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DEPARTMENT OF REGISTRATION AND EDUCATION

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STATE GEOLOGICAL SURVEY

M. M. LEIGHTON, *Chief*

REPORT OF INVESTIGATIONS—NO. 18

THE GASTROPOD GENUS YVANIA

Contribution to the Paleontology of Illinois

BY

J. MARVIN WELLER

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URBANA, ILLINOIS

1929

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LETTER OF TRANSMITTAL

STATE GEOLOGICAL SURVEY DIVISION, March 5, 1929

Hon. A. M. Shelton, Chairman, and Members of the Board of Natural Resources and Conservation.

GENTLEMEN:—I take pleasure in transmitting herewith, for publication as Report of Investigations No. 18, the manuscript of the paper entitled "*The Gastropod Genus Yvania: Contribution to the Paleontology of Illinois*," by Dr. J. Marvin Weller, Paleontologist on our Geological Survey Staff.

This is the first of a series of papers which will give the results of our paleontological studies of fossil forms belonging to the Pennsylvanian (Coal Measures) system of Illinois. As you are aware, these studies are for the purpose of determining the composition, evolution and history of the Pennsylvanian faunas and of ascertaining what fossil forms may be used as horizon markers in correlating isolated outcrops of Coal Measures strata; this in turn is fundamental in determining the coal resources of the State and in working out geologic structures to be tested for commercially valuable accumulations of oil and gas. The genus dealt with in this particular paper belongs to the most characteristic family of gastropods represented in our Coal Measures strata.

Very sincerely yours,

MORRIS M. LEIGHTON, *Chief.*

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THE GASTROPOD GENUS YVANIA

CONTRIBUTION TO THE PALEONTOLOGY OF ILLINOIS

By
J. Marvin Weller

INTRODUCTION

Modern tendencies in paleontology are toward greater discrimination and finer distinctions between genera as well as between species. It is only in this way that paleontology may keep pace with our more exacting stratigraphic studies. This paper on *Yvania* is the first of a series that has been planned in which a number of groups of American Carboniferous Pleurotomariidae will be described. It is anticipated that in most cases it will be possible to classify these forms under already proposed generic appellations, but it will undoubtedly be necessary to redescribe many of the genera in order that their essential characters may be understood and that a grouping more natural and satisfactory than has been accomplished in the past may be made.

THE FAMILY PLEUROTOMARIIDAE

The family Pleurotomariidae includes a very large number of species occurring in strata which range in age from Cambrian to Recent. The family is characterized by a spiral shell-habit and a definitely limited narrow band which terminates in a more or less deep sinus of the outer lip or in a long parallel-sided slit which in some species is closed at intervals.

Within the family the species differ in almost every conceivable detail, so that it has proved a stumbling block to many paleontologists who have attempted to classify its members. The general practice has been to separate a small group as a new genus or subgenus, but differences between the type species chosen and other representatives of the family have not always been clearly understood, and the result has been an unnatural grouping of species. Conservative authors have referred their species either to *Pleurotomaria* or *Murchisonia* according to a single arbitrary character—length of spire. Others have compromised by classifying in genera already proposed those species which seem to possess corresponding characters and referring the remainder to *Pleurotomaria* and *Murchisonia*. Consequently a large number of species whose relationships are not sufficiently understood to warrant more precise generic classification are now included in *Pleurotomaria*. In this

respect this genus resembles *Aviculopecten* among the pelecypods and *Productus* among the brachiopods, except that the present status of *Pleurotomaria* is much more unsatisfactory, both on account of the extensive range of its representatives throughout geologic time and because the work which has been done upon its subdivision is less well understood.

The only discussion of the Pleurotomariidae in American literature which is at all comprehensive is that by Ulrich in the Paleontology of Minnesota.¹ He is primarily concerned with lower Paleozoic forms but proposes two new Carboniferous genera and discusses others confined to or represented in these strata. He also lists those characters which in his opinion may be employed in making generic discriminations.

The most extensive consideration of Carboniferous forms is that by de Koninck in his description of the Belgian Carboniferous fauna.² His forms are grouped in eleven genera, most of them new and rather unnatural systematic units as arranged by him, which have received almost no recognition from later writers. However, several of these genera are potentially useful; among them is that for which he proposed the name *Baylea*. It is the purpose of this paper to redefine this particular genus, establish it as a natural unit, and describe the American species that may be referred to it, several of which are new.

Genus *YVANIA* Bayle (*BAYLEA* de Koninck)

In 1883 de Koninck proposed the name *Baylea* for a group of ten species of Pleurotomariidae, with *Baylea yvanii* Ch. Leveillé as the type.³ This name however was preoccupied by *Bayleia* Munier-Chalmas 1873, and *Yvania*, a name proposed in manuscript by Bayle, was substituted by Fischer without emendation in 1885.⁴

A translation of de Koninck's original description of the genus is as follows:

"Shell conical, turreted, spire in form of steps the vertical and horizontal parts of which join each other at a right angle. The band of the sinus, relatively large, is situated on the lower (upper) plane part and horizontal to the turns of the spire; it lies along the external angle of these turns and is limited on the opposite side by a fine slightly elevated carina. The upper (lower) part of the last turn is very convex and ornamented with a great number of shallow spiral furrows, which largely occupy the median part. The aperture is large and has the form of an inverted escutcheon; its columellar border is thin, and being extended lengthwise, gives rise to the formation of a little umbilical dimple.

¹ Ulrich E. O. and Scofield, W. H., The Lower Silurian Gastropoda of Minnesota: Geol. and Nat. Hist. Survey of Minnesota, vol. 3, pt. 2, pp. 946-960, 1897.

² De Koninck, L. G., Faune de calcaire Carbonifère de la Belgique: Annales Mus. Roy. Hist. Nat. Belg., vol. 8, pt. 4, 1883.

³ Op cit., p. 68.

⁴ Fischer, P., Manuel de Chonchylologie, p. 851, 1885.

"*Dimensions*.—The length of the largest specimens rarely exceeds 40 mm. and the transverse diameter 25 mm

"*Relations and Differences*.—The species which I propose to unite in this group have for principal character the existence of the band of their sinus on the horizontal part and below (above) the turns of the spire; this band is in consequence invisible when the shell is seen in profile. In the shells of all the other genera of the same family, except on those of the genus *Luciella* in which it is found situated on the upper (lower) part of the turns, it is perfectly perceptible, in this same position, at least on the last turn. No other genus possesses, however, a form so perfectly turreted as that of the group which is here in question and which has for type *Baylea* (*Pleurotomaria*) *yvanii*, Ch. Levillé.

"*Geologic Distribution*.—Nearly all the species of this genus belong in the Carboniferous terrain in which it becomes extinct. In Belgium two of these species exist in the lower beds of the terrain; two others have been discovered by Mr. Ed. Dupont in the middle beds, and, finally, two species are found in the upper beds. One species of the middle beds has been figured in Ireland by Mr. F. McCoy and one other from the upper beds has been described by J. Phillips from Yorkshire. I have observed one or two in the middle beds of the Devonian limestone in the neighborhood of Visé."

As may be seen by the above description, the essential feature upon which this genus is based is the presence of the slit band on the upper surface and adjacent to the prominent angle of the volution. The turreted form of the spire, which is emphasized by de Koninck in his generic description, and the meeting of the upper and outer sides of the volution at a right angle are by no means constant characters, and the description is misleading in this respect as may be seen when the illustrations of de Koninck's ten original species are examined.

Koken⁵ held that this genus was an arbitrary group and pointed to a series connecting the type species, which he considered simply an extreme form of development, with species described by de Koninck as *Ptychomphalus* and *Mourlonia*. When it is considered, however, that these latter genera have no meaning as employed by de Koninck and served only to hold those species that he could not place elsewhere, Koken's argument loses its significance. Perhaps the species referred to by him should have been placed originally in the genus *Baylea*. That de Koninck did not place them there is without significance as his grouping is in so many respects unnatural.

In the group of species described in this paper the slit band is located upon the upper slope of the whorl and adjacent to the angle. In five of the species an additional feature serves to sharply distinguish them from most other Carboniferous representatives of the Pleurotomariidae, namely a conspicuous backward curvature of the lines of growth adjacent to the suture. De Koninck's figures of his genotype show that this species also was ornamented by faint growth lines which curved slightly backward in the vicinity

⁵ Koken, E., Ueber die Entwicklung der Gastropoden vom Cambrium bis zur Trias: N. Jahrbuch, Bd. 6, p. 336, 1889.

of the suture⁶ although this character is nowhere mentioned in his descriptions. Because my Coal Measures species possess these two unusual characters in common with de Koninck's Belgian forms, I confidently place them in the same genus which is here emended as follows:

Genus *YVANIA* Bayle emend. Weller

Description.—Pleurotomariidae, medium to fairly high spired, subtrochiform to turreted; mature whorls with one or two sharp lateral angles—if only one angle the whorl has a strongly convex basal portion. Slit band prominent, situated on the upper slope of the whorl just above the upper lateral angle, flat or slightly concave, sharply bounded upon each side by raised costae. Aperture, as shown by the lines of growth, convex between the slit and suture, linguliform, extending backward near the suture and meeting it at an angle acute in a backward direction or producing a shallow concave sinus; on the side below the slit band, strongly convex; on the base more or less broadly concave. Columellar lip somewhat thickened and recurved, umbilicus small or closed, no callosity on the inner lip. Surface ornamented by more or less numerous revolving costae which may or may not be raised slightly at intervals to give a nodose appearance, especially adjacent to the suture. Lines of growth faint, rarely observed on some species.

