THE

ROCKS OF KANSAS,

BY

G. C. SWALLOW AND F. HAWN;

WITH

Descriptions

OF

NEW PERMIAN FOSSILS,

BY

G. C. SWALLOW.

Ext. from Trans. Acad. Sci., St. Louis, Vol. I., No. 2.

ST. LOUIS, MO.

GEO. KNAPP & CO., PRINTERS.

1858.

THE ROCKS OF KANSAS.

BY G. C. SWALLOW AND F. HAWN.

[*Read Feb.* 22, 1858.]

In presenting the following paper to the scientific world, we feel it incumbent upon ourselves to state that it was prepared in great haste, in the midst of other pressing duties; and that the specimens, in many cases, are very imperfect, and would not permit us to determine with certainty all of the specific characters. Where we have represented them as identical with species heretofore described, the proofs of identity are conclusive; where there have been any slight differences, these have been fully stated. Some of those specimens so imperfect that it was impossible to determine whether they are or are not identical with European forms, have, in consideration of the interest which will be felt in knowing all the relations of these new rocks, been deemed worthy of a place in our paper; and we have stated what seems to us to be their most obvious relations to well known European forms, as it is never safe or advisable to form new species on imperfect specimens.

Whatever defects may appear in our descriptions of new species, the characters given can be relied upon as true to the original specimens.

The great importance of these rocks to scientific and practical men* has induced us to present the results of our first hasty examinations, with the promise that we will, at an early day, give our conclusions more in detail, when we have completed the examination of all the collections which will be in our possession.

Our Geological Map of Kansas will show a large development of the Permian Rocks of that Territory, and the still wider range of those beds between the Permian and the Cretaceous, which we suppose may prove to be Triassic.

The following section gives the rocks of Kansas as observed by Maj. Hawn during his lineal surveys in that Territory.

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* The many beds of gypsum which these rocks contain, will enable the farmer to convert the vast sandy plains of Central Kansas into the most productive regions of the West, and fill that wide wilderness with a teeming happy people. These beds will also supply the commercial demands of the Mississippi Valley.

SYSTEM I.—QUATERNARY.

No. 1—150 feet Bluff, the same as in Missouri—2d Ann. Rep. Mo. Survey.
" 2— 4 feet white clay—2d Ann. Rep. of Mo. Survey.
" 3— 15 feet local drift.

169 feet of Quaternary.

SYSTEM II.—CRETACEOUS.

No. 4—45 feet light gray crystaline limestone.*
" 5—27 feet slope strewn with light gray calcareous concretions.*

72 feet of Cretaceous.

SYSTEM III.—TRIASSIC. (?)

No. 6—12 feet light gray arenaceous limestone.
" 7—10 feet blue pyritiferous clay.
" 8—15 feet dark brown ferruginous sandstone.
" 9— 8 feet, like No. 7.
" 10—18 feet flesh-colored quartzitic sandstone.
" 11—14 feet variegated, red and white, clay.
" 12— 8½ feet white granular gypsum. (Local.)
" 13—12 feet, like Nos. 7 and 9.
" 14—20 feet dark brown ferruginous sandstone.
" 15—13 feet variegated, white and red, clay.
" 16—50 feet soft, coarse, buff sandstone.
" 17—30 feet pyritiferous clay.
" 18—10 feet yellowish brown argillaceous sandstone.
" 19—10 feet thin silico-calcareous strata, containing fragments of trees.
" 20— 3 feet brown impure lignite.
" 21—10 feet black pyritiferous clay, containing numerous stellated crystals of selenite.
" 22—60 feet gray, blue and brown clay, with thin seams of fibrous selenite, and flesh-colored nodules of gypsum.
" 23—75 feet soft, crumbling, brick-red sandstone.
" 24—17 feet white clay, with soft concretions of oxide of iron.
" 25—15 feet conglomerate of coarse sand and small brown pebbles.

420½ feet of Triassic. (?)

SYSTEM III.—PERMIAN.

UPPER PERMIAN.

No. 26—100 feet brown and yellow, cellular and brecciated limestone, alternating with brown, blue and white pyritiferous clay, containing a bed of white granular gypsum, 5 feet thick.
" 27— 18 feet conglomerate, of angular, water-worn fragments of limestone, cemented with white argillaceous matter. This bed is local, and may not have its true position.
" 28—15 feet, resembling No. 26, but more compact.
" 29—60 feet dark brown, silicious limestone, alternating with coarse, impure, brown clays, containing crystals of chalcedony and agatized quartz.
" 30—25 feet dark buff, compact limestone.
" 31—45 feet red clay.

LOWER PERMIAN.

No. 32—25 feet brown shale, containing geodes whose drusy cavities are filled with crystals of quartz, and reniform nodules of variegated white and red quartz, often agatized.

* Major F. HAWN'S section of Messrs. F. B. Meek and F. V. Hayden's communications to the Academy of Natural Sciences of Philad'a. (*See Proceedings, May*, 1857.)

No. 33—30 feet gray limestone and flint, with beds of brown clay.
" 34—25 feet massive, cherty, magnesian limestone and brown clay; the lower magnesian beds contain angular fragments of jasper.
" 35—20 feet of brown clay, fossiliferous.
" 36—18 feet red clay.
" 37—60 feet silicious, yellow, magnesian limestone, with heavy beds of brown clay.
" 38—10 feet massive bed of flint and limestone.
" 39—25 feet gray and yellow limestone, containing small globular and pear-shaped nodules of chert, and geodes with crystals, alternating with beds of brown and blue clay.
" 40—75 feet brown magnesian limestone, alternating with beds of brown, olive-green and red clays.
" 41—25 feet light buff amygdaloidal-magnesian limestone and chert.
" 42— 8 feet heavy-bedded yellow, magnesian limestone.
" 43— 3 feet blue fossiliferous slate.
" 44—15 feet brown slate.
" 45—10 feet brilliant yellow, magnesian limestone.
" 46—17 feet dark brown limestone, with numerous joints of large *crinoidal* columns.
" 47— 4 feet light yellow silicious limestone.
" 48—30 feet red clay.
" 49— 8 feet silico-calcareous slate.
" 50— 5 feet olive-green clay.
" 51— 4 feet red clay.
" 52—10 feet dark gray limestone.
" 53— 6 feet olive-green slate.
" 54— 8 feet dark blue slate.
" 55— 6 feet buff limestone.
" 56—16 feet brown slate.
" 57— 3 feet dark blue slate.
" 58—13 feet gray clay.
" 59— 3 feet compact, light buff limestone.
" 60— 5 feet brown clay.
" 61—15 feet blue shale, fossiliferous.
" 62— 3 feet compact, drab, silicious limestone, with small nodules of chert.
" 63— 4 feet brown limestone.
" 64— 3 feet soft, light brown clay.
" 65—15 feet soft, olive-green clay, with a band of red clay, one foot thick.
" 66— 4 feet gray oolitic limestone.
" 67— 4 feet bright olive-green clay.
" 68— 6 feet dark, buff, oolitic limestone.
" 69— 5 feet dark blue slate.
" 70— 7 feet drab limestone.

Total, 820 feet of Permian Rocks.

SYSTEM IV.—CARBONIFEROUS.

1073 feet coal measures, a continuation of, and probably above, the Upper Coal Series of Missouri. (See 2d Mo. Rep. Part I., p. 78.)

NOTE.—The data for the above section, were obtained amidst onerous duties connected with the lineal surveys of the Territory, confining my observations to arbitrary lines and localities; this, together with a want of conformability in the strata near No. 26 of the foregoing section, renders some parts of it hypothetical, but I believe it is sufficiently accurate for general illustration.

F. HAWN.

CATALOGUE OF FOSSILS

Obtained from the Permian Rocks of Kansas.

