world be regarded as characteristic of the Permian epoch.

Taking it for granted then, that we have carried this section down far enough to include, not only all the beds containing almost exclusively Permian forms, but a considerable portion of the upper Coal measures, it will be interesting to notice, as we ascend in the series, how far each of the Coal measure species mentioned in the lower part of the section, as well as of a few others that occur above and below, range upwards. Thus we see that *Fusulina cylindrica* var. *Ventricosa*, *Chonetes Verneuiliana* and *Retzia Mormonii* were not met with above division No. 37; while *Spirifer planoconvexa*, *Productus splendens*? and *Rhynchonella Uta*, were not observed above 34, nor *Spirifer cameratus* above 32. *Fusulina*

* In Russia, *Fusulina cylindrica* is said to occur only in the upper part of the lower Carboniferous series; but the fossil generally referred to that species in this country, appears to be confined to the Coal measures. We have some doubts in regard to its identity with the Russian species.

cylindrica, of the slender variety so common in the Coal measures of Kansas and Missouri, was not seen above 22; nor was any species or variety of that genus observed above this horizon.

Apparently, the same species of *Monotis*, mentioned at various horizons far beneath, were occasionally met with in 30, 25, 23, and 20, generally associated with the same species of *Synocladia*, ranging far down into the upper Coal measures. In division No. 19, we again met with the *Synocladia liserioidis*, and a *Spirigera* allied to *S. subtilita*, if not identical, along with a new species of *Chonetes* we have called *C. mucronata*, which ranges down into the beds near the base of the section. Along with these, were also *Productus Norwoodi*, and *Orthisina Shumardiana*, both of which are common in the Coal measures far below, and a large *Orthisina* similar to *O. umbraculum*, but apparently more finely striate.

Ascending through the intermediate beds to No. 12, we continue to meet with nearly all the species mentioned in 13, with the exception of *Chonetes mucronata*. We also have, first in 18, a large species of *Productus*, called *P. Culhounianus* by Professor Swallow; very similar to some varieties of *P. semireticulatus*, but thought by Prof. S., to present well marked internal differences. There is likewise added in 16, a large *Allorisma* and a *Spiriger* similar to *S. subtilita*, but much more gibbous; and in 14, *Discina tenuilineatus*, together with apparently the same *Monotis*, so often mentioned below. In 12, we also have added a small *Spirifer*, similar to *S. lineatus*, but perhaps more nearly allied to the Permian species *Martinia Clannyana*, King.

The succeeding bed above, No. 11, appears also to contain a mingling of Permian with Coal measure forms, for we have in it the following Permian types, viz.: *Myalina* very similar to *M. Squamosa*, *Pleurophorus? subcuneata*, *Bakewellia parva* and *Monotis Hawni* along with a *Euomphalus* near *E. rugosus*, the same gibbous *Spirigera*, similar to *S. subtilita*, *Orthisina umbraculum?* and *O. Shumardiana*.

On passing into the next division above, No. 10, we find we have lost sight of all the characteristic Carboniferous forms, unless the *Spirigera* mentioned in some of the beds below be regarded as only a variety of *S. subtilita*, from which however, we think it specifically distinct; for with this exception, nearly all the fossils seen by us in this division, are such as would be regarded as Permian types. Although the number of species found by us in No. 10 is not great, individual specimens are often numerous. Above this horizon we saw no more fossils through a great thickness of various colored clays, claystones, &c., until ascending to the Cretaceous sandstones crowning the Smoky Hills.

If we do not admit the existence in this region of an intermediate group of rocks, connecting by slight gradations the Permian above, with the Coal measures below, and must draw a line somewhere, below which all is to be regarded as Carboniferous, and all above as Permian, we should certainly, upon palæontological principles alone, carry this line up as far as the top of division No. 11. The passage from the Carboniferous to the strata containing Permian types, however, is so gradual here, that it seems to us no one, undertaking to classify these rocks without any knowledge of the classification adopted in the old world, would have separated them into distinct systems, either upon lithological or palæontological grounds, especially as they are not, so far as our knowledge extends, separated by any discordance of stratification, or other physical break.* Indeed the fact that some of the Permian types occurring in No. 10, were first introduced in beds below this, containing many Carboniferous species, would seem to indicate that even No. 10, may possibly

* We have been informed by Dr. J. G. Norwood, former State Geologist of Illinois, that the rocks in that State, referred by him and others to the same epoch as the Kansas Permian beds, rest unconformably upon the Coal measures. This, however, would be impossible in Kansas, since no disturbances of the strata occurred there, until after the close of the Cretaceous era, which would, of course, not only cause the Cretaceous and Carboniferous, but all intermediate beds, to dip at the same angle.

have been deposited just before the close of a period of transition from the conditions of the Carboniferous, to those of the Permian epoch.