This genus differs from all other angulated Carboniferous Pleurotomariidae in possessing a slit band situated upon the upper slope of the whorl, and by the form of the aperture which extends backward adjacent to the suture.

Genus *HYPSELENTOMA* Weller, n. gen.

The only other angulated Carboniferous species known to me which possess a band upon the upper slope of the whorl are *Pleurotomaria perhumerosa* and *P. inornata* Meek, possibly *P. humerosa* Meek and Hayden, and an undescribed form from the Graham formation of Texas. These differ from *Yvania* in not possessing a true slit, the band being simply the band of the sinus, and also in the forward direction of the lines of growth as the suture is approached. These forms constitute a well defined and easily distinguished group. It is my desire to establish it as of generic rank, and I propose for it the name *Hypselentoma*⁷ and select *P. perhumerosa* as the type.

⁶ Op. cit., pl. 27, fig. 5.

⁷ ὑψηλός, high up; ἐντομή, incision.

RELATIONS OF *YVANIA*

The genus *Yvania* is apparently most nearly related to *Gosseletina* Bayle (*Gosseletia* de Koninck) as represented by the American Coal Measures species *Gosseletina spironema* (Meek and Worthen). The species of *Yvania* described in the following pages, whose embryonic development is known, pass through a stage which is essentially similar to the mature form of *Gosseletina* in that the slit band is situated well up above the middle of the rounded whorl, and that the lines of growth above the band are more or less linguliform and meet the suture at an angle which is acute in a backward direction. These two groups are probably descended from the same ancestral stock. Of them *Gosseletina* is the more primitive as it lacks the angulation which is developed in the later whorls in *Yvania*.

GROUPING OF AMERICAN SPECIES

Nine species of *Yvania* are described in the following pages. Four of these were described and illustrated by Meek and Worthen in the first series of reports of the Illinois Geological Survey, the remaining five are new. The species of Meek and Worthen have been practically unknown to paleontologists up to this time; the original descriptions and illustrations are rather inadequate and no later notice of them appears in paleontologic literature.

The nine species of *Yvania* described in this paper may be subdivided into four groups as follows:

1. Group of *Yvania gurleyi*. These forms are characterized by a somewhat turreted spire which is ornamented by numerous simple and smooth revolving costae. The upper sloping surface of the whorl is gently concave between the slit band and a costa which lies upon an angle adjacent to the suture. The form of the aperture beneath the sinus of the band is broadly and smoothly curved. The group also includes *Y. inclinata* and *Y. pusilla*.

2. Group of *Yvania supercrenata*. This group differs from the preceding principally in that the upper sloping surface of the whorl is flat rather than concave. These two groups are not as closely related as might appear from superficial examination as the embryonic development is somewhat different. *Y. knighti* is also included in this group.

3. Group of *Yvania adamsi*. This group also contains *Y. salinensis*. These species are confidently referred to *Yvania* even though growth lines have not been observed on any of the specimens examined and therefore it is not certainly known that the aperture above the slit band has the shape characteristic of this genus. However exfoliated specimens clearly show that the slit band is located upon the upper flattened surface of the whorl and adjacent to the periphery. This character, together with the similar form of the shells

and the similar type of ornamentation, leaves little doubt as to the reference of these forms to *Yvania*.

The two species in this group are not as closely similar as those in the other three groups. Nevertheless they possess certain conspicuous common characters, such as the more concave and unornamented lateral surface of the whorl, and the smooth central portion of the basal surface of the whorl occurring between the outer and inner series of spiral costae.

4. Group of *Yvania subconstricta*. This group which also contains *Y. giffordi* is sharply distinguished from all of the preceding. In fact the other groups are probably much more closely related to each other than this one is to any of them. The concave form of the upper sloping surface of the whorl is reminiscent of *Y. gurlleyi* and its relatives, but in this group, the slit band is flat and continues uniformly in the slope of the concave portion of the upper surface of the whorl, whereas in the group of *Y. gurlleyi* it is concave and is inclined downward from this slope.

The group of *Y. subconstricta* differs from the others in two important particulars. Growth lines, represented by fine transverse costae, which are prominent on well preserved specimens in the spaces between the revolving ribs, are more conspicuously developed. The transverse costae have not been seen to cross the revolving costae, but the latter are rendered somewhat irregular and lack the smoothness characteristic of the other groups. This is most conspicuous upon the costa at the angle adjacent to the suture, and in some specimens on the next lower one, which are rendered somewhat nodose. A less noticeable character, but probably more significant, is the linguliform outline of the aperture on the lateral slope which is produced by a comparatively sharp concave curvature below. The basal surface of the whorl is also considerably more convex than in any of the preceding groups.

SPECIES TENTATIVELY REFERRED TO *YVANIA*

A search through the literature has failed to reveal a single species from the American Carboniferous, other than those described in this paper, which may with certainty be included in the genus *Yvania*. There are, however, four species which should be provisionally placed in this genus on account of certain similarities, but the descriptions and illustrations of them are inadequate for a precise determination of their relationships. Of these four species, one, *Worthenia alamillana* Girty, is described from the Upper Pennsylvanian of New Mexico, and the other three, *Pleurotomaria arenarea* Girty, *P. delawarensis* Girty, and *P. agnostica* Beede, are from the Permian of Texas and Oklahoma. No species even suggestive of this genus has been described from the Mississippian. Apparently *Yvania* did not appear in America until Pennsylvanian time.

DESCRIPTIONS OF SPECIES

Class GASTROPODA
Order ASPIDOBANCHIA
Family PLEUROTOMARIIDAE
Genus YVANIA Bayle

YVANIA INCLINATA Weller, n. sp.

Pl. I, fig. 1; Pl. II, fig. 9; Pl. III, figs. 2-3b, 6

Description.—Shell small, slightly turreted, spiral angle about 93° ; whorls angular, base convex; umbilicus small, partially closed; last whorl forms over half the height of the shell; surface marked by numerous revolving costae of various sizes; slit band prominent, concave, inclined slightly to the upper sloping surface of the whorl and adjacent to the angle.

The dimensions of the holotype are: height of entire shell 5.6 mm.; height of last whorl 3.4 mm.; and width at base 5.4 mm. It is composed of about five and a quarter whorls. The first two turns of the spire are uniformly convex and smooth. The third turn is also convexly rounded but it is ornamented by eight fine equally prominent costae, five below and three above the slit band which is outlined by two of them. A much finer costa appears upon the band itself. Late in the third whorl the costae bounding the slit band and lowest costa visible below the band become larger and more prominent than the others and the ones above the band also become somewhat more conspicuous than those below. In the course of the fourth turn the mature characters of the shell are fully developed as exemplified by the angulation and surface markings.

The mature whorls are subrhomboidal in outline and are slightly wider than high. The outer surface is divided into three parts by two angulations the upper of which is sharply localized along the outer border of the slit band and forms an angle of about 112° , situated below the suture by about one fourth of the height of the whorl. The lower angulation is little more than a regular inward curving of the shell from the flat lateral surface to the convex basal surface of the whorl. The lateral surface makes up a little more than one third the height of the whorl and slopes slightly outward from a vertical position, as the diameter of the whorl at the lower angulation is a little greater than at the upper. The basal surface is gently and nearly uniformly convex into the umbilicus.

The whorls are practically non-embracing, as the spire is formed by each succeeding whorl being attached to little more than the basal surface of the preceding one. The suture is narrowly concave and follows the prominent

costa which marks the beginning of the curvature into the basal surface of the preceding whorl.

The columellar lip is blunt and recurved upon itself but not greatly thickened. It extends over and almost completely hides a very small umbilicus. No thickening or callosity is present upon the inner lip.

The slit band is situated along the outer margin of the upper sloping portion of the whorl and is inclined slightly downward from its general direction. The band is equal in width to slightly less than one fourth of the complete width of the upper surface of the whorl and is bounded by two prominent costae having angular or narrowly rounded crests whose converging slopes give to the band a concave outline. No ornamentation is present upon the surface of the slit band in the mature portion of the shell. Lines of growth are indicated by a few scattered, very faint, crescentic lirae which are slightly asymmetrically curved so that each one touches the outer of the bounding costae at a position a little farther to the rear than that at which it touches the inner.