NAMES OF SPECIES.	COAL MEASURES.	LOWER PERMIAN.	UPPER PERMIAN.	TRIASSIC (?).	LOCALITIES.
PLANTÆ.					
A trilobate leaf of an unknown exogenous plant	..	..	..	*	No. 14(?) of the forgoing section.
ZOOPHYTA.					
Stenopora crassa, *Lonsdale*	..	*	..	..	Valley of Cotton-wood.
Stenopora spinigera, *Lonsdale*	..	*	..	..	Rock Creek, Santa Fé road.
Chætetes, three species, (*undetermined*)	..	*?	..	..	Valley of Kansas, west of Fort Riley.
BRYOZOA.					
Fenestella flabellata (?), *Phillips*	..	*	..	..	Near Council Grove.
Synocladia virgulacea (?), *King*	..	*	..	..	Valley of Cotton-wood.
Thamniscus dubius, *Schlotheim*	..	*	..	..	Valley of Cotton-wood.
Acanthocladia anceps (?), *Schlotheim*	..	*	..	..	Near Hay's Ranch.
Phyllopora Ehrenbergi, *Geinitz*	..	*	..	..	Valley of Cotton-wood.
ECHINODERMATA.					
Archæocidaris Verneuiliana, *King*	..	*	..	..	Near Lost Spring, S. Fé road.
Cyathocrinus ramosus (?), *King*	..	*	..	..	Near Council Grove.
ANNELLATA.					
Serpula (Spirorbis) valvata, *Goldfuss*	..	*	*	..	Near Smoky-Hill Fork.
Spirorbis orbiculostoma, *Swallow*	..	*	..	..	Valley of Cotton-wood.
CRUSTACEA.					
Phillipsia, *species not determined*	..	*	..	..	Near Council Grove.
BRACHIOPODA.					
Productus Calhounianus, *Swallow,*	..	*	..	..	Valley of Cotton-wood.
Productus semireticulatus, *Martin,*	*	*	..	..	Valley of Cotton-wood.
Productus Rogersii. *Norwood & Pratten*	*	*	..	..	South Fork Cotton-wood.
Productus æquicostatus, *Shumard,*	*	*	..	..	Valley of Kansas, W. Ft. Riley
Productus Norwoodii, *Swallow*	..	*	..	..	Valley of Cotton-wood.
Spirifer cameratus, *Morton*	*	*	..	..	Rock Creek, Santa Fé road.
Spirifer planoconvexa, *Shumard*	*	*	..	..	Valley of Cotton-wood.

NAMES OF SPECIES.	COAL MEASURES.	LOWER PERMIAN.	UPPER PERMIAN.	TRIASSIC (?).	LOCALITIES.
Spirifer pectinifera (?), *Sowerby*	*	*	..	..	Valley of Big Blue.
Chonetes Flemingii, *Norwood & Pratten*	*	*	..	..	Near Council Grove.
Orthisina umbraculum, *Buch*	*	*	..	..	Generally diffused.
Orthisina Shumardiana, *Swallow*	..	*	..	..	Red Water and Cotton-wood.
Orthisina Missouriensis, *Swallow*	*	*	..	..	Red Water.
Rhynchonella Osagensis, *Swallow,*	*	*	..	..	Valley of Big Blue River.
Terebratula(?) subtilita, *Hall*	*	*	..	..	Generally diffused.
ACEPHALA.					
Monotis speluncaria(?), *Schlotheim,*	..	*	..	..	
Monotis " var. Americana, *Swallow*	..	..	*	..	Near Smoky-Hill Fork.
Monotis radialis, *Phillips*	..	..	*	..	Near Smoky-Hill Fork.
Monotis variabilis, *Swallow*	..	..	*	..	Valley of Cotton-wood.
Monotis Halli, *Swallow*	..	*	*	..	Valley of Cotton-wood.
Avicula gryphæata(?), *Munster*	..	..	*	..	Near Smoky-Hill Fork.
Pecten Cleavelandicus, *Swallow*	..	*	..	..	Valley of Cotton-wood.
Pecten ringens, *Swallow*	..	*	..	..	Valley of Cotton-wood.
Pecten acutialatus, *Swallow*	..	*	..	..	Valley of Kansas.
Mytilus (Myalina) Permianus, *Swallow*	..	..	*	..	Valley of Kansas.
Mytilus (Myalina) concavus, *Swallow*	..	..	*	..	White Water.
Mytilus (Myalina) squamosus, *Sowerby*	..	*	..	..	Valley of Cotton-wood.
Mytilus (Myalina) rectus, *Shumard*	*	*	..	..	Valley of Verdigris.
Myalina subquadrata, *Shumard*	*	*	..	..	Valley of Verdigris.
Myalina Kansasensis, *Shumard*	*	*	..	..	Near Council Grove.
Bakevellia antiqua, *Munster*	..	..	*		Valley of Kansas.
Bakevellia pulchra, *Swallow*	..	*	..	..	Valley of Kansas.
Edmondia gibbosa, *Swallow*	..	*	..	..	Valley of Cotton-wood.
Edmondia Otoensis, *Swallow*	..	*	..	..	Valley of Cotton-wood.
Edmondia semiorbiculata, *Swallow*	..	*	..	..	Council Grove.
Nucula (Leda) Kazanensis, *Vern.*	..	*	..	..	Valley of Cotton-wood.
Nucula speciosa(?), *Munster*	..	..	..	*	No. 18 of foregoing section.
Nucula, *(species not determined).*					
Solemya Biarmica(?), *Verneuil*	..	*	..	..	Valley of Kansas.
Solemya, *(species undetermined)*	..	..	*	..	Smoky-Hill Fork.
Soken(?) Permianus, *Swallow*	..	..	*	..	Smoky-Hill Fork.
Cardiomorpha rhomboidea, *Swal.*	..	*	..	..	Council Grove.
Cardiomorpha Kansasensis, *Swal.*	..	*	..	..	Valley of Cotton-wood.
Cardinia cordata, *Swallow*	..	*	..	..	Valley of Cotton-wood.
Cardinia subangulata, *Swallow*	..	*	..	..	Valley of Cotton-wood.
Cardinia, *(species undetermined).*					
Cardinia Listeri(?), *Sowerby*	..	..	..	..	
Pleurophorus(?) Permianus, *Swal.*	..	*	..	..	Smoky-Hill Fork.
Schizodus obscurus, *Sowerby*	..	*	..	..	Valley of Cotton-wood.

NAMES OF SPECIES.	COAL MEASURES.	LOWER PERMIAN.	UPPER PERMIAN.	TRIASSIC (?).	LOCALITIES.
Schizodus triangularis, *Swallow*	..	*	..	..	Valley of Cotton-wood.
Schizodus Rossicus, *Verneuil*	..	..	*	..	Smoky-Hill Fork.
Lyriodon (Myophoria) orbiculare, *Goldfuss*	..	..	..	*	No. 18 foregoing section.
Allorisma lanceolata, *Swallow*	..	*	..	..	Near Council Grove.
Allorisma curta, *Swallow*	..	*	..	..	Near Council Grove.
Allorisma Minnahaha, *Swallow*	*	*	..	..	Near Council Grove.
GASTEROPODA.					
Murchisonia subangulata(?), *Vern.*	..	..	*	..	No. 26 foregoing section.
Murchisonia Kansasensis, *Swallow*	..	*	..	..	Valley of Cotton-wood.
Murchisonia perversa, *Swallow*	..	*	..	..	Valley of Cotton-wood.
Loxonema fasciata, *King*	..	*	..	..	Valley of Kansas.
Macrocheilus spiratus, *McCoy*	..	*	..	..	Valley of Kansas.
Naticopsis Pricei, *Shumard*	*	*	..	..	Valley of Kansas.
CEPHALOPODA.					
Nautilus Permianus, *Swallow*	..	..	*	..	Smoky-Hill Fork.
Nautilus occidentalis, *Swallow*	..	..	..	..	Valley of Cotton-wood.
Orthoceras Kickapooense, *Swallow*	..	..	*	..	Smoky-Hill Fork.
Cyrtoceras dorsatum, *Swallow*	..	..	*	..	Smoky-Hill Fork.

FOSSILS OF THE PERMIAN ROCKS OF KANSAS.*

PLANTS.

A trilobate leaf of an exogenous plant, is the only fossil plant in the collection belonging to the beds above the Permian.

ZOOPHYTA.

STENOPORA CRASSA, *Lonsdale*, Ge. Rus., Vol. I., p. 632, pl. A, fig. 12.

CALAMOPORA MACKROTHII, *King*, Per. Fos., pl. III., figs. 3–6.

CHAETETES (?) MACROTHII, *Edwards and Haime*, Brit. Fos. Corals.

Whatever may be the generic and specific relations of the above corals, I will not pretend to decide among the conflicting opinions; but our specimens agree with Lonsdale's in ev-

* *Descriptions of the following species read, Feb.* 22, 1858 : — *Monotis Halli, Pecten Cleavelandicus, Murchisonia Kansasensis, M. perversa, and Nautilus occidentalis; the others read March* 8, 1858.

ery particular indicated in his figures and descriptions. They do not show the *mural foramina* of King's figures.