The apparent absence of fossils in the beds above No. 10, renders it impossible, with our present information, to determine with certainty the upper limits of the series containing Permian forms. It is true, there is at places a kind of conglomerated mass, occupying the horizon No. 9, which might appear to form a natural line of division between the beds containing the Permian fossils, and those above, in which we found no organic remains; but this seems to be local, and although there is a new feature presented by the zone of gypsum deposits above it, we find between the beds and layers of gypsum, and far above the horizon at which they occur, bluish, greenish, and other colored clays, not only similar to those between the beds and layers of limestone containing the Permian fossils in division No. 10, but also precisely like the laminated clays between the beds of limestone of the upper Carboniferous series far below. Again, in these clays of the gypsum zone, as well as through a considerable thickness of clays above it, there are occasional seams of claystone, which sometimes pass into seams of magnesian limestone, exactly like some of those containing Permian fossils, in division No. 10. We saw no fossils in these seams amongst the gypsum bearing beds, nor higher in the series, but it is probable they may yet be found in some of the more calcareous portions.

Another fact apparently indicating some kind of relation between the gypsum-bearing beds, as well as some of the higher deposits, and the rocks below, is, that we often find both in the clays between the beds of gypsum, and those between the limestone containing the Permian fossils, the same peculiar appearance caused by the cracking of the clays and subsequent infiltration of calcareous matter, seen in division No. 5. At some places the thin plates of limestone formed by the impure calcareous matter filling these cracks, may be seen ramifying through some rather thin beds of these clays in all directions, so as to cross and intersect each other at every angle. Where beds of this kind have been exposed for any length of time along near the tops of bluffs, the softer clays filling the interstices, often weather out, so as to have a curious cellular mass, with the numerous angular cavities.

From these facts we are inclined to suspect,—though we are fully aware that it is a question which can only be determined upon evidence derived from organic remains,—that not only the gypsum-bearing deposits, but a large portion, if not all, of division No. 5, belongs to the same epoch as the beds containing the Permian fossils below.

Between No. 5, and the Cretaceous above, there is still a rather extensive series of beds in which we found no organic remains; these may be Jurassic or Triassic, or both, though as we have elsewhere suggested, we rather incline to the opinion that they may prove to belong to the former. As we have fully discussed the question in regard to the Cretaceous age of the highest division of the foregoing section in a paper read before the Academy in December last, and in an article in the American Journal of Science, January, 1859, it is unnecessary for us to add any thing further on that subject here.

As already stated, our observations along the Kansas valley, to within twelve or fourteen miles of the mouth of the Big Blue river, were too isolated to determine in all cases the relations between outcrops seen at different places. Consequently, although we saw at several points along this part of the valley, indications of a westward or north-westward inclination of the strata, we were left in some doubt whether or not there is a general inclination of the rocks in that direction, between Waboune and the Missouri. Above this point, however, our observations being more connected, and the exposures more continuous, we were able to determine very satisfactorily that there is at least from near Waboune, a uniform dip towards the west or north-west, so that in ascending the Kansas valley from this region, we are constantly meeting with more and more modern rocks, as those we leave behind pass beneath the level of Kansas.

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To illustrate this more clearly, we would, in the first place, remark that a bed of light greyish yellow granular magnesian limestone, mentioned on page 12, as occupying a horizon about 115 feet above the Kansas, two or three miles west of Zeandale, passes beneath the level of Kansas before reaching the mouth of the Big Blue river, a distance of near seven miles; while another bed (No. 26 of the foregoing section) seen on the very summit of the hills two or three miles north of Zeandale, at an elevation of about 320 feet above the Kansas, was observed opposite Manhattan at the mouth of Big Blue river, only some 214 feet above the Kansas. Again, bed No. 12 of the foregoing general section, which was seen at a locality nearly opposite Ogden, at an elevation of about 363 feet above the Kansas, is at Fort Riley, eight or nine miles further west, elevated only some 215 feet above Kansas. Above Fort Riley this bed forms a marked horizon, and can be followed by the eye without interruption for several miles along the hills on both sides of the river. We observed it gradually sinking as we ascended the Kansas valley, until at a point on Chapman's Creek, some fifteen miles a little south of west from Fort Riley, we saw it nearly down on a level with the Kansas; beyond this it was not again met with on the north side of the Kansas, but we saw it at somewhat higher elevations on the south side of the river a little west of this.

As the distance by an air-line, from the locality nearly opposite Ogden, where this rock occupies a horizon at an elevation of 363 feet above the Kansas to the mouth of Chapman's Creek, is about 23 miles, the dip would appear to be not far from $15\frac{1}{2}$ feet to the mile. It must be borne in mind, however, that the average fall of the Kansas,—at least below Fort Riley,—according to the Barometrical observations of Col. Fremont and others, is near one and a half feet to the mile, and that if we assume the distance by the windings of the river between Chapman's Creek and Ogden, to be about thirty miles, it would make the elevation of the Kansas at the former locality some forty-five feet greater than at Ogden, which would reduce the dip to a fraction less than 14 feet to the mile. Still as the direction of the dip in this region is to the north of west, and the direction of the mouth of Chapman's Creek from Ogden is considerably south of west, it is probable the inclination of the strata here is greater than the above figures would indicate, and that it may not be less than twenty feet to the mile, in a north-west direction.