The two costae which border the slit band are the most prominent markings upon the upper surface of the whorl. A third somewhat less conspicuous costa parallels the suture and is separated from it by a distance about equal to the width of the band. The space between this costa and the band is slightly concave and is marked by as many as seven fine thread-like costae, somewhat unequally spaced and in general alternating in size between fine and very fine. A single fine costa occurs midway between the suture and the more prominent costa mentioned above. Lines of growth are well developed upon the upper surface of the whorl and are displayed by slight unevenness of the shell surface. They are linguliform and attain their most advanced position at about the midline of this part of the whorl. They are here regularly convex and sweep backward to join the edge of the band at a sharp angle. Toward the suture the growth lines extend in a sinuous curve, first convex, but as the suture is closely approached the curve becomes slightly concave, and they join the suture in a direction nearly normal to it.

The lateral slope of the whorl below the outer edge of the slit band is nearly as wide as the upper slope. It is bounded below by a conspicuous costa which marks the beginning of the curvature into the basal surface. This costa is broad and angular or narrowly rounded, the two slopes being of about equal intensity. Above this costa and separated from it by a distance somewhat less than one third of the width of the lateral surface is another slightly less prominent costa of similar character. Midway between them occurs a third finer costa. The surface between the angle of the whorl and the second costa mentioned above is about equally divided into two parts. The upper is without revolving markings and the lower is ornamented by

three thread-like costae. Growth lines are fairly well shown upon the lateral surface of the whorl. They meet the costa which marks the lower limit of this portion of the shell at right angles and above curve strongly backward, approaching the border of the slit band at a very acute angle.

The basal surface of the whorl is ornamented by numerous revolving costae which are separated from each other by about .15 mm. over the greater part of this surface. On the outer portion, however, they are more widely spaced, the first two being separated from each other and the costa marking the boundary of the basal surface by distances about equal to that which intervenes between the two most prominent costae of the lateral surface of the whorl. A very fine thread-like costa is present in the outer of these interspaces. The costae of the base apparently do not extend down into the umbilicus. The holotype possesses 15 costae upon its basal surface. Growth lines are not conspicuous upon the base but where observed are broadly and shallowly concave over most of this portion of the shell.

Remarks.—The species *Yvania inclinata* is closely related to *Y. pusilla* and *Y. gurleyi*. The *Y. pusilla*, which is probably a dwarfed form, may be distinguished from *Y. inclinata* not only by its much smaller size but also by its relatively narrower slit band and the outward slope of the lateral surface of its last whorl. The ornamentation of revolving costae is also somewhat more simple. *Yvania inclinata* may be distinguished from *Y. gurleyi* by its wider slit band bounded by more prominent costae, by the finer nature of its other markings, and by the thread-like costae adjacent to the suture and upon the lateral surface of the whorl.

Yvania inclinata is associated with *Y. supercrenata* from which it may be differentiated by the concave upper surface of the whorl, the slightly inclined and narrower slit band, the lower spire, the finer and more numerous revolving costae, and the more uniform spacing of these costae upon the base.

The holotype of this species is No. 19 in the collection of the Illinois State Geological Survey.

Occurrence.—This species occurs in a limestone bed which closely underlies the Colchester (No. 2) coal over large areas in western Illinois. The holotype and a series of other specimens were collected from an outcrop in the northeast bank of Wilson Creek near the southwest corner sec. 26, T. 3 N., R. 2 E., Fulton County, Illinois.

YVANIA PUSILLA Weller, n. sp.

Pl. I, figs. 4a-c

Description.—Shell very small, somewhat wider than high, slightly tur-reted, spiral angle about 96° ; whorls angular, base convex, umbilicus moderate; last whorl forms over half the height of the shell; surface marked

by numerous revolving costae; slit band prominent, concave, located on upper sloping surface of whorl and adjacent to the angle.

The dimensions of the holotype which is the largest specimen collected are: height of entire shell 3.3 mm.; height of last volution 2.0 mm.; width at base 3.6 mm. This specimen is composed of five whorls. The first three turns are uniformly convex. A number of fine revolving costae are present upon the surface of the third turn but they are so faint that nothing can be said concerning their number or arrangement. At the beginning of the fourth turn there are plainly developed four costae of about equal prominence and nearly equally spaced, the second and third of which bound the area of the slit band. By the end of this turn the whorl has achieved its mature angulation. The slit band has become very little wider than it was at the beginning of this turn but the other costae have spread apart to accommodate themselves to the enlarged surface of the whorl, and a fine thread-like costa has made its appearance in the space just above the slit band. In the course of the fifth and last whorl two more fine costae appear in the space above the slit band and in a similar manner three appear upon the flattened space below it.

The mature whorl is subrhomboidal in outline and about as wide as high. The outer surface is divided into three parts by two angulations the upper of which is sharply localized along the outer border of the slit band and forms an angle of about 125° , situated below the suture by about one fourth the height of the whorl. The lower angulation is not so sharp but consists of an abrupt inward curving of the shell from the nearly flat lateral surface to the convex basal surface of the whorl. The lateral surface makes up a little more than one third the height of the whorl, it is slightly concave and slopes outward from a vertical position inasmuch as the diameter of the whorl at the lower angulation is somewhat greater than at the upper. The curve of the basal surface is gently and nearly uniformly convex until the umbilicus is approached into which it plunges more steeply.

The whorls are practically non-embracing, as the spire is formed by each whorl being attached to little more than the basal surface of the preceding one. The suture is narrowly rounded and occurs at or near the prominent costa which marks the beginning of the curvature into the basal surface of the preceding whorl.

The columellar lip is rather blunt and recurved upon itself but not greatly thickened. It extends over and partially hides the umbilicus. No thickening or callosity is present upon the inner lip.

The slit band is situated along the outer margin of the upper sloping portion of the whorl and is inclined slightly downward from its general direction. The band is equal in width to about one fifth of the complete width of the upper surface of the whorl and is bounded by two prominent costae

having angular or narrowly rounded crests whose converging slopes give to the band a concave outline. No ornamentation is present upon the slit band. Lines of growth are indicated by very slight unevenness of its surface but their details cannot be made out.

The two costae which border the slit band are the most prominent markings upon the upper sloping surface of the whorl. A third slightly less conspicuous costa parallels the suture and is separated from it by a distance about equal to the width of the band. The space between this costa and the suture is flat, smooth, and unornamented. The space between the costa and the band is slightly concave and carries three fine thread-like costa nearly evenly spaced. Growth lines are not apparent upon this part of the shell.

The lateral slope of the whorl below the outer edge of the slit band is about equal in width to the upper surface. It is bounded below by a conspicuous costa which marks the beginning of the curvature into the basal surface. This costa is broad and angular and its upper slope is somewhat steeper than its lower one. Above this costa and separated from it by a distance of between one third to one half of the width of the lateral surface is another slightly less prominent costa of similar character. The space between these two costae is broadly and evenly concave and bears a single fine thread-like costa. Above the second prominent costa the surface is flat and smooth except for two delicate costae upon its lower part and a third along the upper edge just slightly below the angulation. Lines of growth are not conspicuous but can be made out here and there. They cross the lower edge of the lateral surface at nearly right angles and then curve strongly backward above, meeting the border of the slit band at a very acute angle.

The basal surface of the whorl is ornamented with numerous revolving costae which are separated from each other by about .1 mm. over the greater part of this surface. On the outer portion, however, they are more widely spaced, the first one being separated from the costa marking the boundary of the basal surface by a distance only a little less than that between the two prominent costae of the lateral surface of the whorl. The second costa of the base is in turn separated from the first by a somewhat smaller interval and the spacing of the remainder is nearly uniform. These costae are very low and are separated from each other by angular furrows which have long gentle outer slopes and short steep inner slopes. The costae of the base do not extend down into the umbilicus. The holotype possesses about 15 costae upon its basal surface. Growth lines have not been observed upon this portion of the shell.

Remarks.—The species *Yvania pusilla* may be distinguished from the other similar species principally by its much smaller size. It is not improbable that the shell described above is a dwarfed form but nevertheless it is sufficiently distinct from *Y. inclinata* and *Y. gurleyi* to receive recogni-

tion. Its chief points of difference are the relatively narrower slit band and the conspicuous outward sloping of the lateral surfaces of the whorls. In its ornamentation the species under discussion is intermediate between the other two. It is, however, more closely related to *Y. inclinata* than to *Y. gurleyi*.

The holotype of this species is No. 7 in the collection of the Illinois State Geological Survey.

Occurrence.—This species occurs in a silicified condition in a dark limestone near the base of the Pennsylvanian in the NW. $\frac{1}{4}$ sec. 35, T. 21 N., R. 9 W., Warren County, Indiana.

YVANIA GURLEYI (Meek)

Pl. III, figs. 1a-d, 7

1871 *Pleurotomaria gurleyi*. Meek, Acad. Nat. Sci. Phil., Pr. p. 117.