STENOPORA SPINIGERA, *Lonsdale*, Ge. Rus., Vol. I., pl. A, fig. 11.

STENOPORA COLUMNARIS, *King*, Per. Fos., pl. III., figs. 7–9.

Our specimens agree with those delineated by Lonsdale and King, except they are not "incrusting" like some of King's.

Both of the above species of Stenopora are from the Lower Permian rocks in the valley of the Cotton-wood, associated with *Monotis Halli.*

CHAETETES. Three undetermined species, probably new.

All of these corals were obtained in strata supposed to be Lower Permian of Kansas Territory. They are very abundant in some of the beds.

BRYOZOA.

FENESTELLA FLABELLATA (?), *Phillips*, Ge. York, Pt. II., pl. I., fig. 7–10.

Our specimen presents the striated surface only; all the characters displayed are like those delineated by Phillips.

Lower Permian strata, near Council Grove, K. T.

SYNOCLADIA VIRGULACEA (?), *Phillips*, Trans. Ge. Soc. Lon. 2d Series, Vol. III.., pl. XII., fig. 6, p. 120; and the Encyclopedia Metropolitana, pl. III.

SYNOCLADIA VIRGULACEA(?), *King*, Per. Fos., p. 39, pl. IV., figs. 1–8.

It is impossible to tell whether our specimens are identical with those figured and described by Phillips, as cited above; but they differ from King's in having but two or three rows of *cellules*, generally two. His species is described as having from "three to five" rows of *cellules.* Whether the specific characters should be so extended as to include those specimens with two rows only, as seems most reasonable, is left for others to decide. *S. biserialis* would be a good name for our species, unless it be included in the *virgulacea.*

From the Lower Permian strata in the valley of the Cotton-wood, K. T.

THAMNISCUS DUBIUS, *Schlotheim.*

GORGONIA DUBIA, *Goldfuss*, Pet. Ger., p. 18, pl. VII., fig. 1.

THAMNISCUS DUBIUS, *King*, Per. Fos. p. 44, pl. 5, figs. 7–12.

There can be no doubt of the identity of our fossils with those figured and described by Goldfuss and King.

From the Lower Permian strata in the valley of the Cotton-wood, K. T.

ACANTHOCLADIA ANCEPS (?), *Schlotheim.*
GORGONIA ANCEPS(?), *Goldfuss* (?), Pet. Ger. p. 98, pl. XXXVI. fig. 1.
ACANTHOCLADIA ANCEPS(?), *King* (?), Per. Fos. p. 48, pl. v., figs. 13–18.

Our specimens differ in having the rows of *cellules* diagonal to the axis of the stem, instead of longitudinal, as represented by King, and on ridges like that figured by Goldfuss; they are less regularly branched, and not so distinctly pinnated as those delineated by Goldfuss and King. Should these differences entitle our fossils to a specific distinction, *Americana* would be a good name.

Lower Permian strata in the valley of the Cotton-wood, K. T.

PHYLLOPORA EHRENBERGI, *Geinitz.*
PHYLLOPORA EHRENBERGI, *King*, Per. Fos., p. 43, pl. v., figs. 1–6.
PHYLLOPORA EHRENBERGI, *Pictet*, Tra. Palæ., pl. XCII., fig. 16.

Our specimens from the Lower Permian strata in K. T. seem to be perfectly identical with the specimen figured and described by King and Pictet.

ECHINODERMATA.

ARCHÆOCIDARIS VERNEUILIANA, *King*, Per. Fos., pl. VI., figs. 22–24.
ARCHÆOCIDARIS ACULEATUS(?), *Shumard*, Trans. Acad. Sci., St. Louis.

Our specimens seem to be identical with those delineated by King.

Near the junction of the Upper and Lower Permian strata west of Council Grove, K. T.

CYATHOCRINUS RAMOSUS (?), *King*, Per. Fos., pl. VI., figs. 15–21.

We have one plate and several internodes from near the junction of the Upper and Lower Permian rocks, west of Council Grove, which are very analogous to the above fossil described by King, but probably specifically different.

ANNELLATA.

SERPULA (*Spirorbis*) VALVATA, *Goldfuss*, Pet. Ger., p. 225, pl. 67, fig. 4.

This species from the Muschelkalk seems to be identical with one of our species from the Upper Permian strata of K. T.

SPIRORBIS ORBICULOSTOMA, *Swallow.*

Shell small; spire elevated; volutions about three; convex on the free side and marked with transverse rugæ; aperture oblique, sub-orbicular, not modified by the preceding volution; umbilicus small.

Our shell differs from the *S. valvata.* of Goldfuss, which it most resembles in the number of volutions and the transverse rugæ; and from *S. helix* of King, (Per. Fos., p. 54, pl. VI., figs. 10–11,) in the form of the aperture.

Maj. Hawn's collection from the Permian Strata of Kansas, attached to *Nautilus Permianus* and *N. occidentalis.*

CRUSTACEA.

PHILLIPSIA. Species not determined.

From the Lower Permian strata, on a slab with *Thamniscus dubius* and *Acanthocladia anceps* (?).

BRACHIOPODA.

PRODUCTUS CALHOUNIANUS, *Swallow.*

Shell, large, sub-hemispherical; *sinus*, narrow, extending from the visceral region to the anterior border of the dorsal valve; *beak*, small, recurved beyond and within the cardinal border; *ears* large, triangular, strongly arched, curving towards the cardinal border, ornamented with numerous tubular spines, those on the cardinal border somewhat regularly arranged in parallel rows; *cardinal border*, as long as the greatest width of the shell, the extremities somewhat reflexed towards the visceral region of the dorsal valve; *dorsal valve*, regularly arched, with a curve constantly increasing from the anterior border to the beak, ornamented with numerous, somewhat irregular, longitudinal costæ, narrow and prominent towards the beak, but broader and more flattened towards the anterior margin, their number increased by insertion and subdivision; the whole surface ornamented with tubular spines, which are more numerous towards the borders and on the ears, and usually spring from the costæ; *visceral region*, for a short distance from the beak, marked with irregular, concentric, waving, more or less prominent rugæ; *ventral valve*, strongly arched, slightly flattened on the visceral region and towards the anterior margin, ornamented with costæ and rugæ, like the op-

posite valve; *mesial ridge*, corresponding to the dorsal sinus; *internal surface* of ventral valve garnished with a prominent trifid *cardinal process*, fortified at its base with three diverging ridges, two extend laterally nearly parallel to the cardinal line and become obsolete on the ears; the third or the mesial ridge, extends perpendicularly from the cardinal border to the middle of the valve, where it becomes prominent and sharp; on each side of the last, and in the angles between it and the two former ridges, are the oval rugose scars of the *adductor muscles; vascular impressions*, ovate, nearer the anterior and lateral borders, connected by recurved sinuses to the anterior part of the mesial ridge; *central portion* of the visceral region punctate and marked with longitudinal costæ; around the anterior border is a zone, ornamented with tubes, those on the inner portion large and prominent, while those nearer the border are small, depressed and more numerous. Interior of dorsal valve marked with oblong, elliptical rugose *adductor muscles*, separated by a deep, narrow, longitudinal sinus.

Length from beak to anterior border, 1.65; breadth, 2.25; height of dorsal valve, 1.15.

The *Calhounianus*, so far as observed, is confined to the Lower Permian.

The variety *Kansasensis* ranges down to the base of the Carboniferous System. They were found very abundant by Major Hawn in Kansas.

By request of Major Hawn, this magnificent species is named in honor of Gen. John Calhoun, Surveyor General of Kansas, whose liberal official policy enabled Major Hawn to make the Geological survey of that Territory.

PRODUCTUS (*Strophalosia?*) NORWOODII, *Swallow*.