From the foregoing statements it will be seen that in consequence of the dip of the strata to the north-west, and in some slight degree to the fall of the Kansas and Smoky Hill rivers, the whole of the foregoing general section below No. 12 passes beneath the level of the Smoky Hill, between the mouth of Blue river and Chapman's Creek. Consequently, the limestones of the succeeding beds above being thinner and less durable than those below, and separated by heavy beds of clay; we find, as might be expected, that the country here in the region of the mouth of Chapman's Creek, is much lower than at Fort Riley and below.

On reaching the mouth of Solomon's Fork, we found the face of the country characterized by long gentle grassy slopes, no part of it near the river being apparently elevated more than about 60 or 70 feet above its surface. A short distance beyond this, we caught the first glimpse of the Smoky Hills, which were seen in a direction a little south of west from us, rising above the surrounding low country like dark blue clouds above the horizon. On approaching these, we found them always situated several miles back from the river, and rising some three hundred and fifty feet above it. The immediate bluffs of the river here, are generally composed of divisions No. 4 and 5 of the foregoing general section, and that portion of these hills above the level of the summits of the bluffs along the river, is made up of division Nos. 3, 2, 1, of the same section. On the south side of the river these hills have but a comparatively thin capping of the sandstone No. 1, but on the north side we saw it showing a thickening on some of them of sixty feet.

From some of these hills on the north side of Smoky Hill river, between it and the Grand Saline, we had an extensive and beautiful view of the surround-

ing country. In the north and north-west, many similar hills were in sight, and as the dip of the strata here is in that direction, it is probable some of this are not only chiefly made up of the sandstone No. 1, but surmounted by the other Cretaceous beds Nos. 2 and 3 of the Nebraska Cretaceous series; indeed, Dr. Engleman found all these formations occupying this relation on Republican river, not more than seventy miles north of this.*

Although this paper is merely designed to give a brief sketch of the leading geological feature of those portions of north-eastern Kansas visited by us, we cannot close it without alluding to the truly great agricultural and other natural resources of this new and interesting Territory. We mean no disparagement to other portions of the Mississippi valley, when we state, that after having travelled extensively in the Great West, and after having seen many of its most favored spots, we have met with no country combining more attractive features than Kansas Territory. Her geographical position gives her a comparatively mild and genial climate, intermediate between the extremes of heat and cold, while the rich virgin soil of her beautiful prairies is admirably adapted to the growth of all the great staple grain and root crops of the west.

It is true that in some districts there is rather a deficiency of timber, but as a general thing there is along the streams sufficient for the immediate wants of the country. In addition to this, the wonderful rapidity with which forests are known to have sprung up on similar prairie lands in Missouri, as the country became settled so as to keep out the annual fires, shows that the present scarcity of timber should not be regarded as presenting any serious obstacle to the settlement of the most extensive prairie district in Kansas.

Before going out into the interior of the Territory, we had expected to find the whole country immediately west of Fort Riley comparatively sterile; on the contrary, however, we were agreeably disappointed at meeting with scarcely any indications of decreasing fertility as far as our travels extended, which was about sixty miles west of Fort Riley. Here we found the prairies clothed with a luxuriant growth of grass, and literally alive with vast herds of Buffalo that were seen quietly grazing as far as the eye could reach in every direction. Even on the high divide between the Smoky Hill and Arkansas rivers, south of this, we found the soil rich and supporting a dense growth of grass; and from all we could learn from persons who have gone further out, the same kind of country extends for a long distance beyond this, towards the west. Hence we infer that the belt of unproductive lands between the rich country on the east, and the eastern base of the Rocky Mountains on the west, is much narrower than is generally supposed; and even this so-called desert country is known to possess a good soil, which may be rendered fruitful by artificial irrigation.

In regard to the mineral resources of Kansas, we have at present only time and space to say a few words. As already stated, coal is known to exist, though its extent is not yet fully determined, at several localities in the region of Leavenworth City, while the geological structure of the country, as well as discoveries already made, warrant the conclusion that this important and useful mineral abounds at many localities south of there. Limestone suitable for building purposes, and the production of quicklime, exist throughout large areas, while inexhaustible beds of gypsum are known to occur at several places not far west of the mouth of Solomon's river. Near this place we likewise saw in the lower Cretaceous rocks crowning the summits of the Smoky Hills, deposits of iron ore, but were unable to determine in the limited time at our command, whether or not it exists in large quantities.

Of the discoveries of gold in the mountains on the western borders of Kansas, much has been said; nothing, however, but a thorough geological survey, by authority of the Territorial or State government, (for Kansas must soon be a State,) can lay before the public such full, accurate, and reliable information on these subjects as will bring from the older States the capital, skill and enterprise necessary to develop the great natural resources of the country.

* See Report of Secretary of War, Dec. 5th, 1857, page 497.

NOTE.—It affords us much pleasure to acknowledge here our obligations to Prof. Henry, of the Smithsonian Institution, for free access to the extensive series of books on Geology, Paleontology, &c., in the Smithsonian Library, while investigating these and our former collections from the west: also for the use of rooms in the Institution, and for many other favors of great value to us.