Coal Measures: Danville, Illinois.

1873 *Pleurotomaria Gurleyi*. Meek and Worthen, Geol. Survey of Illinois, vol. 5, Pl. 30, figs. 6a, b.

Coal Measures.

1874 *Pleurotomaria Gurleyi*. Meek, Am. Jour. Sci. (3) vol. 7, p. 584.

Description.—Shell small, slightly turreted, spiral angle about 92° ; whorls angular, base convex, umbilicus small; last whorl forms over half the height of the shell; surface marked by numerous revolving costae; slit band prominent, concave, slightly inclined to the upper sloping surface of the whorl and adjacent to the angle.

The dimensions of the holotype are: height of the entire shell 5.8 mm.; height of the last whorl 3.2 mm.; and width at base 5.4 mm. It is composed of five and three quarters whorls. The first turn is practically flat, the second is very low, and it is only in the later ones that the elevated spire is developed. The first two and one half whorls are uniformly convex. In the next the angularity appears and rapidly attains mature development. No markings are observed upon the surface of the first whorl. On the second whorl there appear a number of indistinct revolving striae. At the beginning of the third turn these resolve themselves into a series of seven, approximately equally prominent and equally spaced revolving costae. The space between the second and third of these, counting outward from the suture, is occupied by the slit band. Early in the third turn this area becomes wider, and another revolving costa appears between the suture and the first costa previously visible. In the latter part of the third turn the costa bordering the slit band becomes relatively more conspicuous whereas the first one on the lateral surface below the band and the first one above it on the upper surface become very faint and shortly become obsolete. Also the lowest costa upon the lateral

surface passes beneath the suture of the next whorl and disappears. Early in the fourth turn the next lower costa disappears in a similar manner. Later in the course of this same turn two fine thread-like costae arise upon the broad smooth space adjacent to the band upon the upper surface. This number is subsequently increased to four.

The mature whorls are subrhomboidal in outline and are slightly wider than high. The outer surface is divided into three parts by two angulations the upper of which is sharply localized along the outer border of the slit band and forms an angle of about 120° , situated below the suture by about one fifth the height of the whorl. The lower angulation is little more than a regular inward curving of the shell from the flat lateral surface to the convex basal surface of the whorl. The lateral surface constitutes a little more than half the height of the whorl and is practically vertical in position. The slope of the basal surface is gently and nearly uniformly convex into the umbilicus.

The whorls are practically non-embracing, as the spire is formed by each succeeding whorl being attached to little more than the basal surface of the preceding one. The suture is almost right angular and either follows or occurs slightly above the prominent costa which marks the beginning of the curvature into the basal surface of the preceding whorl.

The columellar lip is blunt and recurved upon itself but not greatly thickened. It extends over and partially hides a moderately sized umbilicus. No thickening or callosity is apparent upon the inner lip.

The slit band is situated along the outer margin of the upper sloping portion of the whorl and is inclined slightly downward from its general direction. The band is equal in width to slightly more than one fifth of the complete width of the upper surface of the whorl and is bounded by two prominent costae having angular crests whose converging slopes give to the band a concave outline. No ornamentation is present upon its surface. Lines of growth, however, are faintly indicated by slightly concave transverse markings which meet the outer of the bounding costae at a position a little farther to the front than that at which they touch the inner.

The two costae bordering the slit band and a third costa adjacent to the suture are the most prominent markings upon the upper sloping surface of the whorl. The costa last mentioned is separated from the suture by a flat and nearly horizontal area a little wider than the width of the slit band. Between the upper prominent costa and the slit band the surface is shallowly concave and carries as many as four fine thread-like costae which are somewhat more pronounced and closely spaced upon the inner upper portion. Lines of growth are well developed upon the upper surface of the whorl and are displayed by fine lirae and unevenness of the shell surface. They are linguiform and attain their farthest forward position about midway between the

inner edge of the slit band and the suture. They are here regularly convex and sweep backward to join the edge of the band at an acute angle. Toward the suture the growth lines extend in a sinuous curve, first convex but as the suture is approached the curve becomes slightly concave and they join the suture in a direction nearly normal to it.

The lateral slope of the whorl below the outer edge of the slit band is nearly as wide as the upper slope. It is arbitrarily bounded below by a prominent costa which marks the beginning of the curvature into the basal surface. This costa is narrow and angular and the slope upon the upper side is somewhat steeper than upon the lower. Above this costa and separated from it by a distance somewhat less than one third of the width of the lateral surface is another similar or slightly more prominent costa. Above this to the slit band the surface is flat or smooth with the exception of growth lines which curve strongly backward and approach the border of the slit band at an acute angle. Between the two costae on the lower part of the lateral slope the growth lines are essentially normal to these markings.

The basal surface of the whorl is ornamented by numerous revolving costae separated from each other over the greater part by .2 mm. or less. On the outer portion, however, they are more widely spaced, the first two or three being separated from each other and the costa bounding the basal surface by spaces about equal to or slightly less than that which intervenes between the two costae of the lateral surface of the whorl. The costae of the base do not extend down into the umbilicus. The holotype possesses 12 costae upon the basal surface. The growth lines are very slightly concave in the central part of the basal surface, but as the umbilicus is approached they become slightly convex.

Remarks.—The species *Yvania gurlleyi* is very closely related to *Y. inclinata* from which it may be recognized by its slightly narrower slit band bounded by less prominent costae, the coarser nature of its other markings, the absence of fine costae upon the lateral surface of the whorl and of those adjacent to the suture on the upper surface.

The holotype of this species is No. 6351 in the collection of Walker Museum at the University of Chicago.

Occurrence.—This species was obtained in a beautifully pyritized condition from the black shales which overlie the Danville coal near Danville, Vermilion County, Illinois.

YVANIA SUPERCRENATA Weller, n. sp.

Pl. I, figs. 2a-3; Pl. III, fig. 8

Description.—Shell small, somewhat higher than wide, slightly turreted, spiral angle about 86° ; whorls angular, base convex, umbilicus small; last

whorl forms slightly less than half the height of the shell; surface marked by numerous revolving costae; slit band prominent, concave, located on the upper flattened surface of whorl and adjacent to the angle.

The dimensions of the holotype which is the most completely preserved specimen in our collection are: height of entire shell 4.8 mm.; height of last whorl 2.2 mm.; and width at base 4.6 mm. It is composed of about six and one half whorls. The first three turns of the spire are uniformly convex and smooth. Early in the course of the fourth turn the revolving costae appear, first upon the lateral slope adjacent to the lower suture and then progressively above until four are present. The two central costae represent those which bound the slit band, the lower one is the upper large costa of the lateral surface of the whorl. The uppermost costa continues prominently on all the later whorls adjacent to the suture. Additional costae originate by implantation at various stages in the development of the shell. The regular convex outline of the whorls persists into the fifth turn during the course of which, however, the angulation of the mature portion of the shell develops and the slit band, which up to this time had been inclined, becomes more nearly horizontal and takes its position upon the outer edge of the upper flattened portion of the whorl.

The mature whorls are subrhomboidal in outline and are wider than high. The outer surface is divided into three parts by two angulations: the upper is sharply localized forming an abrupt angle of about 130° , situated below the suture by between a quarter and a third the height of the whorl; the second, which is located below the first by about half the height of the whorl, is less localized and more in the nature of a sharp inward curving of the shell. The upper slope is flat and inclined slightly downward from the suture. The lateral slope is vertical in position and flat or slightly concave in outline. The basal surface is gently and rather evenly convex. The convexity may or may not locally increase notably as the basal surface slopes into the umbilicus.

*The whorls are practically non-embracing as the spire is formed by each whorl building downward and outward from the base of the preceding one to which it is attached. The suture is sharp, angular, and slightly excavated due to the conspicuous parallel costa upon the upper surface of the later whorl. The suture closely follows the position of the prominent costa which marks the lower angulation of the preceding whorl.

The columellar lip is blunt and recurved upon itself but not much thicker than the rest of the shell. It extends over and partially hides the umbilicus which is small and shaped like a comma, being rounded at one end and drawn out to a curved point at the other. There is no thickening or callosity of the inner lip. Several specimens indicate that there was partial but not complete resorption of the basal ornamentation for a short distance within the aperture.

The slit band is situated along the outer margin of the upper flattened portion of the whorl and is equal to about one fourth of the width of this surface. It is bounded by two prominent costae having narrowly rounded crests and slopes which are concave toward the slit band and give this portion of the shell a broadly concave appearance. On the mature portion of the shell the band may be ornamented by one or more fine revolving costae. No transverse markings or lines of growth have been observed upon the slit band.

A prominent costa, similar to the one which occurs upon the inner edge of the slit band, lies upon the upper surface of the whorl next to the suture. Between these two costae on the last whorl of the holotype occur two others which are locally almost if not quite as prominent as the one adjacent to the suture. No transverse ornamentation exists upon the upper slope of the whorl and no lines of growth have been observed on any of the specimens examined.