Shell thin, of medium size, hemispherical, somewhat depressed, ornamented with indistinct concentric rugæ and numerous small tubular spines; *dorsal valve* arched, curve regularly increasing from the anterior margin to the beak; *mesial sinus* well defined in some specimens, obsolete in others; *cardinal margin* slightly curved, less than the greatest width of the shell; *cardinal line* sub-linear, expanded beneath the beak into a narrow area, which is divided by a small deltoid aperture; *ears* of medium size, sharply defined, triangular, arched, rugose, ornamented with numerous spines inclined towards the posterior lateral angles, which are well defined, and vary but little from right angles. *Ventral valve*, sub-orbicular, narrowed towards the posterior border so as to present an ovate form, truncated by the cardinal margin, slightly concave, with a semi-circular depression parallel to the anterior margin; *ears* rugose, separated from the visceral region by a ridge more or less distinct; *trifid cardinal process* curves up under the

beak and closes the aperture; in front of the cardinal process is a flat, narrow area. Both valves are ornamented with irregular, indistinct, concentric corrugations or lines of growth, which rarely assume the form of thin, scaly laminæ; they are most distinct near the beak and the anterior margin; numerous small, unequal, depressed tubular spines are developed on all parts of the surface, even to the point of the beak; their attachments make the shell appear as if marked with small, rounded, interrupted, longitudinal costæ; they are smaller on the ventral valve. In some specimens there are indications of an effort to range them in concentric lines, particularly near the margins; but usually there is no perceptible order, which together with the narrow area of the dorsal valve, and other characters, gives the shell strong affinities with the *Productus horrescens* of Verneuil.

Length of dorsal valve, 1.08; greatest width, 1.11; height, 0.55; length of cardinal line, 0.87; length of ventral valve, 0.91; width, 1.07.

The *P. Norwoodii* may be distinguished from the *P. horrescens* of Verneuil, by its entire beak and smaller area; and from the *P. Rogersii*, *N. & P.*, which it faintly resembles, by the want of large concentric ridges, and by the smaller size and greater number, and irregular arrangement of the spines. The *Strophalosia Morrissiana*, King, has a larger area.

Major Hawn's collection from the Lower Permian Rocks, in the valley of the Cotton-wood, where it was associated with *Thamniscus dubius*, *Productus Rogersi*, and *Monotis Halli*.

ORTHISINA SHUMARDIANA, *Swallow.*

Shell depressed, transverse, sub-orbicular, each valve marked with about ten irregular, broad depressed, rounded, radiating plications, which become obsolete towards the beaks; the whole surface is ornamented with prominent, nodular, rounded, radiating striæ, and by smaller concentric lines, which are themselves finely striated; the concentric striæ most obvious between the radiating lines; the latter are increased by implantation. *Dorsal valve* semi-conical, highest at the beak, depressed in the center, and in a circular zone parallel to the anterior margin; *beak* pointed, semi-conical, often slightly oblique; *area* triangular, vertical, base the longest side, decussate with fine striæ; aperture elongated, sub-deltoid, closed with a convex, transversely rugose deltidium. *Ventral valve* convex, gibbous towards the beak, depressed near the junction of the lateral and cardinal margins, forming small, flat, obtuse ears, flattened towards the ventral margin, giving in many specimens a slight mesial sinus; very much incurved

towards the beak, which is small and curved beneath the deltidium; *area*, very narrow or obsolete.

Length, 0.94; breadth, 1.25; thickness, 0.62; height of area, 0.28; width of area and length of cardinal line, 0.64.

Our shell differs from the *O. Missouriensis* in being less gibbous; area and deltidium wider, and not so high; *ribs* more depressed; radiating lines regular and continuous from the beaks to the margins. It also may be distinguished from the *O. eximia Ver.* (Ge. Rus. pl. XI. fig. 2, p. 192,) in the markings, although the two shells present the same general characters. M. Verneuil says of the *eximia*: "La surface est ornée de stries déliées, filiformes, deux ou trois fois plus étroites que les intervalles qui les separent," which is not true of our shell; and, besides, ours has concentric striæ.

Major Hawn's collection from the Lower Permian Rocks, in the valley of the Cotton-wood, K. T., where it is associated with *Thamniscus dubius*, *Monotis Halli*, and *Monotis variabilis*.

ACEPHALA.

PECTEN CLEAVELANDICUS, *Swallow.*

Shell of medium size, orbicular, oblique, with a deep, rounded sinus between each ear and the adjacent sides; *cardinal border* long, slightly curved. *Left valve* very convex, flattened towards the margins, particularly on the posterior slope, ornamented with broad, rounded, radiating costæ, crossed by fine concentric striæ, which are nearly obsolete on the ribs, large and more numerous towards the margin, increased by implantation; *anterior wing* large, triangular, marked with from eight to twelve radiating costæ, and coarse, transverse striæ, parallel to the anterior margin; *posterior wing* longer and narrower, marked with eleven radiating costæ, which are crossed by striæ parallel to the posterior border; *beak* pointed, depressed, extending nearly to the cardinal border. *Right valve*, plane or concave, marked like the one opposite, but the costæ are not so prominent; *posterior wing* nearly smooth, with a few fine rugæ parallel to its posterior border; *anterior wing* convex, strongly wrinkled parallel to its anterior border.

Length, 0.95; height from beak to base, 1.63; length of posterior wing, 0.48; length of anterior wing, 0.38.

Collected by Major Hawn, in the valley of South Cotton-wood, K. T., where it is associated with *Monotis Halli*, *Nautilus occidentalis*, *Spirorbis orbiculostoma* and *Mytilus squamosus*.

PECTEN RINGENS, *Swallow.*

Shell transversely elongate, ovate; *left valve* convex, with a

rounded ridge extending from the beak to the middle of the ventral margin, and convex towards the posterior side; *ventral margin* angular in the middle, depressed towards the sides with which it forms obtuse angles; *lateral margins* nearly straight, converging to the beak; *anterior wing* triangular, separated from the body by a well-defined convex margin; a wide sinus separates it from the anterior lateral margin; *beak* small, depressed, projecting slightly beyond the cardinal margin.

Our specimens are imperfect, and show no surface markings, save a few irregular corrugations.

Height from beak to ventral margin, 0.95; length, 0.70; depth of left valve, 0.16.

Major Hawn's collection from the valley of the Cotton-wood, in Permian strata.

PECTEN ACUTIALATUS, *Swallow.*

Shell small, depressed, polished, inflated part of the left valve orbiculo-cuneate, rounded on the ventral margin; *anterior wing* long, narrow, acuminate, separated from the side by a deep, rounded sinus, and a sharply-defined boundary from the sinus to the back; *posterior wing* separated by a deep, narrow sinus; *cardinal border* as long, or longer, than the length of the shell; no surface markings seen, save some faint indications of wide, depressed, radiating costæ on the inflated part of the left valve. Our specimens have no well-preserved surfaces.

Length, 0.74; height from beak to ventral margin, 0.76.

Major Hawn's collection from the Permian Rocks in the valley of the Kansas.

MONOTIS HALLI, *Swallow.*

Shell ovate or sub-orbicular, somewhat oblique, inequilateral, irregularly plano-convex; *left valve* gibbous on the middle towards the beak, flattened near the lateral and basal margins, ornamented with radiating costæ; *costæ* smaller, or entirely obsolete near the beak, larger and more numerous towards the margin, unequal, usually two or more small ones between the larger, all armed with vaulted and tubular scales, which are larger, more prominent and numerous towards the margin; *beak* prominent, depressed or incurved, extending to or beyond the cardinal border; *posterior wing* of medium size, flat, sub-costate or rugose, sometimes spinose, outer angle obtuse; *anterior wing* thin, flattened, extending down into the sinus, impressed on the anterior margin of the convex part of the valve, marked with numerous sharp, sinuous wrinkles; *right valve* sometimes irregular, sub-orbicular, nearly plane, ornamented with costæ similar to those on the opposite valve, but

usually more numerous and more densely set with vaulted and tubular scales; *anterior wing* narrow, lingulate, marked with irregular rugæ, separated from the valve below by the deep, bissiferous notch; *aperture* for *byssus* deep, funnel-form, with two semi-cylindrical channels, one extending out and upwards to the cardinal margin under the beak, the other obliquely down to the anterior margin; *posterior wing* obtuse, rugose, extending down to the sinus, depressed in the posterior border of the valve. On both valves the stages of growth are marked with concentric, scaly, crenulated laminæ, which are most numerous at the margin; they are crenulated, and seem to form the vaulted scales and spines on the costæ.

A large ovate specimen measured in inches:—Length, 2.00; breadth, from beak to ventral margin, 2.38; length of cardinal border, 0.85; depth of left valve, 0.38. Length of a small orbicular specimen, 2.00; breadth, 2.04; length of cardinal border, 0.85; depth of left valve, 0.48.

Our specimens are very nearly allied to the *M. Garforthensis*, King, (Per. Fos. pl. XIII., figs. 24–25); but ours have very unequal radiating costæ; the right valve is very distinctly costate on the inner side; its anterior ear is long, longitudinally rugose, with sides nearly parallel. It is also very distinct from *Ostrea spondyloides*, Schlot., as represented by Goldfuss, which Mr. King says, resembles his shell.