We are likewise under especial obligations to Capt. Stewart Vanvliet, and Mr. Levi Wilson of Fort Leavenworth, for favors while out in Kansas, without which we could have accomplished nothing: we also received many civilities from Major Sedgwick, Dr. T. G. Madison, Capt. W. S. Walker, and other officers of the army at Fort Riley.

List of the species mentioned in this paper with some remarks on the synonymy, and references to the works, in which they are described.

FORAMINIFERA.

Fusulina cylindrica, Fischer, Oryct. Moscow, p. 126, p. 18, fig. 1—5.

In Russia this species is said to occur only in the upper part of lower carboniferous or mountain limestone. Yet the species usually referred to *F. cylindrica* in this country, so far as our knowledge extends, is not found below the coal measures. From this fact, and some slight differences we observe between our specimens and the figures of the Russian species, we suspect a careful comparison of good specimens may possibly prove them to be distinct. Ranges in Kansas from division No. 22, of the foregoing section, far down into the coal measures. Found at numerous localities between Manhattan and the Missouri, usually in great numbers.

Fusulina cylindrica, var. *ventricosa*, Meek and Hayden, Proc. Acad. Nat. Sci. Phila. Dec. 1858, page 261. Division No. 37, of foregoing general section at Manhattan on the Kansas, and at Juniata on big Blue river.

BRYOZOA.

Synocladia biserialis. Prof. Swallow refers this species with doubt to *S. virgulacea*, Philips, sp. in Transactions Acad. Sci. St. Louis, vol. 1, p. 179, and points out some of the characters in which it differs, stating at the same time, in case it should prove to be distinct, that *biserialis* would be a good specific name for it. We regard it as quite distinct from Phillips' species, not only in scarcely ever having more than two rows of cellules, but also because the ?gemuliferous vesicles, instead of being merely "tubercular and open at the summit," have the form of short, but distinct spines apparently closed and rather obtusely pointed at the apex. The branches or connecting process are likewise less distinctly angulated between the longitudinal stems, than in *S. virgulacea*. Occurs at Fort Riley in No. 19 of foregoing general section, and at various lower horizons on the Kansas below there, down into the upper coal measures.

Acanthocladia Americana. In the Trans. Acad. Sci. St. Louis, vol. 1, p. 180, Prof. Swallow refers this species with a query to *A. anceps*, Schlot. sp. and remarks that it differs from that species in having "the rows of cellules diagonal to the axis of the stems, instead of longitudinal, as represented by King, and on ridges like that figured by Goldfuss." He also further remarks that "it is less regularly branched, and not so distinctly pinnated as those delineated by Goldfuss and King." In the specimens in our collection, the cellules are more numerous, and much more crowded, than in *A. anceps* as figured by King. The specific name *Americana*, was suggested by Prof. Swallow.

We found this species in Division No. 18, of the foregoing general section, on Cottonwood Creek.

ECHINODERMATA.

Cyathocrinus — ? A few scapular plates bearing some similarity to those of *C. ramosus*, Schlot. sp. were met with by us in division No. 18, but they are proportionably much thicker, and the articulating surfaces quite different.

Cottonwood Creek.

Archæocidaris — ? In No. 12, we found spines and detached plates of apparently an undescribed species of this genus, but they were too much weathered to show clearly the specific characters. The spines are rather slender, terete, nearly straight, and provided with short scattering spinous processes, directed rather obliquely outwards and forward.

Cottonwood Creek.

Archæocidaris — ? The spines of this species are much larger than the last, and apparently destitute of spinous processes. They are as much as from three to four inches in length, nearly or quite straight, and not flattened or compressed.

Division No. 26, Manhattan and in same position on Cottonwood Creek.

BRACHIOPODA.

Discina tenuilineata n. sp.—We have only seen the lower valve of this species, which is extremely thin, nearly orbicular, and provided with a narrow perforation extending from very near the centre about half way out to the margin. The inner surface is ornamented by distant, extremely slender, distinctly elevated lines of growth, arranged concentrically around a point very nearly in the middle of the valve. The apex of the upper valve was probably nearly central. Diameter 0.50 inch.

Locality and position.—Cottonwood Creek, division No. 16.

Discina Manhattanensis n. sp.—Shell rather small, nearly circular; upper valve moderately elevated, apex rather obtusely pointed, located a little less than half the diameter of the shell from the posterior edge. Surface black and shining, marked by fine closely set concentric lines. Lower valve unknown. Greater diameter from 0.32 in. to 0.46.

Found in great numbers in division No. 37, opposite Manhattan, on Kansas river.

Productus splendens (?), Norwood and Pratten, Jour. Acad. Nat. Sci. Phila. N. S. vol. 3, pl. fig. 5. We refer this shell to the above species with some doubt; it is always smaller than the figure given by Norwood and Pratten, and rather more convex over the visceral region of the larger valve, while the smaller valve appears to want the band-like flattening around the border mentioned in the description of *P. splendens*. The ears extend beyond the body of the shell, are distinctly vaulted, and rarely have more than one spine on each, often none. The spines, however, are more numerous over the surface of the larger valve, being in this respect more like *P. muricatus* N. and P., but both valves want the concentric wrinkles represented in the figures of that species.