The lateral slope of the whorl below the outer edge of the slit band is nearly as wide as the upper slope. It is bounded below by a prominent angular or narrowly rounded costa and bears upon its surface another conspicuous costa about one third of the distance above the lower one. This latter costa is steeper upon its upper slope than its lower and the space between it and the lower one is asymmetrically concave with the deepest portion about three fourths of the way to the lower costa. The upper two thirds of the lateral surface of the whorl is practically flat or only slightly concave and extends smoothly from the crest of the outer bounding costa of the slit band, which produces the sharp angularity of the shell, to the base of the costa below. Lines of growth upon the lower third of the lateral surface are nearly vertical between the costae, but above they bend sharply backward to the edge of the slit band.

The basal surface of the whorl is ornamented by numerous low, step-like costae having steep outer slopes and long gentle inner slopes. The outermost of these is separated from the costa which marks the lower angle of the whorl by a distance about equal to that which separates the two costae of the lateral slope. Inward upon the basal slope the costae become progressively more closely spaced until those upon the edge of the umbilicus are separated by less than .2 mm. These costae apparently do not continue all the way down into the umbilicus or else they become too faint to be discernable. The holotype possesses 11 costae upon its basal surface but this number may be variable and dependent to some extent upon the size of the shell. New ones if added make their appearance out of the umbilical depression and never by implantation. Growth lines upon the basal surface show that the aperture was broadly concave in this part.

Remarks.—The species *Yvania supercrenata* is very closely allied to *Y. knighti* from which it may be distinguished by its relatively narrower band, the more numerous revolving costae above the band, the greater prominence of the costa adjacent to the suture, the ornamentation which may occur upon the band, the less prominent costa upon the outer border of the band, the lesser concavity of the smooth area just below it, the more convex basal surface, the presence of a well formed umbilicus, the more equal spacing of the costae of the basal surface, and the uniform enlargement of the whorl resulting in a more regular spire.

Yvania supercrenata may be distinguished from *Y. inclinata* with which it is associated by its slit band which lies in the plane of the upper surface of the whorl, the flatness of the upper surface, the higher spire, the fewer and coarser revolving costae, and the less uniform spacing of the costae upon the basal surface.

The holotype of this species is No. 1 in the collection of the Illinois State Geological Survey.

Occurrence.—This species occurs in a limestone bed which closely underlies the Colchester (No. 2) coal over large areas in western Illinois. The holotype and a series of other specimens were collected from an outcrop in the northeast bank of Wilson Creek near the southwest corner sec. 26, T. 3 N., R. 2 E., Fulton County, Illinois.

YVANIA KNIGHTI Weller, n. sp.

Pl. I, figs. 5-8; Pl. III, fig. 9

Description.—Shell small, higher than wide, turreted, spiral angle about 75°; whorls angular, base slightly convex, umbilicus closed; last whorl forms less than half the height of the shell; surface marked by numerous revolving costae; slit band prominent, concave, located on upper flattened surface of whorl and adjacent to the angle.

The dimensions of the holotype are: length of entire shell 7.6 mm.; height of last whorl 3.3 mm.; and width at base 6.4 mm. This specimen is composed of seven whorls, the first four of which are uniformly convex. The early ones are smooth but at the beginning of the fourth turn four revolving costae are conspicuously developed. These are of about equal size, are uniformly spaced, and the second and third enclose the area of the slit band. During the course of the fourth turn the characteristic mature angulation develops, due principally to the more prominent development of the costae which bound the band. The interspace below the band increases somewhat in width but the upper slope of the whorl remains divided into three areas of almost equal width until in the course of the sixth turn the interspace above the band becomes relatively wider and there appears upon its surface

a centrally located, fine thread-like costa which gradually becomes stronger. The later whorls of some of the larger specimens are enlarged at a rate which is somewhat less rapid than that of the younger whorls and the result is a spire having a slightly convex profile.

The mature whorls are subrhomboidal in outline and are somewhat wider than high. The outer surface is divided into three parts by two angulations the upper of which is sharply localized and forms an abrupt angle of about 125° , situated below the suture by about one third the height of the whorl. The second, which is located below the first by a little less than one half the height of the whorl, is less localized and more in the nature of a sharp inward curving of the shell. The upper slope is flat and inclined slightly downward from the suture. The lateral slope is vertical in position and slightly concave in outline. The basal surface is gently convex, curving into the columella.

The whorls are practically non-embracing as the spire is formed by each whorl building downward and outward from the base of the preceding one to which it is attached. The suture is distinct and occurs at or near the position of the prominent costa which marks the lower angulation of the preceding whorl.

The columellar lip is somewhat thickened and recurved and completely or nearly closes the umbilicus. There is no thickening or callosity on the inner lip.

The slit band is situated along the outer margin of the upper flattened portion of the whorl and is equal to one third of the entire width of this surface. It is bounded by two prominent costae having narrowly rounded crests whose converging slopes give the band a broadly concave profile. The band is unornamented by spiral markings and lines of growth are rarely preserved upon it. Where they do remain they are seen to be unevenly crescentic with the axis of the sinus located above the middle of the band so that the growth lines meet the outer costa at a position a little in advance of their junction with the inner one.

The flat upper surface of the whorl bears two costae between the suture and the costa which lies upon the inner side of the slit band. These may be equally prominent or the lower one may be less conspicuously developed, but never are they quite as pronounced as those which bound the slit band. The spacing of the upper costae may be equal or not; where it is not the lower costa is usually much the smaller. Lines of growth are rarely to be observed but where present they show that this portion of the aperture was convex and linguliform and curved strongly backward toward both the suture and the slit band.

The lateral slope of the whorl below the outer edge of the slit band is nearly as wide as the entire upper slope. It is bounded below by the begin-

ning of the curvature into the basal surface which occurs at the position of a prominent revolving costa. Upon its surface is another costa, the distance between the two varying from one third to nearly one half of the width of the lateral slope. Both costae are steeper above than below and the space between them is asymmetrically concave with the deepest portion three quarters of the distance to the lower costa. The upper portion of the lateral slope is shallowly concave, due to the prominence of the costa along the outer edge of the slit band. Growth lines where visible show a strong backward sweep toward the slit band above and a convex curve below, crossing onto the basal surface with a slight backward inclination.

The basal slope is marked by numerous low step-like spiral costae having steep outer slopes and long inner slopes. The outer of these costae are separated by distances about equal to that which intervenes between the two costae of the lateral surface. There may be two, three, or four such broad interspaces and then they become much narrower and continue so to the columellar region. The number of the costae may vary from about ten to fifteen, depending largely upon the spacing of the outer ones. The growth lines are curved, broadly and shallowly concave on the outer half of the basal surface, and continuing nearly straight toward the columella but becoming slightly convex just before they reach it.

Remarks.—The species *Yvania knighti* is closely related to *Y. supercrenata* from which it may be distinguished by the greater relative width of the band, the fewer revolving costae above it, the lesser prominence of the costa adjacent to the suture, the unornamented character of the band, the more prominent costa upon the outer border of the band, the concavity of the smooth area just below the band, the flatter basal surface, the general absence of an umbilicus, the more unequal spacing of the costae of the basal surface, and the inequality in the enlarging of the whorls resulting in a spire having a slightly convex profile.

The holotype of this species is No. 3 in the collection of the Illinois State Geological Survey.

Occurrence.—This species occurs abundantly in the Piasa limestone of St. Louis County, Missouri. The holotype and a series of other specimens were obtained from weathered limestone that was temporarily exposed by grading in the Davis Subdivision, one mile south of Clayton.

YVANIA SALINENSIS Weller, n. sp.

Pl. I, figs. 9-10c

Description.—Shell small, higher than wide, turreted, spiral angle about 63° ; whorls angular, base slightly convex, umbilicus small or entirely closed; last whorl forms about two fifths the height of the shell; surface marked

by revolving costae; slit band prominent, concave, located on the upper flattened surface of the whorl and adjacent to the angle.

The dimensions of the holotype are: height of the entire shell 7.4 mm.; height of last whorl 2.9 mm.; and width at base 5.8 mm. It is composed of about seven whorls. None of the specimens in our collections are sufficiently well preserved to determine the progressive development of the shell from the embryonic state to maturity.

The mature whorls are subrhomboidal in outline and are wider than high. The outer surface is divided into three nearly equal parts by two distinct angulations the upper of which is the more sharply localized and forms an angle of about 130° , situated below the suture by about one third the height of the whorl. The lower one, which is located below the first by about one third the height of the whorl, is more in the nature of a sharp inward curvature of the shell. The upper slope is flat and inclined slightly downward from the suture. The lateral slope is nearly vertical in position and broadly concave in outline. The basal surface is somewhat depressed, only gently convex, and curves slightly into the umbilical region.