Our species is found in both divisions of the Permian Rocks of Kansas, in the valley of the Cotton-wood, and near Council Grove, associated with *Nautilus occidentalis*, *Monotis speluncaria*, *Monotis variabilis*, and *Pecten Cleavelandicus*.

MONOTIS SPELUNCARIA, *Schlotheim.*

MONOTIS SPELUNCARIA, *King*, Mon. Per. Fos., p. 155, pl. XIII., figs. 5–21.

VAR. AMERICANA,* *Nobis.*

I am unable to detect any specific differences between our specimens and those described by Mr. King. The fossil is very variable, and with a few specimens one might be disposed to make several species. They differ nearly as much from each other as they do from those figured in the Monograph of Permian Fossils. But there appear to be two points of distinction which are constant. The left valve of the Kansas fossils is not so elevated, and the inside of the right is marked with depressed, radiating costæ.

Major Hawn's collection from the upper division of the Permian strata, near Smoky-Hill Fork and Council Grove.

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* Since the above was written, Mr. Meek has published this shell under the name *M. Hawni*.

MONOTIS RADIALIS, *Phillips*, Enc. Met.

MONOTIS RADIALIS, *King*, Per. Fos., p. 157, pl. XIII., figs. 22–23.

Our specimens are identical with those figured and described by Messrs. King and Phillips.

Major Hawn's collection from the Upper Permian strata, near Smoky-Hill Fork, K. T.

MONOTIS VARIABILIS, *Swallow*.

Shell variable, oblique, inequilateral, transversely elongate, ovate; *left valve* more or less gibbous, regularly arched, ornamented with fine, radiating and concentric striæ; on the ventral and lateral margins are variable, radiating spinose, and scaly costæ extending from one-fourth to one-half of the distance from the margin to the beak, where they entirely disappear; *beak* small, pointed, depressed, extending to the border or a little beyond; the whole surface is marked with concentric lines of growth; *cardinal margin* oblique, posterior part more so than the anterior, slight sinus below the anterior wing. *Right valve* not seen.

This species is very easily distinguished by the peculiarity of its markings, by the smooth, finely-decussated visceral region, and the coarsely costate and spinose or scaly marginal zone. It is very variable in form.

Length, 0.88; height, from beak to the anterior margin, 1.31.

It most resembles the *M. radialis*, *Phillips*, in form; but it is larger and very differently marked.

Major Hawn's collection from the Lower Permian Rocks, in the valley of the Cotton-wood, K. T.

MYTILUS (*Myalina*) PERMIANUS, *Swallow*.

Shell elongate, sub-quadrilateral; *anterior margin* long, concave, depressed, so as to produce a somewhat flat or concave plane nearly as wide as the thickness of the shell; *cardinal margin* rather short and straight, meeting the anterior border at an angle of about 58°, and the posterior by an obtuse angle or abrupt curve; *posterior margin* long, convex, parallel to the anterior border for more than half of the length of the shell, curved rather abruptly towards the base, meeting the opposite slope in an abrupt curve nearer the anterior margin. *Each valve* is marked with an angular ridge extending from the beak to the opposite extremity; these ridges are very angular and parallel to the anterior margin for more than half the length of the shell, forming a sharp ridge between the flat anterior surface and the convex cardinal and posterior slopes; but they diverge from the line of the anterior margin, become rounded and depressed as they approach the basal ex-

tremity; *beaks* sharp, terminal, curved in and forward. The *surface* is marked with numerous imbricating lines of growth, sub-parallel, but most distant on the posterior basal slopes; on the flat anterior surface the lines of growth appear like fine striæ, slightly diverging towards the basal extremity; punctate under the magnifier.

Height from the beak to the basal extremity, 1.96; width from the anterior to the posterior margins, .86; thickness, .72.

Our shell differs from the *M. rectus*, Shumard, in having a concave anterior margin; beaks curved forward, posterior margin parallel with the anterior, and a more abrupt curve or angle between the cardinal and posterior margins. *M. vetustus*, Goldfuss, (Pet. p. 169, pl. 128, fig. 7,) from the Muschelkalk, is less curved on the anterior margin, not so thick and the extremity of the base not so near the anterior margin.

Maj. Hawn's collection from the Permian(?) strata in K. T.

MYTILUS (*Myalina?*) CONCAVUS, *Swallow.*

Shell short, triangular, marked with sub-imbricating laminæ or lines of growth, which are concentric on the posterior cardinal slopes, but straight and slightly diverging on the concave anterior surface. *Anterior margin* concave, nearly as long as the shell; *cardinal margin* long, straight or slightly convex; posterior basal margin regularly curved from the cardinal to the anterior margin, with both of which it forms angular junctions; *anterior slopes* so flattened as to present a sharply defined, even, concave surface as long as the anterior margin, and as wide as the thickness of the shell; cardinal and posterior slopes slightly convex, forming sharp edges on the corresponding margins; the ridges bounding the anterior surface are sharp, well defined and parallel to the anterior margin; *beaks* pointed, curved in and forward.

Height from beaks to base, 1.07; width from anterior to the posterior margins, 0.60; thickness, 0.40.

This shell may be distinguished from the *M. Permianus* by its shorter triangular form, longer cardinal, and shorter, more convex posterior margin, and by the more sharply defined and regularly concave anterior surface.

Maj. Hawn's collection from the Permian (?) strata in the valley of the Kansas, K. T.

MYTILUS SQUAMOSUS (?), *Sow.*

MYTILUS HAUSMANNI (?), *Goldfuss*, Pet. Ger., p. 168, pl. 138, fig. 2.

MYTILUS SQUAMOSUS, *King*, Per. Fos., p. 159, pl. XIV., fig. 1–7.

Our specimens are like the smooth variety mentioned and figured by King.

Lower Permian, valley of Cotton-wood, K. T.

BAKEVELLIA ANTIQUA, *Munster.*

AVICULA ANTIQUA, *Goldfuss*, Pet. Ger., p. 126, pl. CXVI., fig. 7.

AVICULA ANTIQUA, *Verneuil*, Geo. Rus., pl. XX., fig. 13.

BAKEVELLIA ANTIQUA, *King*, Per. Fos., p. 168, pl. XIV., figs. 28–34.

This fossil has a wide range; it is found in the Bunter Sandstein of Germany, the Permian strata of Russia and England, and the Upper Permian Rocks near Smoky-Hill Fork, Kansas Ter.

BAKEVELLIA(?) PULCHRA, *Swallow.*

Shell rather large, polished, elongate, depressed, with a ridge from the back to the posterior ventral angle, where it becomes obsolete, marked with indistinct concentric plications or lines of growth and a few radiating costæ on the posterior cardinal slope; *cardinal margin* oblique, long; *posterior wing* narrow, two-thirds as long as the shell, with a deep sulcus parallel to and near the cardinal edge; *ventral margin* slightly curved; *posterior extremity* oblique, most prominent near the ventral margin.

Length, 0.81; height at the beak, 0.32.

Lower Permian Rocks, in the valley of the Kansas.

AVICULA GRYPHÆATA(?), *Munster.*

AVICULA GRYPHÆATA(?), *Goldfuss*, Pet. Ger., pl. 116, fig. 10.

We have a cast from the Upper Permian(?) of Kansas which very much resembles this species.

EDMONDIA GIBBOSA, *Swallow.*

Shell gibbous, sub-equilateral, marked with regular concentric costæ, and very indistinct striæ; valves regularly convex or flattened toward the ventral margin, with rounded ridges from the beaks to the anterior and posterior ventral angles; beaks very large, gibbous, strongly incurved, approximate, subcentral; *cardinal margin* depressed, shorter than the shell; extremities narrow, posterior the longer, flattened near the end, rounded; anterior rounded, forming an angle with the cardinal margin; *lunule* and *escutcheon* broad and depressed; ventral margin regularly curved.

Length, 0.77; width, 0.48; thickness, 0.46.

Maj. Hawn's collection from the Lower Permian Rocks, in the valley of the Cotton-wood, K. T.

EDMONDIA OTOENSIS, *Swallow.*

Shell small, sub-orbicular, oblique, gibbous, inequilateral, or-

namented with regular concentric costæ and striæ; *beaks* large and strongly incurved.

Maj. Hawn's collection from the Lower Permian Rocks, in the valley of the Cotton-wood, K. T.