This neat little *Productus* is found in great numbers between Fort Riley and Manhattan, as well as at the latter place, in Division No. 34; also at various horizons below that in the upper coal measures of Kansas.

Productus Norwoodi, Swallow, Trans. Acad. Sci. St. Louis, vol. 1, p. 182. A few specimens of this species in our possession have the extreme point of the beak of the larger valve flattened or truncate, as though it had in the young state been attached to some marine body by that part of the shell. We have also in several instances found other shells associated with this species, with small discs not more than 0.20 inch in diameter, attached by the whole surface, as well as by a series of small spines seen radiating from the margin. May not these little bodies be the young of this species?

We think the specimen figured by Prof. Marcou in his work on the Geology of North America, plate 6, fig. 1, as *P. pustulosus*, is the same as the above species, and quite distinct from *P. pustulosus*. It occurs in Kansas at various horizons from No. 14 far down in the upper Coal measures. We found it at Fort Riley and numerous places between there and the Missouri, as well as at Leavenworth city.

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Productus Rogersi, Norwood and Pratten, Jour. Acad. Nat. Sci. Phil. N. S. vol. iii, page 9, pl. 1, fig. 3. This species is nearly related to the last, and when the shell is exfoliated, may be easily confounded with it. *P. Norwoodi*, however, appears never to have the distinct concentric wrinkles of this species, nor do the pustules, at the base of the spines have the tendency to elongate into indistinct ribs as in *P. Rogersi*. Prof. Maroou has figured in N. Am. Geol. pl. 5, fig. 6, as *Productus scabriculus*, a shell very like this.

Kansas valley below Mouth Blue river, in upper Coal measures.

Productus pustulosus (?) Phillips' Geol. Yorkshire, vol. 2, p. 316, pl. 7, fig. 15. We have a specimen agreeing very nearly with this species in its external markings, but it is much narrower, and the beak of the larger valve more extended, in which respect it differs quite as much from *P. punctatus*.

Near Steam Boat Landing at Leavenworth city, in Coal measures.

Productus Prattenianus, Norwood, Jour. Acad. Nat. Sci. Phil. N. S. vol. 3, p. 17, pl. 1, fig. 10. In Coal measures at Indian creek and at Leavenworth city.

Productus Calhounianus, Swallow, Trans. Acad. Sci. St. Louis, vol. 1, p. 181. This fine large shell is scarcely distinguishable from *P. semireticulatus* var. *antiquus*, but Prof. Swallow, who has seen the interior, thinks it presents well marked internal differences. It occurs in No. 12 and below, at Fort Riley, also on Cotton-wood creek. Prof. S. thinks it even ranges down into the lower Carboniferous.

Chonetes Verneuiliana, Norwood and Pratten, Jour. Acad. Nat. Sci. Phila. vol. 3, p. 26, pl. 2, fig. 6, N. S. Occurs in Kansas in division No. 37, at Manhattan, and perhaps in upper Coal measures at lower horizons.

Chonetes mucronata, Meek and Hayden, Proceed. Acad. Nat. Sci. Phila. Dec., 1838, page 262. Lower part of the section at Fort Riley, (division 9) and down near the base of the foregoing general section, also in same position on Cottonwood creek.

Orthisina crassa, Meek and Hayden, Proceed. Acad. Nat. Sci. Phila. Dec. 1858, p. 261. Occurs in Coal measures near landing at Leavenworth city.

Orthisina umbraculum? Schlot. sp. Petrefakt. 1, p. 256, et 2, p. 67. We find in Kansas, ranging from 16 to 19 of foregoing sections, many specimens of a large species of *Orthisina* having almost exactly the form and other characters of *O. umbraculum*, excepting that the striæ appear to be more numerous. According to Koninck that species has about 108 striæ on each valve, while on our Kansas specimens, we count from 160 to 200; consequently we suspect it may be a distinct but closely allied species; if so, we would propose to designate it by the name of *O. multistriata*. We found it at Fort Riley and at several localities between there and Blue river; also in same position on Cottonwood creek.

Orthisina Missouriensis, Swallow, Trans. Acad. Sci. St. Louis, vol. 1, p. 219. This is a very peculiar plicated species, often much distorted. When partly embedded in the matrix, it frequently bears a striking resemblance to *Plicatula striato-costata*, Cox, 3d vol. Dr. Owen's report on the Geol. Survey of Kentucky, page 558, pl. 8, fig. 7, of Atlas. Common in the upper Coal measures of Kansas, at Leavenworth city and west of there.

Orthisina Shumardiana, Swallow, Trans. St. Louis Acad. Sci. vol. 1, p. 183. Although like the last, a plicated species, this is more symmetrical, and presents other well marked differences. Ranges from No. 11, down some distance in upper Coal measures. Found at Fort Riley and between there and Blue River.