The whorls are practically non-embracing, each subsequent one being attached merely to the basal surface of its predecessor. The suture is sharp, angular, and impressed, and follows just below the prominent costa which marks the lower limit of the lateral surface of the preceding whorls.

The columellar lip is somewhat thickened and recurved upon itself. It either extends over and completely closes the umbilicus or almost does so; which it does could not be determined satisfactorily from the specimens examined. There is no thickening or callosity on the inner lip.

The slit band is situated along the outer margin of the upper flattened portion of the whorl and is equal in width to a little less than one third the total width of this surface. It is bounded by two prominent costae whose converging slopes give to the band a broadly concave outline. It bears no ornamentation and growth lines are not visible.

Two costae about as prominent as those which bound the slit band occur upon the upper portion of the upper surface of the whorl. The inner one is separated from the suture by a smooth level area a little over half as wide as the band. It is this area in combination with the prominent costa above which gives the suture its sharply impressed condition. The second of the two costae occurs below the first and is separated by a space equal in width to the area between the upper costa and the suture. The space between the costa upon the inner edge of the band and the lower of the two costae described above is as wide or slightly wider than the band and resembles it in general appearance except that it is somewhat more concave. No growth lines have been observed upon this portion of the shell.

The lateral slope of the whorl below the outer edge of the slit band is somewhat narrower than the upper slope. It is smooth and broadly concave, and is bounded below by the most prominent costa on the whole shell. Growth lines have not been observed upon this part of the whorl.

The basal slope of the whorl bears a prominent costa within and below the larger one which marks the boundary between this part of the shell and the lateral surface. They are separated by a space somewhat less than the width of the slit band. Upon the inside of this costa is a shallow concave furrow similar to those which separate the costae on the basal surface of other species in this genus, but in this case no costa rises upon the inside of it and the basal surface is smooth for the remainder of the distance to the columella. It is entirely possible that the basal surface was originally ornamented by additional spiral costae that have been destroyed and do not appear upon the imperfectly preserved specimens examined. This is indicated by one specimen which preserves indistinct traces of a few fine costae adjacent to the columella. On the other hand this species is closely similar to *Y. adamsi*, upon the central part of the base of whose whorls I have never observed costae, a fact suggesting that most of the basal surface of the species under discussion was probably smooth. No lines of growth have been observed upon the basal slope of the whorl.

Remarks.—The specimens upon which the species *Yvania salinensis* is erected are poorly preserved as compared to other forms described in this paper. Although much of the surface detail has been destroyed, enough remains to characterize this species in a reliable manner. It is possible that the future discovery of more perfect specimens will reveal some more delicate surface markings than those described above.

Yvania salinensis is closely related to *Y. adamsi* from which it may be distinguished by the more acute spiral angle, the more convex base, the less concave lateral slope and the single costa which marks its lower limit, and the sharply impressed suture.

The holotype of this species is No. 5 in the collection of the Illinois State Geological Survey.

Occurrence.—This species occurs in the limestone cap rock of the Herrin (No. 6) coal at the railroad cut in the SW. $\frac{1}{4}$ NW. $\frac{1}{4}$ sec. 31, T. 9 S., R. 6 E., near Ledford, Saline County, Illinois.

YVANIA ADAMSI (Worthen)

Pl. II, figs. 1-3b; Pl. III, fig. 4

1884 *Pleurotomaria adamsi*. Worthen, Illinois State Mus. Nat. Hist., Bull. 2, p. 5.

Coal Measures: Peoria County, Illinois.

1890 *Pleurotomaria adamsi*. Worthen, Geol. Survey of Illinois, vol. 8, p. 137, Pl. 23, figs. 5-5a.

Coal Measures: Peoria County, Illinois.

Description.—Shell small, a little higher than wide, trochiform, spiral angle about 65° ; whorls angular, base nearly flat, umbilicus small; last whorl forms somewhat over one third the height of the shell; surface marked by revolving costae; slit band prominent, concave, located on upper sloping surface of the whorl and adjacent to the angle.

The dimensions of an average specimen are: height of the entire shell 7.1 mm.; height of the last whorl 2.8 mm.; and width at base 6.2 mm. About seven whorls are present in mature individuals. The first two and one half whorls are uniformly convex. Two revolving costae become apparent at about this stage in the development and are located a little above the periphery of these rounded whorls. These costae inclose the area of the slit band. They gradually become more prominent and during the course of the fourth turn the shell takes on its mature form and ornamentation.

The mature whorls are subrhomboidal in outline and are wider than high. The outer surface is divided into three parts by two distinct angulations, the upper of which is sharply localized along the costa which marks the outer edge of the slit band. The angle of this edge is slightly acute but due to the slight concavity of the band and the greater concavity of the lateral surface of the whorl these two sides of the whorl form an angle of about 130° . This angle is situated below the suture by slightly less than one third the height of the whorl; the lower angle is located below the first by a little less than half of the height of the whorl. The upper surface is flat and inclined downward and outward from the suture. The lateral surface is nearly vertical in position and rather strongly concave in outline. The basal surface is much depressed, only slightly convex, and curves into the umbilicus with a somewhat greater inclination.

The whorls are non-embracing, each subsequent one being attached merely to the basal surface of its predecessor. The suture is rather inconspicuous and may be either angular or rounded, depending upon its exact position. It usually follows the lower of the two costae which occur upon the lower border of the lateral surface but it may vary from slightly above to slightly below this position.

The columellar lip is somewhat thickened and recurved upon itself. It extends over and partially hides the shallow umbilicus. There is no thickening or callosity developed upon the inner lip.

The slit band is situated along the outer margin of the upper flattened portion of the whorl and occupies slightly less than one third the width of this surface. It is bounded by two prominent costae whose converging slopes meet about one fourth of the way below the upper costa and thus produce the asymmetrically concave band. No markings of any kind have been observed upon the band.

A prominent costa occurs upon the upper flattened surface of the whorl adjacent to the suture but separated from it by a space equal to about half the width of the slit band. This costa is about as prominent as the one bounding the inner side of the band. Upon the final whorls a second costa somewhat finer than the first occurs below the first and is separated from it by a space equal in width to that between the first costa and the suture. The space between the costa upon the inner edge of the band and the lower of the two costae described above is about as wide as or slightly wider than the slit band and resembles the band in general appearance except that it is somewhat flatter. No growth lines have been observed upon this portion of the shell.

The lateral slope of the whorl below the outer edge of the slit band is somewhat narrower than the upper slope. It is bounded below by a prominent keel which bears upon its crest two costae of about equal development although the lower projects beyond the upper. Together the costae are somewhat narrower than the slit band but the space between them does not resemble the band as it is much narrower and relatively more concave. A smooth concave surface separates these costae from the upper angle of the whorl and makes up about three fourths of the lateral surface. The surface is usually somewhat asymmetrically concave, the steepest part being in its lower portion. No lines of growth have been observed upon this portion of the shell.

The basal surface of the whorl bears two or three costae on its outer portion. The outermost of these is the most prominent, but is somewhat less conspicuous than the costae on the lower part of the lateral slope. The second costa of the base is slightly less developed than the first, and the third where present is very fine and thread-like. The first costa of the base is separated from the edge by a space slightly wider than that which separates the two costae of the lateral surface. The space between the first and second costae of the base may be about equal to or slightly greater than the space between the first and the edge of the basal surface. The space between the second and third costae where the latter is developed is considerably greater. The central part of the basal surface is without ornamentation but fine costae

appear upon the slope from the basal surface into the umbilicus, three or four of these having been observed upon one specimen. Lines of growth upon the base are broadly and gently concave and have a slight backward sweep, becoming slightly convex in the umbilical area.

Remarks.—The species *Yvania adamsi* is most closely related to *Y. salinensis*, from which it may be distinguished by the less acute spire, the flatter base, the more concave lateral slope and the double costa which marks its lower limit, the less prominent suture, and the general trochiform shape.

The holotype of this species is catalogued as No. 2536 in the paleontological collection of the Illinois State Museum. A substitution of specimens has however apparently taken place for the specimen bearing this number is not *Y. adamsi* and the type of this species has not been located.

Occurrence.—This species is typically developed in the Lonsdale limestone. It is present in many collections from this horizon but the preservation is very rarely such that the details of the external features may be noted. The specimens illustrated on Plate II are from the NW. $\frac{1}{4}$ sec. 34, T. 8 N., R. 6 E., Peoria County, Illinois. The exact locality from which the type of this species was obtained is unknown.

YVANIA SUBCONSTRUCTA (Meek and Worthen)

Pl. II, figs. 4a-5c; Pl. III, fig. 10

1860 *Pleurotomaria subconstricta*. Meek and Worthen, Acad. Nat. Sci. Phil., Pr. p. 458.

Coal Measures: Hodge's Creek, Macoupin County, Illinois.

1866 *Pleurotomaria subconstricta*. Meek and Worthen, Geol. Survey of Illinois, vol. 2, p. 351, Pl. 28, figs. 6a-c.