EDMONDIA SEMIORBICULATA, *Swallow.*

Shell elongate, sub-elliptical, inequilateral, slightly convex, regularly curved at the extremities; posterior end, the wider marked with regular concentric plications with sharp prominent edges. *Beaks* sub-central of medium size, slightly inclined forward; *cardinal border* sub-rectilinear; *valves* regularly convex, flattened at the posterior cardinal border.

Length, 0.55; width, 0.39; thickness, 0.33.

Maj. Hawn's collection from near Council Grove, K. T., in Lower Permian Rocks, with *Monotis Halli.*

Our specimens very much resemble the *Edmondia Murchisonia*, King, (Per. Fos., pl .XIV., figs. 14 & 15,) but the plications are larger, the beaks more prominent and central, and the posterior margin more regularly convex.

NUCULA (*Leda*) KAZANENSIS, *Verneuil*, Ge. Rus., Vol. II., pl. XIX., fig. 14.

Upper and Lower Permian in Valley of Cotton-wood and near Smoky-Hill Fork, K. T., where it is associated with *Monotis Halli*, *Monotis speluncaria*, *Schizodus Rossicus* and *Schizodus triangularis.*

NUCULA SPECIOSA(?), *Munster.*

NUCULA SPECIOSA(?), *Goldfuss*, Pet. Ger., p. 152, pl. CXXIV., fig. 10.

We have an imperfect cast which resembles the above fossil of Goldfuss from the Muschelkalk.

It is from No. 18 of what we suppose may prove to be Triassic.

NUCULA—species not determined—from the Upper Permian strata, K. T.

SOLEMYA BIARMICA(?), *Verneuil*, Ge. Rus.

SOLEMYA BIARMICA(?), *King*, Per. Fos., p. 178, pl. XVI., fig. 7.

Our specimens are imperfect casts, but so far as the characters are shown they agree with this species from the Permian of Russia and England.

From the Upper Permian strata, near Council Grove.

SOLEN(?) PERMIANUS, *Swallow.*

Shell small, cylindrical, narrowed and flattened towards the

posterior extremity, marked with fine distinct concentric striæ and large irregular lines of growth; cardinal line straight, or very slightly convex; anterior extremity rounded.

Length, 0.68; width, 0.44.

From the Upper Permian strata, near Smoky-Hill Fork, K. T.

CARDIOMORPHA (?) RHOMBOIDEA, *Swallow.*

Shell inequilateral, transversely elongated, oblique, ovate, rhomboidal, gibbous from the beaks to the ventral posterior angle, flattened on the posterior slope, anterior and ventral margins regularly curved from the beaks to the posterior margin, ornamented with about twenty large concentric costæ or laminæ parallel with the ventral and posterior margins; cardinal margin nearly straight, forming with the posterior an obtuse angle; *beaks* prominent, approximate, recurved, inclined towards the anterior margin.

Length, 0.55; longest diameter from the beak to the posterior part of the ventral margin, 0.71; length of cardinal border, 0.42; thickness, 0.39.

Major Hawn's collection from the Lower Permian strata, near Council Grove, K. T.

CARDIOMORPHA KANSASENSIS, *Swallow.*

Shell elongate, ovate, oblique, gibbous from the beaks towards the posterior extremity, flattened near the posterior and ventral margins; ornamented with large, flattened, concentric costæ and small concentric and radiating striæ, rendering the surface finely tuberculated; regularly curved from the beak around the ventral margin to the posterior; cardinal margin nearly straight; *beaks* large, terminal, incurved, approximate.

Length, 1.83; height, 1.23; thickness, 1.05.

Major Hawn's collection from the Permian Rocks in the valley of the Cottonwood, K. T.

CARDINIA CORDATA, *Swallow.*

Shell oblong, inequilateral, ovato-cordate, sparingly convex, marked with regular prominent, concentric costæ; *beaks* large, pointed, incurved, inclined forward; presenting in profile a margin regularly convex from the beak to the posterior extremity of the ventral margin, and a concave border from the beak to the anterior margin, which is short and rounded; *ventral margin* convex and regularly curved; posterior margin obsolete.

Our specimens are casts, and show no surface markings.

Length, 0.92; breadth, 0.67; thickness, 0.38.

Major Hawn's collection from the Lower Permian Rocks, in the valley of the Cotton-wood, K. T.

CARDINIA (?) SUB-ANGULATA, *Swallow.*

Shell oblong, sub-oblique, inequilateral, sub-pentagonal, marked with strong, irregular, concentric ribs or plications, slightly convex, flattened towards the margins. *Beaks* large, prominent, incurved, inclined forward and approximate; a profile view gives a line slightly convex from the beak to the posterior margin, and a very concave line from the apex to the anterior margin; *cardinal border* nearly as long as the shell, and sub-rectilineal; *posterior ventral margin* convex, rounded at the anterior extremity and sub-angular at the posterior; *anterior margin* short, oblique, convex, forming a well-defined right angle with the cardinal border; posterior *extremity* oblique, sub-truncate.

Length, 0.83; greatest breadth, 0.58; thickness, 0.42.

Major Hawn's collection from the Lower Permian Rocks, in the valley of the Cotton-wood, K. T.

CARDINIA, species undetermined, but similar to *C. fasciculatis Buvignier*, as given by *Pictet*, Tra. Pal., pl. LXXIX., fig. 7. It is like the

CARDINIA LISTERI (?), *Sowerby*, Min. Con., p. 123, pl. 154.

Our specimens are very similar to this fossil from the Lias of England; I should scarcely think of separating them if they were from the same formation. Specimens from England and Kansas together in my cabinet do not appear out of place.

PLEUROPHORUS (?) PERMIANUS, *Swallow.*

Shell elongate, inequilateral, gibbous, posterior end broad, angular at the extremity, anterior end short, contracting rapidly to the rounded extremity, flattened towards the anterior ventral angle; the cast shows the impressions of concentric laminæ and radiating costæ on the posterior cardinal slope, and a rounded ridge from the beaks to the ventral posterior angle. *Beaks* elevated, inclined forward near the anterior extremity; cardinal line appears oblique, two-thirds as long as the shell; posterior margin very oblique, slightly curved; ventral margin strongly curved at the ends, meeting the anterior and posterior slopes near the middle of the extremities.

Length, 1.55; greatest width near the posterior extremity, 0.87; thickness, 0.75.

Major Hawn's collection from the Upper Permian Rocks, near Smoky-Hill Fork, K. T., associated with *Monotis speluncaria*, *M. radialis*, and *Schizodus Rossicus*.

SCHIZODUS TRIANGULARIS, *Swallow*.

Shell small, sub-triangular, inequilateral, marked with fine, concentric striæ. Both *extremities* are acuminate and rounded at the points; the anterior a little broader and more rounded; *beaks* large, prominent, incurved, approximate, nearer the anterior extremity; *posterior cardinal slope* rounded, slightly less convex than the anterior; both sharply carinated; *ventral margin* arched, curve increasing about equally at each extremity.

Length, 0.49; width, 0.36; thickness, 0.21.

It most resembles the *Schlotheimi*, *Geinitz*, from the Upper Zechstein of Germany, and the Permian of England. The *triangularis* is more nearly equilateral, and is not truncated at the posterior extremity, and is more elongated.

Major Hawn's collection from the Lower Permian Rocks, associated with *P. Calhounianus*, *Cardinia subangulata*, on the waters of the Cotton-wood, K. T.

SCHIZODUS OBSCURUS, *Sowerby*, Min. Con., Vol. IV., p. 12, pl. 314.

SCHIZODUS OBSCURUS, *King*, Per. Fos. p. 189, pl. XV., figs. 23–24.

We have but one cast of this fossil. It is very similar to Sowerby's figures, and King's figure No. 23 is as much like our specimen as an engraving can well be made to the original. This fossil is found in many localities in the Permian Rocks of England and in the Lower Permian strata of Kansas with *Monotis Halli*.

SCHIZODUS ROSSICUS, *Verneuil*, Ge. Rus., Vol. II, p. 309, pl. XIX., figs. 7–8.

SCHIZODUS ROTUNDATUS, *King*, Per. Fos., p. 190, pl. XV., fig. 30.

(?) AXINUS ROTUNDATUS, *Brown*, Man. Ge. Soc., Vol. I.

Our specimens are evidently identical with the *Rossicus* of Verneuil from the Permian Rocks of Russia, and there is scarcely a doubt of its identity with King's *rotundatus* from the Permian of England; but there is more doubt about Mr. Brown's *rotundatus*, which he says is smooth. All the other specimens are striated, including those from Kansas.