Tercbratula millepunctata, Hall, Pacific Rail Road Report, vol. 3, p. 101, plate 2, figs. 1 2. We have the impression that this species is probably identical with *T. bovidens*, Morton (Silliman's Jour. vol. 29, p.) from Ohio. Our Kan-

sas specimens appear, however, to be more elongated than those figures by Dr. Morton, and may be distinct. In form they resemble very much some varieties of *Epithyris elongata*, Schlot. sp. as figured by King, in Perm. Fos. Eng. pl. vi., particularly the narrower varieties, such as fig. 35. The beak of our Kansas shell, however, is not truncate but pointed, the perforation being on the outside, and a little removed from the extremity. If it is identical with *T. bovidens*, Morton's specific name will have to take precedence, being the older. It remains to be determined whether its internal characters agree with *Terebratula*, as now restricted.

This is a rather common form in the upper Coal measures of Kansas, and southward. We found it near the summit of the hills back of Leavenworth city, also at Indian creek near Indianola, &c.

Rhynchonella Uta. (*Terebratula Uta*, Marcou, Geol. N. A., p. 51, pl. vi. fig. 12.) We have from the upper Coal measures in Kansas many specimens of a species agreeing exactly with Prof. Marcou's description of the above species. These we suspect may possibly go into the genus *Camerophoria*, King, if not into *Rhynchonella*; at any rate they are certainly not *Terebratula*. We are inclined to the opinion that a shell described by Prof. Swallow, in the Trans. Acad. Sci. St. Louis, vol. 1, page 219, under the name of *Rhynchonella (Camerophoria) Osagensis*, may be identical also with the above; yet Prof. S. says his species has from "two to six" plications in the sinus of the dorsal valve, while in the shell before us, of which we have quite a number of specimens, there are *invariably* but two plications in the sinus.

Quite common in division No. 94 at Manhattan and at several localities between there and the Missouri, in the Upper Coal Measures. Prof. Marcou, cites it as a mountain limestone species, but we know nothing of its existence in rocks of that age.

Retzia Mormonii. (*Terebratula Mormonii*, Marcou, Geol. N. A., p. 51, pl. vi., f. 11.) We found this species quite abundant in division 37, at Manhattan, where it is associated with the last. It also ranges far below this in the upper Coal measures between Manhattan and the Missouri, being quite common near the summits of the hills back of Leavenworth city. Dr. B. F. Shumard has described a species in the Trans. Acad. Sci. St. Louis, under the name of *Retzia punctilifera*, which we suspect may possibly be a variety of the above; but as he describes it as having usually in the dorsal valve "a moderately wide, shallow sinus, which extends from the front nearly to the beak," and the species before us, of which we have many specimens, has no traces of a sinus, we are left in doubt. In other respects his description agrees exactly with our shell, and he also states that he has it from K. T. Prof. Marcou found this species at the Salt Lake City, Utah, in a rock he refers to the mountain limestone. We have never seen it from below the Coal measures.

Spirifer Kentuckensis, Shumard, Geol. Survey of Missouri, part 2, page 203. Found in upper Coal Measures near the top of bluffs, back of Fort Leavenworth, also near the landing at Leavenworth City, and at other localities between the Missouri and Blue river.

Spirifer cameratus, Morton, American Jour. Sci. vol. 29, p. 150, plate 11, fig. 3. This is the same species—as has been determined by Prof. Hall,—described by Dr. Roemer as *S. Meusebachanus*. (Kreid von Texas, p. 88, pl. xi. fig. 7) and subsequently by himself as *S. triplicatus*, in Stansbury's Rept. p. 420, pl. iv. fig. 5. Prof. Marcou has recently figured it in his work on the Geol. North America, page 49, pl. viii. fig. 3, as a variety of *Spirifer striatus*, Martin, from which it is quite distinct. He found it at Pecos Village in a rock he refers to the lower Carboniferous or mountain limestone. It has a great geographical range, being common in the coal Measures from Pennsylvania to the Rocky Mountains, and from Nebraska to New Mexico; we have never seen it, however, from lower Carboniferous rocks.

Spirifer hemiplicata, Hall. Stansbury's report, p. 409, pl. 4, fig. 3. Upper Coal Measures near summit of hills back of Leavenworth, and at other localities between there and Blue River.

Spirifer lineatus. *Anomites lineatus*, Martin. *Spirifer lineatus* of Phillips. Geol. Yorks., 2, p. 219, pl. 10, fig. 17, and of other authors. We have, from near Leavenworth landing, in the coal measures, a *Spirifer*, apparently identical with the above. It appears not to range very high in the upper coal measures of Kansas.

Spirifer ——. In division No. 12, above Fort Riley, we found a few imperfect specimens of a small, smooth *Spirifer*, similar in some respects, to *S. lineatus*, but apparently more like *Martinia Clannyana*, King, from the Permian of England.

Spirifer planconvexa, Shumard. Geol. Report, Missouri, 2d part, p. 202. We found this handsome little shell quite abundant in the upper coal measures (divisions 34 and 37,) at Manhattan; also at Juniata, on Big Blue River, and near summit of hills, back of Leavenworth City.