Lower Coal Measures: Hodge's Creek, Macoupin County, Illinois.

Description.—Shell small to medium sized, higher than wide, subtrochiform to slightly turreted. spiral angle about 60° to 70° ; whorls angular, base convex, not umbilicated; last whorl forms a little more than half the height of the shell; surface marked by numerous revolving costae which are nodose adjacent to the suture, and by transverse lines of growth; slit band prominent, flat, located on the upper sloping surface of whorl and adjacent to the angle.

The dimensions of an average specimen are: height of entire shell 7.4 mm.; height of last whorl 4.2 mm.; and width at base 6.1 mm. This specimen is composed of about seven whorls. Another individual, the largest one that has been obtained, has the following measurements: height of entire shell 12.6 mm.; height of last whorl 7.4 mm.; and width at base 8.9 mm. It is made up of about eight whorls. The first three turns of the spire are uniformly convex. The first two are coiled in a practically flat spiral but thereafter the spire is uniformly developed. Upon the third whorl

five equally prominent and uniformly spaced spiral costae are apparent. The slit band occupies the space above the central costa. Early in the fourth turn the slit band becomes proportionately wider and more prominent and the angulation along its outer border begins to become apparent. Also the lowest of the costae mentioned above disappears beneath the suture. On the latter part of the fourth turn a fine thread-like costa appears by implantation in the interspace above the slit band and another fine costa is developed below the band. In the course of the fifth turn the whorl becomes essentially mature in all its characters. The costa adjacent to the suture becomes quite prominent and marks a distinct angle between the sloping upper surface of the whorl and the narrow level shelf along the suture. This costa, and sometimes the next lower one, becomes nodose. Additional costae are introduced within the area between the nodose costa and the slit band, as they also are upon the lateral slope of the whorl below the slit band. The last whorl of the large specimen mentioned above shows gerontic development, chiefly evinced by the costae of the upper slope of the whorl becoming obsolete and the growth lines becoming much more rugged and conspicuous. In addition to this change in ornamentation the slit band becomes slightly concave.

The mature whorls are subrhomboidal in outline and are wider than they are high. The outer surface is divided into three parts by two angulations in addition to which a third angulation occurs along the upper border of the whorl adjacent to the suture. The upper of the two main angulations is situated along the outer edge of the slit band and forms an angle of about 135° . This angulation occurs below the suture by somewhat more than one third the height of the whorl. The second angulation is located below the first by slightly less than one third the height of the whorl. It is not as sharp as the upper one but marks the abrupt inward curve of the basal surface. The upper surface is rather sharply concave just above the slit band. From this depression the surface slopes outward to the margin of the slit band and upward to the angulation which occurs adjacent to the suture. This latter angulation is one of about 125° and is separated from the suture by a narrow horizontal area. The lateral surface of the whorl is slightly concave. In most cases it slopes inward a little due to the greatest diameter of the shell being developed along the edge of the slit band. The basal surface is regularly convex and slopes evenly into the columellar area.

The whorls are non-embracing, each one being attached to the base of its predecessor. The suture is sharp, angular, and may be slightly excavated. It closely follows the costa which marks the lower main angulation of the preceding whorl.

The columellar lip is strongly recurved upon itself and considerably thickened. It extends over and in most specimens completely closes the

umbilicus. There is no thickening or callosity developed upon the inner lip. Some specimens seem to indicate that resorption of the spiral costae took place within the aperture.

The slit band is situated along the outer margin of the upper sloping portion of the whorl and occupies from slightly more to slightly less than one third the width of the surface between the angulation along its outer border and the angulation adjacent to the suture. It is essentially flat and is bounded by two low narrow angular costae. Its surface is covered by numerous fine crescentic, transverse costae which show the form of the sinus. They are low and rounded, closely though irregularly spaced, and are separated by interspaces, the wider of which are flat. These crescentic costae are somewhat asymmetrically curved, the greatest concavity occurring above the middle of the band so that they meet the outer edge in a position somewhat more advanced than their junction with the inner boundary. No revolving ornamentation is present upon the slit band.

The most conspicuous costa upon the upper surface of the whorl occurs upon the angle adjacent to the suture. Below this angle and above the costa which marks the inner side of the slit band occur two to four additional costae. Each of the lower ones is in turn smaller than the ones above and the lowest may be finer than those that bound the band, from which they differ in being rounded. In a few cases the first costa below the one which occupies the angle is equal to it in size. The interspaces which separate these costae in general are progressively somewhat narrower between the lower finer costae. The narrow, flat, horizontal area adjacent to the suture is about equal to or slightly narrower than the slit band. The sloping surface between the edge of the band and the angle bounding the horizontal surface along the suture is about one and one half times or more often twice as wide as the band. Lines of growth are well developed upon the upper surface of the whorl. On the narrow flat area adjacent to the suture they bend backward and meet the suture at an angle slightly acute, or they become concave and develop a small sinus. The lines of growth on this portion of the shell may be somewhat grouped and form rounded transverse ridges. Upon the sloping portion of the upper surface the growth lines extend slightly forward from the angle which parallels the suture. The most forward position is reached in the upper part of this area. They then make a gently convex curve and sweep strongly back, meeting the edge of the slit band at an acute angle. The nodose character of the costa occurring on the angle adjacent to the suture, and on some specimens of the next lower one, is associated with the lines of growth, but where growth lines cross the lower costae only minor irregularities occur.

The lateral surface of the whorl is about equal to or slightly wider than twice the width of the slit band. It is bounded below by a prominent rounded

costa and bears upon its surface three or less commonly four more. These costae are not quite as prominently developed as the one along the lower boundary of the lateral slope and are somewhat more closely spaced on the upper portion of this surface. Where the fourth costa is present it is very fine and is located just below the angle. These costae are rounded and the interspaces are gently concave to flat. Lines of growth are conspicuous on this portion of the shell. They cross the lowest bounding costa at about right angles but just above it they bend sharply forward and traverse the first interspace in a diagonal direction; in the second interspace they are approximately vertical but swing strongly backward on the remainder of the lateral slope and meet the edge of the slit band at an acute angle. The growth lines are conspicuous only in the interspaces and are not visible crossing the revolving costae except for slight irregularities which they produce.

The basal surface carries about eleven rounded spiral costae separated by concave interspaces. The costae are rather uniformly spaced except in the region of the columella where the spaces are somewhat narrower. A few specimens show the outer costae as well as the inner spaced somewhat more closely than those which occupy the central part of the basal surface of the whorl. Lines of growth are fairly distinct. From the outer angle they sweep very gently backward in a broad shallow concave curve to the middle part of the basal surface; on the inner portion a slight convexity is developed in the vicinity of the columella.

Remarks.—The species *Yvania subconstricta* is closely related to *Y. giffordi* from which it may be distinguished by its less acute spire, the wider slit band, and the horizontal area adjacent to the suture.

The holotype of this species is preserved in the paleontological collection at the University of Illinois.

Occurrence.—This species was originally described from an outcrop of the limestone which underlies the Belleville (No. 6) coal on Hodges Creek in the SW. $\frac{1}{4}$ sec. 30, T. 10 N., R. 9 W., Macoupin County, Illinois. It has subsequently been collected from the same horizon in Greene County, the limestone cap rock of the Herrin (No. 6) coal in Saline and Gallatin Counties, Illinois, the Piasa limestone in St. Louis County, Missouri, and from the Lonsdale limestone in Peoria County, Illinois. This stratigraphic range is greater than has been observed for any of the other species of *Yvania* in our Coal Measures strata. Most of the other species, so far as is known at present, are confined to a single horizon, but future investigation will probably reveal that each of these also occurs in other neighboring horizons.

Since this paper was prepared a representative of this species has been recognized in a collection made from the Drum limestone at Kansas City, Missouri, during the summer of 1928.

YVANIA GIFFORDI (Worthen)

Pl. II, figs. 6-8b; Pl. III, figs. 5, 11

- 1884 *Pleurotomaria giffordi*. Worthen, Illinois State Mus. Nat. Hist., Bull. 2 p. 5.

Coal Measures: Peoria, Illinois.

- 1890 *Pleurotomaria giffordi*. Worthen, Geol. Survey of Illinois, vol. 8, p. 135. Pl. 23, figs. 8-8a.

Coal Measures: Peoria County, Illinois.

Description.—Shell small to medium sized, one and one half times as high as wide, spiral angle about 45° to 50° ; whorls angulated, base convex, not umbilicated; last whorl forms slightly less than half the height of the shell; surface marked by numerous revolving costae which are nodose adjacent to the suture, and by transverse lines of growth; slit band prominent, flat, located on upper sloping surface of whorl and adjacent to the angle.

The dimensions of an average individual are: height of entire shell 9.0 mm.; height of last whorl 4.0 mm.; width at base 6.0 mm. It is composed of about seven whorls whose development is probably very similar to that of *Y. subconstricta*. The specimens examined, however, are not sufficiently well preserved to show these details.