In the Upper Permian strata, near Smoky-Hill Fork, associated with *Nucula Kazanensis*, *Bakevellia antiqua* and *Mo-*

notis speluncaria. Our specimens present the varieties mentioned by M. Verneuil as occurring in Russia.

ALLORISMA LANCEOLATA, *Swallow.*

Shell elongate, lanceolate, with a well-defined, rounded ridge from the beaks to the ventral posterior angle, marked with large, regular, prominent, concentric costæ, strongly recurved toward the cardinal margin; it is also ornamented with nodular, concentric, and radiating striæ; the radiating striæ most obvious on the posterior extremity; *beaks* small, pointed, recurved forward to, or beyond, the anterior margin; *lunule* ovate, depressed.

Length, 1.30; width, 0.67; thickness, 0.42.

Major Hawn's collection from Permian Rocks in the valley of the Cotton-wood, K. T.

ALLORISMA (?) CURTA, *Swallow.*

Shell short, transverse, sub-rectangular, inequilateral, gibbous, broad at the anterior extremity and narrower at the posterior; marked with large, rounded, concentric costæ and small striæ, which are parallel to the costæ, and more prominent in the depressions between them; *beaks* large, depressed, approximate, sub-terminal; *anterior margin* rounded; *lunule* short, depressed, extending down the anterior slope; *cardinal margin* as long as the shell, straight.

Length, 0.97; width at beaks, 0.64; thickness, 0.56.

This species resembles the lata; but it is more gibbous, and the dorsal margin is not curved down towards the posterior extremity.

Major Hawn's collection from the Permian Rocks, near Council Grove, K. T.

ALLORISMA (?) MINNEHAHA, *Swallow.*

Shell elongate, inequilateral, trapezoidal, tumid, with a strong diagonal ridge from the beak towards the posterior ventral angle, where it becomes obsolete; marked with irregular longitudinal costæ and striæ, parallel to the ventral and posterior margins, forming an acute angle at the posterior extremity of the ventral margin; the *costæ* becoming narrower and more crowded and sometimes obsolete as they approach the cardinal margin; *posterior extremity* wide, tumid, gaping, obliquely truncate, and marked with fine, nodular, radiating striæ, nearly parallel to the diagonal ridges; *anterior extremity* short, narrow, rounded; *beaks* large, pointed, strongly incurved, approximate, nearly terminal; *lunule* ovate, depressed, extending down the anterior slope; escutcheon or suture

nearly as long as the cardinal border, depressed, bounded by the obtuse ridges of the dorsal margin; *lunule* and *suture* divided by a longitudinal elevated ridge, in the cast; *valves* flattened towards the ventral margin where they meet at an obtuse angle, rounded and depressed on the dorsal border; *posterior margin* straight, oblique; *ventral* elongate, arched; *anterior* short, rounded; *dorsal* short, depressed, and strongly curved up at the posterior extremity; external ligament nearly as long as the cardinal border.

Dimensions of a large specimen:—Length, 2.31; greatest breadth at the posterior extremity of the cardinal border, 1.26; greatest thickness near the middle, 1.11; thickness at posterior extremity, 1.02.

Missouri State collection, from the Middle Coal Measures, near Lexington; and Major Hawn's collection from the Permian rocks, in the valley of the Cotton-wood, K. T.

LYRODON (*Myophoria?*) ORBICULARE (?), *Goldfuss*, pl. 135, fig. 10, p. 196.

Our specimen is a cast, and it agrees in size and form with the cast figured and described by Goldfuss from the Muschelkalk of Germany.

From No. 18 of the Triassic (?) System, K. T.

GASTEROPODA.

MURCHISONIA (?) KANSASENSIS, *Swallow.*

Shell elongated, with from eight to nine convex volutions; volutions marked with six nodular, spiral costæ.

Length, 0.19; diameter of anterior whorl, 0.07; spiral angle, 13°; sutural angle, 98°.

Collected by Major Hawn, in the valley of the Cotton-wood, K. T.

MURCHISONIA (?) PERVERSA, *Swallow.*

Shell minute, elongated, sinistrorsal, with from six to seven convex volutions which are marked with fine, spiral, nodular costæ.

Length, 0.12; diameter of anterior whorl, 0.06; spiral angle, 27°; sutural angle 59°.

From the valley of the Cotton-wood, K. T.

MURCHISONIA SUBANGULATA (?), *Verneuil*, Ge. Rus., p. 340, pl. XXII., fig. 6.

Our specimens are very imperfect, but they resemble this more than any other species.

From the Cellular Limestone of the Upper Permian strata, K. T.

LOXONEMA FASCIATA, *King*, Per. Fos., pl. XVI., fig. 30, p. 209.

Lower Permian strata, K. T.

MACROCHEILUS SPIRATUS, *McCoy*, Brit. Pal. Fos., p. 549, pl. 3H., figs. 1–2.

I am unable to see any specific distinctions between our specimens from the Lower Permian and that described and figured by McCoy, from the Carboniferous Limestone in Northumberland.

CEPHALOPODA.

NAUTILUS PERMIANUS, *Swallow*.

Shell of medium size, discoidal; *spire* formed of two or three rapidly increasing sub-hexagonal volutions; *dorsal margin* broad, flattened, slightly concave along the middle of some specimens; *sides* flattened; *interior lateral slopes* convex; *internal margin* concave, as modified by the succeeding whorl; *umbilicus* large, showing all the volutions; septa convex, sub-reniform, curved forward from the centre of the dorsal and ventral margins to the lateral, direct on the lateral; *siphuncle* large, sub-central, a little nearer the dorsal margin; *last chamber* large, enlarging rapidly toward the aperture, and becoming less angular; *aperture* transverse, reniform, slightly modified by the succeeding whorl. Surface markings not seen.

Diameter, 2.68; width of aperture, 2.25; length of aperture in middle, 1.64.

Major Hawn's collection from the Permian Rocks, near the Smoky-Hill Fork, K. T.

NAUTILUS OCCIDENTALIS, *Swallow*.

Shell of medium size, discoidal, tapering gradually, ornamented with six longitudinal rows of nodules, rendering the spire heptagonal; the two dorsal rows, separated by a deep concave channel, have each a large nodule on every chamber, one on

the anterior and the other on the posterior side; those on the dorso-lateral angles have one nodule on every alternate chamber; the nodules around the umbilicus are smaller and less numerous. *Septa* very concave, periphery curved back on the dorsal and lateral margins, forming a rounded sinus in the dorsal channel, and a more obtuse curve on the flat lateral surfaces; *siphuncle* large, sub-central; *umbilicus* large; *aperture* small, sub-ovate.

Our specimens are imperfect casts of the last volution, from which we can not determine the surface markings or the number of volutions; but it may be easily identified by the arrangement of the nodules and septa.

Maj. Hawn's collection from the valley of the Cotton-wood, where it was associated with *Monotis Halli* and *Pecten Cleavelandicus.*

ORTHOCERAS KICKAPOOENSE, *Swallow.*

Shell elongate, conical, tapering gradually, sub-cylindrical, slightly flattened on the side next to the siphuncle; *septa* convex, distant less than one-third their smallest diameter; *periphery* sub-elliptical and slightly curved in the direction of the major axis; siphuncle small, eccentric, one-third of the diameter from the flattened side. Surface markings not seen.

Maj. Hawn's collection from the Upper Permian Rocks, near Smoky-Hill Fork.

CYRTOCERAS DORSATUM, *Swallow.*

Shell short, ventricose, conical, tapering rapidly toward the posterior extremity, strongly curved, depressed on the dorsal and ventral surfaces; last chamber large; *aperture* elliptical, dilated, somewhat irregular and corrugated on the inner margin; *siphuncle* cylindrical, touching the dorsal margin; *septa* convex, elliptical, oblique, distant on the dorsal margin less than one-third of the least diameter, approximate on the inner margin, periphery slightly sinuous, curved forward from the back to the sides and back on the sides. Surface markings not seen.

Major axis of the last septum, 1.26; minor axis, 1.01; distance between the last and penultimate septum on the outer margin, 0.31.

From the Permian Rocks of Kansas, near Smoky-Hill Fork, associated with *Nautilus Permianus* and *Spirorbis orbiculostoma.*

NOTE BY MAJ. F. HAWN.

The very extraordinary note of Mr. Meek, appended to his paper on Some Organic Remains, "indicating the existence of Permian Rocks," demands a few words in reply, that the subject may be fully understood.