Spirigera subtilita. (*Terebratula subtilita*, Hall. Stansbury's Report, p. 409, pl. 4, fig. 1-2.) *Spirigera subtilita* of Dr. George Shumard. Trans. St. Louis Acad. Sci., vol. i.

This is a very abundant species in Kansas; we found it ranging up, at least as far as division No. 37, at Manhattan, and met with some obscure forms resembling it, still higher in the series. From these horizons, it ranges far down in the other members of the coal measures. Several of our specimens collected at Leavenworth City, show that it was provided with internal spiral appendages, as in the *Spirifer*, and consequently cannot remain in the genus *Terebratula*, as now restricted. It has a wide geographical range, and is almost everywhere the companion of *Spirifer cameratus*. Prof. Marcou figures it in his work on the Geology of North America, pl. vi. fig. 9, from a formation in the Rocky Mountains, which he refers to, the lower carboniferous; but we have never seen it from any position below the coal measures.

Spirigera —? At Fort Riley, and above there, as well as in the same position on Cottonwood Creek, we found, ranging from division 18 up to 10 of the foregoing section, a *Spirigera* resembling *S. subtilita*, but much more gibbous in form; it also appears to have a much thicker shell. If distinct from *S. subtilita* this might be designated by the specific name *gibbosa*.

LAMELLIBRANCHIATA.

Monotis Hawni, Meek and Hayden. Trans. Albany Inst., vol. iv., March 2, 1858. Prof. Swallow thinks this species not distinct from *M. speluncaria*, Schot sp. Although, like that species, it is quite variable, and some of its varieties are very similar to it; after a careful comparison of a large number of individuals with King's figures and descriptions, we still regard it as distinct. We have never seen any of its various forms with the beak of the larger valve elevated so far above the hinge, as in fig. 5, 6, 7 and 8, pl. 13, of King's work. Nor do any of our specimens possess the peculiar oblique posterior sulcus, seen in the figures cited above. High Country, south of Kansas Falls; also above there, on Smoky Hill River and Cottonwood Creek, in division 10.

Myalina (*Mytilus*) *perattenuata*, Meek and Hayden. Trans. Albany Inst., vol. iv., March 2d, 1858. Our description of this species was made out from one of the more slender varieties of this shell, sent to us from near Smoky Hill River by Mr. Hawn. We were probably wrong, however, in referring to it a specimen in our possession from a locality on the Missouri, opposite the northern boundary of Missouri; and we even suspect the rock from which this latter specimen was obtained may belong to an older epoch.

The species above cited, is we think identical with *M. permianus* of Swallow, Trans. Acad. Sci., St. Louis, vol. i. p. 187. And we also suspect the form he describes in the same paper, as *Mytilus* (*Myalina*) *concavus*, is only a broader va-

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riety of the same; at any rate, we have these two forms, and every intermediate gradation between them, from the same bed. Locality and position same as the preceding.

Myalina squamosa. (*Mytilus squamosa*, J. de C. Sowerby. Morris's Catalogue, p. 93. *Myalina squamosa* of some other authors.)

Of the form, we refer with doubt to the above species; we have but one imperfect specimen. As far as the characters can be made out, it agrees with this species. We found it in division No 11, at Kansas Falls, above Fort Riley.

Myalina subquadrata, Shumard. Missouri Geol. Rept., 2d part, p. 207, pl. c., fig. 17. Upper coal measures, Leavenworth City, on the Kansas, at Lawrence and other localities in Kansas Valley, below mouth of Big Blue River.

Edmondia? Calhouni, Meek and Hayden. Trans. Albany Inst., vol. iv., March 2, 1858. We are still in doubt in regard to the generic relations of this species, having procured no better specimens than that first described by us. We suspect it may be a *Cardinia*. Near Smoky Hill river, in division 10.

Bakevellia parva, Meek and Hayden. Trans. Albany Inst., vol. iv., March 2d, 1858. This is probably the same species referred by Prof. Swallow to *Avicula antiqua*, Munster,—*Bakevellia antiqua* of King, and others. In describing this species, we spoke of its very near relation to *B. antiqua*, but pointed out some characters in which it differs. At that time we had seen but a few imperfect specimens; since then, however, we have obtained many others, a careful examination of which causes us still to regard it as distinct from *B. antiqua*. Of a large number of individuals, we have never seen any one-half the size of the smallest, nor one-eighth the size of the largest figures of that species given by King, while the cardinal area is also proportionably much narrower in our shell. Division No. 10. On Smoky Hill river and cottonwood creek.

Area carbonaria, Cox. Vol. iii. Geol. Report, Ky., p. 567, pl. 8, fig. 5. Our fossil is smaller, and less distinctly striate, but exactly the form of the above. Near Leavenworth landing, coal measures.

Leda subscitula, Meek and Hayden. Trans. Albany Inst., vol. iv. March 2d, 1858. Division No. 10. Smoky Hill river and Cottonwood creek.