The mature whorls are subrhomboidal in outline and of about equal height and width. The outer surface is divided into three parts by two angulations in addition to which a third minor angulation occurs adjacent to the suture along the upper border of the whorl. The upper of the two main angulations is situated along the outer edge of the slit band and forms an angle of about 140° , occurring below the suture by slightly more than one third the height of the whorl. The second angulation is located below the first by somewhat less than one third the height of the whorl. It is not as sharp as the upper one but marks the beginning of the sharp inward curve of the basal surface. The upper slope is constricted and concave just above the slit band. From this constriction the surface slopes outward to the margin of the slit band and upward to the angulation which occurs adjacent to the suture. This last angulation is one of about 115° and is separated from the suture by a narrow horizontal area. The lateral surface of the whorl is concave and is approximately vertical in position. The basal surface is regularly convex and slopes evenly into the columellar area.

The whorls are non-embracing, each one being attached to the base of its predecessor. The suture is sharp, narrowly concave to angular, and may be slightly excavated. In the upper whorls of the spire it rather closely follows the position of the costa that marks the lower limit of the lateral surface of the preceding whorl, but in the later turns it commonly follows a somewhat

lower position so that a narrow strip of the basal surface of the preceding whorl remains visible.

The columellar lip is strongly recurved upon itself and considerably thickened. It extends over and in most cases completely closes the umbilicus. There is no thickening or callosity developed upon the inner lip.

The slit band is located along the outer margin of the upper sloping portion of the whorl and occupies a zone somewhat less than a half but usually more than a third of the width of the surface between the angulation along its outer border and the angulation adjacent to the suture. The slit band is essentially flat and is bounded by two low narrow angular costae. Its surface is covered by numerous fine crescentic transverse costae which are closely though irregularly spaced. They are asymmetrically curved, the greatest concavity occurring above the middle of the band so that they meet the outer edge in a position somewhat more advanced than that of their junction with the inner boundary. No revolving ornamentation is present upon the slit band.

The most conspicuous costa upon the upper surface of the whorl occurs upon the angle adjacent to the suture. Below this angle and above the costa which marks the inner side of the slit band occur on most specimens two additional costae which become obsolete in the gerontic stage in the growth of the shell. The narrow flat horizontal area adjacent to the suture is about two thirds as wide as the slit band. Lines of growth are well developed upon the upper surface of the whorl. On the narrow flat area adjacent to the suture they extend sharply backward, curve into a small sinus and join the suture at nearly right angles. The lines of growth on this portion of the shell may be somewhat grouped and form low rounded transverse ridges. Upon the sloping portion of the upper surface the growth lines are linguiform, reaching their most forward position slightly above the middle, from which they sweep backward to the upper angulation and more strongly to the border of the slit band which they meet at a very acute angle. The nodose character of the costa occurring on the angle adjacent to the suture is associated with the growth markings, but where growth lines cross the lower costae only minor irregularities occur.

The lateral slope of the whorl is from two to two and one half times as wide as the slit band. It is bounded below by a broad rounded costa and bears upon its surface two or three smaller costae that are commonly finer and more closely spaced toward the upper border. These costae are rounded and the interspaces are gently concave to flat. Lines of growth are conspicuous on this portion of the shell. They cross the lowest bounding costa at about right angles but just above it they bend sharply forward and traverse the first interspace in a diagonal direction; in the second interspace they

are approximately vertical or slightly convex forward but they swing strongly backward on the remainder of the lateral slope and meet the edge of the slit band at an acute angle. The growth lines are conspicuous only in the interspaces and are not visible crossing the revolving costae except for slight irregularities which they produce.

The basal surface carries about ten to twelve rounded spiral costae separated by concave interspaces. In rare cases this number may be as great at seventeen or eighteen. The interspaces are commonly slightly wider in the central portion of the basal surface of the whorl. The outermost costa generally occurs very close to the one which marks the angle between the lateral and basal surfaces. On those specimens where an unusually large number of costae are present upon the basal surface they are much more closely spaced in the columellar region than over the remainder of the base. Lines of growth are fairly distinct and appear as fine transverse costae in the interspaces. From the outer angle they sweep very gently backward in a broad shallow concave curve to the middle part of the basal surface, and become slightly convex in the vicinity of the columella.

Remarks.—The species *Yvania giffordi* is very closely related to *Y. subconstricta* which occurs principally at somewhat lower horizons. *Y. giffordi* may be distinguished principally by its more acute spire but also by its relatively narrower slit band and the horizontal area adjacent to the suture. At most localities the specimens are badly exfoliated and the surface features cannot be observed.

The holotype of this species is No. 2535 in the paleontological collection of the Illinois State Museum.

Occurrence.—This species was originally described from Peoria County, Illinois, without notation as to either locality or horizon. This gastropod is one of the most characteristic members of the Lonsdale limestone fauna and is present in most of the collections from this horizon in Peoria County and vicinity. Two specimens in the Gurley Collection preserved in Walker Museum at the University of Chicago are labeled as having been obtained from above coal No. 7 in Peoria County. The accuracy of this reference seems doubtful as the specimens are preserved much like some of those obtained from the Lonsdale limestone and this latter horizon is the only one from which I have obtained this species.

PLATES AND EXPLANATIONS

EXPLANATION OF PLATE I

All figures are enlarged four diameters

- Fig. 1. *YVANIA INCLINATA* Weller, n. sp. ....p. 15
The holotype.
- Figs. 2a-3. *YVANIA SUPERCRENATA* Weller, n. sp. ....p. 22
2a, b. The holotype.
3. A paratype.
- Figs. 4a-c. *YVANIA PUSILLA* Weller, n. sp. ....p. 17
The holotype.
- Figs. 5-8. *YVANIA KNIGHTI* Weller, n. sp. ....p. 25
5. The holotype.
6-8. Paratypes. The basal view shows a specimen whose outer costae are more widely spaced than usual.
- Figs. 9-10c. *YVANIA SALINENSIS* Weller, n. sp. ....p. 27
9. A paratype.
10a-c. The holotype.

1

5

9

2A

6

10A

2B

7

10B

3

8

10C

4A

4B

4C

EXPLANATION OF PLATE II

All figures are enlarged four diameters except 4b and 9 which are enlarged eight diameters.

- Figs. 1-3b. *YVANIA ADAMSI* (Worthen).....p. 30
Specimens from Peoria County.
- Figs 4a-5c. *YVANIA SUBCONSTRUCTA* (Meek and Worthen).....p. 32
4a-5c. Specimens from Peoria County.
4b. Upper surface of whorl (x 8).
- Figs. 6-8b. *YVANIA GIFFORDI* (Worthen).....p. 36
Specimens from Peoria County.
- Fig. 9. *YVANIA INCLINATA* Weller, n. sp.....p. 15
Holotype. Upper surface of whorl (x 8).

1

4A

6

2

5A

7

3A

5B

3B

5C

8A

9

4B

8B

EXPLANATION OF PLATE III

Figures 1a to 5 are enlarged four diameters except 1d which is enlarged eight diameters.

Figs. 1a-1d. <i>YVANIA GURLEYI</i> (Meek).....	p. 20
1a-d. The holotype.	
1d. Immature portion of the spire showing development (x 8).	
Figs. 2-3b. <i>YVANIA INCLINATA</i> Weller, n. sp.....	p. 15
2. A paratype.	
3a-b. The holotype.	
Fig. 4. <i>YVANIA ADAMSI</i> (Worthen).....	p. 30
Internal cast from Peoria County.	
Fig. 5. <i>YVANIA GIFFORDI</i> (Worthen).....	p. 36
Internal cast from Peoria County.	

The following curves indicate in a diagrammatic fashion the form of the apertures of several of the species described. The whorl is to be considered as flattened out with the suture above and the columella or umbilicus below. The horizontal mark midway on the curves indicates the position of the angulation separating the lateral and basal surfaces. It is to be noted that the apertures are broken away in all specimens observed and therefore the depth of the slit is unknown. It probably does not exceed one eighth of a turn. The relations of the aperture above and below the slit are also uncertain. The curves presented herewith have been drawn from growth lines which left the slit band opposite each other, although it is possible that the aperture was actually more advanced upon one side than upon the other.

Fig. 6. <i>YVANIA INCLINATA</i> Weller, n. sp.....	p. 15
Fig. 7. <i>YVANIA GURLEYI</i> (Meek).....	p. 20
Fig. 8. <i>YVANIA SUPERCRENATA</i> Weller, n. sp.....	p. 22
Fig. 9. <i>YVANIA KNIGHTI</i> Weller, n. sp.....	p. 25
Fig. 10. <i>YVANIA SUBCONSTRICTA</i> (Meek and Worthen).....	p. 32
Fig. 11. <i>YVANIA GIFFORDI</i> (Worthen)	p. 36

1A

1B

1C

2

3A

3B

4

1D

5

6

7

8

9

10

11

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