In 1855, I commenced my explorations of the Geology of Kansas in connection with other duties. I wished to have the opinions of others respecting the rocks (as I do not profess to have any extensive knowledge of Palæontology). I sent the fossils (which I supposed to be) of the Coal Measures to Prof. Swallow and the Cretaceous to Mr. Meek, and a portion of the Smoky-Hill fossils to each, as I did not know where to place them.

Mr. Meek was at liberty to use any of the information furnished as he might think best, and Prof. Swallow had the same privilege, save that he was not to interfere with the Cretaceous rocks. It appeared to be Prof. Swallow's desire to make a connection between the Coal Measures of Missouri and the Cretaceous rocks of Kansas, as he questioned the existence of Lower Carboniferous rocks in Eastern Kansas, as represented by several of our most distinguished Geologists, and as my own observations seemed to indicate.

It seemed to be the desire of Mr. Meek to show the relations of the Cretaceous group of the Northwest with Mr. Marcou's sections in New Mexico, etc.

In June of 1857, I sent Prof. Swallow the first fossils which passed out of my hands from the Smoky-Hill Fork and localities in the Coal Measures. On the 15th of September following he acknowledged the receipt of them, and added: "From the hasty glance I gave them, I am satisfied that all the fossils, which I remember as Carboniferous, have been found in the *Coal Measures* in this State; and I am now, as before, inclined to the opinion that all the Carboniferous rocks from which you have sent me fossils are Coal Measures."

I sent the first fossils (Smoky-Hill) to Mr. Meek in July, 1857, stating my supposition that they might be Cretaceous. This box was delayed, and Mr. Meek feared Prof. Swallow might use those sent to him from the same locality. I then wrote to him, as stated in his note, on August 21st, that Prof. Swallow would not interfere with him in this matter (meaning the Cretaceous fossils), as no mention had, up to that time, been made by Mr. Meek of any formations but the Cretaceous and Carboniferous.

September 3d, he writes:—"The fossils from Smoky-Hill are of a rather suspicious character; that is, they lead me to think these beds may be, after all, *Triassic* or *Permian*, though they may belong to the Upper Coal Measures."

Mr. Meek's next letter of importance in this connection was dated Dec. 15, 1857. In this he speaks of his numerous engagements as preventing him from taking up my fossils (as I had desired him to do) of the "Coal Measures" and Archimedes Limestone, which I had mentioned; but nothing of the *Permian*. He also spoke of his desire to help Dr. Hayden examine his "fine collection," etc.

In reply to this letter, which seemed to indicate that he could not attend to my work as soon as I would need it for my book, I wrote to him in sub-

stance that I had collections from the various formations in Kansas; that I would start with them to Columbia in a few days to get Prof. Swallow to assist me in making up the results for publication; but if he could not, or would not, I should go on East and get him (Mr. Meek) to do it.*

Nor is it strange that I did not tell him in particular that I should ask Prof. Swallow to examine the "new formation," for I did not suppose Mr. Meek had any exclusive claim to any but the Cretaceous fossils. After this note was sent, I received his note of the 21st Dec.,† saying:

"If you do not intend to come on this winter, you would oblige me by sending on the new collections you have made from the Cellular limestone. I do not pretend to say that they *are* Permian, but that some of them look suspicious. They may, however, belong to the Coal Measures."

This was the last letter received from Mr. Meek before Prof. Swallow had determined the existence of Permian fossils in beds far below those of Smoky-Hill Fork, and the above quotation is the strongest intimation of Mr. Meek's opinion that any of the Kansas rocks were Permian; and this, according to his request, was not even hinted to Prof. Swallow until he had expressed his determination to announce the discovery.

When we commenced the classification of the fossils (of which more than nine-tenths were Carboniferous), by the request of Prof. Swallow those from Smoky-Hill Fork, and all which I supposed to be from the same formation, were put away in drawers.‡

An arrangement was then made between Prof. Swallow and Dr. Shumard to take up and describe the Coal Measure fossils of Kansas and Missouri in a joint paper. While prosecuting this labor, Prof. Swallow's suspicions were excited by the resemblance of the *Productus Norwoodii* to the *P. horrescens* of Verneuil. He next identified the *Thamniscus dubius;* the *Monotis Halli, Stenopora crassa, Fenestella rectiformis(?)*, etc., followed. He then declared his firm conviction that the rocks in the valley of the Cotton-wood, under consideration, were Permian (although filled with well known Carboniferous fossils), and his determination to publish the same forthwith.

He was at this time informed of Mr. Meek's opinion of the Smoky-Hill fossils, which were then hastily examined for the first time and pronounced *Permian*, though very different from those in the valley of the Cotton-wood; as the *Monotis speluncaria* (*Hawni* of Meek), *Monotis radialis, Schizodus Rossicus, Bakevellia antiqua* and *Nucula Kazanensis* were identified, and only one known Carboniferous species.

Prof. Swallow was then urged to describe the Smoky-Hill fossils, as I was anxious to get the results for my work, and, fearful lest the discovery would be made by others, I urged this the more as Mr. Meek's engagements were numerous, and his opinions too indefinite (as I judged from the last he had said on the subject, as above quoted) to incite him to the announcement and the completion of the matter; for it seemed rather hard, after sending my collection to two friends, that I should lose the benefits of my labor through the numerous engagements of one, and the too punctilious scruples of the other. I could but feel that I had spent too much time and money in the examinations to lose the benefits of the immediate results; and besides I did not imagine Mr. Meek had any better claim upon the fossils under consideration than Prof. Swallow, to whom they were first sent.

On the 18th Feb., Prof. Swallow wrote to the St. Louis Academy of Science announcing the discovery; it was read at the regular meeting on the 22d, and published in the Missouri Republican of the next day.

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* I have no copy of this letter, but feel confident it was my design to express to Mr. Meek my intentions in going to Columbia.

† It should be borne in mind that the mails in Western Missouri, during the winter, are very irregular. I have this day received a letter mailed at Weston twenty days since.

‡ Prof. Swallow refused to examine these fossils, as a part of them had been sent to Mr. Meek with permission to describe the same.

On the 2d of March, eight days after, Mr. Meek's announcement was made in the Albany Institute.

As to Dr. Shumard's opinion, quoted from my private letter, it is but justice to the Doctor to say, that he had never examined the Smoky-Hill fossils, as they were not in the collection when his attention was called to it; and the question then in his mind, as I am assured, was, whether there were any Lower Carboniferous fossils with those from the Coal Measures, and not as to the existence of later forms. He did not hesitate to pronounce them Coal Measures rather than Lower Carboniferous, as all the known forms recognized had been found in the Coal Measures of Missouri. But the question with me and Mr. Meek was entirely different. and the word I carelessly used, *Carboniferous*, expressed the Doctor's opinion in distinction from the Permian, just as well as *Coal Measures*, the word used by Dr. Shumard.

The foregoing facts and those stated in Mr. Meek's note seem to warrant the following conclusions:

1st. Mr. Meek first suggested the Smoky-Hill rocks "may be, after all, Triassic or *Permian*, though they may belong to the Coal Measures," in his note of Sept. 3d.

2d. On the 16th of February, Prof. Swallow wrote to the Journal of Science his discovery of well known Permian fossils among his Carboniferous specimens from Kansas Territory.

3d. Prof. Swallow's announcement that "the *rocks are* Permian," was read in the St. Louis Academy on the 22d of February.

4th. Mr. Meek's paper, "*Existence of Permian Rocks*," was read in the Albany Institute, March 2d.

5th. Mr. Meek had the fossils from July to March with full liberty to announce his conclusions.

6th. Prof. Swallow was informed of Mr. Meek's opinions after he had determined to announce *what he supposed was his exclusive discovery*, under the impression on my mind that he should not be permitted to proceed further, ignorant of Mr. Meek's opinions.

7th. All the rights which Mr. Meek could possibly claim from the fact that I have sent him the fossils and other information with full liberty to use them as he pleased, and my promise that Prof. Swallow should not interfere with the Cretaceous, were carefully guarded by Prof. Swallow and myself.

8th. If Mr. Meek has lost any thing by not announcing the matter first, he alone is responsible for it.

In conclusion, I can but say I regret exceedingly any misunderstanding with a gentleman of Mr. Meek's honorable bearing. Nothing but the duty, which I have no right to neglect, to defend myself against the unjust imputations of Mr. Meek's note, could have induced me to quote private letters, and use the names of mutual friends in a note connected with a scientific paper. In my ignorance, I had imagined the pure walks of Science free from all such matters.

F. HAWN.