Pleurophorus? subcuneata, Meek and Hayden. Trans. Albany Inst., vol. iv., March 2d, 1858. Our specimens of this species being casts we are left in doubt in regard to its generic relations. We suspect it may be a *Cardinia*. Same locality and position as preceding.

Azinus (Schizodus) ovatus, Meek and Hayden. Proceed. Acad. Nat. Sci. Phila. Dec., 1858. This is very much like the Permian forms, *S. rotundatus* and *S. truncatus*, but we found it in a rock on Cottonwood creek which we regard as below the Permian.

Azinus rotundatus, Brown. Trans. Manch. Geol. Soc. vol. i. p. 31, pl. 6, fig. 29. We have referred this little shell to the above species with some doubt, but we have seen no characters by which it can be distinguished. No. 10. Near Smoky Hill river.

Allorisma? Leavenworthensis, Meek and Hayden. Proc. Acad. Nat. Sci., Phila., Dec., 1858, p. 263. Upper coal measures, Leavenworth City.

Allorisma subcuneata, Meek and Hayden. Proceed. Acad. Nat. Sci. Phila. ec., 1858, p. 263. Locality and position same as last.

Allorisma? altirostrata, Meek and Hayden. Proceed. Acad. Nat. Sci., Phila. Dec. 1858, p. 263. Upper coal measures, Grasshopper creek.

Allorisma? Cooperi, Meek and Hayden. Proceed. Acad. Nat. Sci., Phila. Dec., 1858, p. 264. (*Panopæa Cooperi*, Meek and Hayden. Trans. Albany Inst., vol. iv., March 2, 1858.) Near Helena, in upper coal measures.

Leptodomus granosus, Shumard. Trans. Acad. Sci., St. Louis, vol. i. p. 207. Upper coal measures, near summit of hills, back of Leavenworth City; also near Leavenworth landing.

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GASTEROPODA.

Pleurotomaria lumerosa, Meek and Hayden. Proceed. Acad. Nat. Sci., Phila. Dec., 1858. In upper coal measures, at Grasshopper creek.

Pleurotomaria subtrilinata, Meek and Hayden. Proceed. Acad. Nat. Sci., Phila. Dec., 1858, p. 254. Locality and position same as last. In the Proceedings of the Academy above cited, the locality of this species is erroneously given as at Helena.

Bellerophon —? We found a small undetermined species of this genus in division 10. On Smoky Hill river and near Cottonwood creek; also casts of a large species at Leavenworth landing and Grasshopper creek, in the upper coal measures.

Euomphalus —? The species here alluded to, was found in No. 11 and 37 of the foregoing general section. Either it or a very closely allied species, also ranges far below this, in the upper coal measures. It is nearly related to, if not identical with a species Prof. Hall has described in the Iowa Report, under the name of *E. rugosus*.

CEPHALAPODA.

Nautilus eccentricus, Meek and Hayden. Trans. Albany Inst., vol. iv., March 2d, 1858. Smoky Hill river, division No. 10.

FISHES.

Vystracanthus acutus, Leidy. Upper Carboniferous rocks at Leavenworth landing.

Cladodus bostonensis, Leidy. Division No. 37 of foregoing general section. At Manhattan.

Petrolodus Alleghaniensis, Leidy. Jour. Acad. Nat. Sci. vol. iii. p. 161. Division No. 10, of foregoing general section. Fort Riley.

Catalogue of Birds collected on the Rivers Camma and Ogobai, Western Africa, by Mr. P. E. Duchaillu in 1853, with notes and descriptions of new species.

BY JOHN CASSIN.

The collection made by Mr. Duchaillu on the River Camma or Fernando Vaz and its tributaries, the Ogobai, Rembo, and Ovenga rivers, is the most extensive and interesting yet made by him, or ever yet received from Western Africa, in the Museum of this Academy. The two last names of rivers I have not used in the localities given in the succeeding catalogue, mainly because I have not succeeded in finding them in any geographical work to which I have access, but now state that these names occur in Mr. Duchaillu's letters, and that they appear to be tributaries to the River Camma. Much valuable information will undoubtedly be added to the geography of this part of Western Africa by Mr. Duchaillu.

As in former collections, Mr. Duchaillu has not sent birds of which numerous specimens had already been sent in former collections. This fact will account for the absence of the names of some well known species from the present catalogue.

1. GYOPHIERAX ANGOLENSIS, (Gmelin.)

Falco angolensis, Gm. Syst. Nat. i. p. 252 (1788.)

Polyborus hypoleucus, Bennett.

Gray's Genera, i. pl. 4. Jard. and Selby, Ill. N. S., pl. 13.

From the Camma and Ogobai. Young, with plumage entirely dull ashy brown, the head only becoming spotted with white. This is the only vulture received from Mr. Duchaillu, and has come in all his collections.

2. POLYBOROIDES TYPICUS, Smith.

Polyboroides typicus, A. Smith, Ill. Zool. S. Afr. Birds.

"*Polyboroides radiatus*, (Scopoli,)" Auct.

Smith, Ill. S. Afr. Birds, pl. 81, 82.