DEPARTMENT OF THE INTERIOR
Hubert Work, Secretary

U. S. GEOLOGICAL SURVEY
George Otis Smith, Director

Professional Paper 150

SHORTER CONTRIBUTIONS TO GENERAL GEOLOGY

1927

W. C. MENDENHALL, CHIEF GEOLOGIST

UNITED STATES
GOVERNMENT PRINTING OFFICE
WASHINGTON
1928

THE POCONO FAUNA OF THE BROAD TOP COAL FIELD, PENNSYLVANIA

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INTRODUCTION

Marine invertebrate fossils are extremely rare in the Pocono formation of Pennsylvania, although they are found in rocks of equivalent age that occur in the northwestern part of the State. Because such occurrences are rare and because the one near Saxton was recorded many years ago, somewhat special interest attaches to the fauna from the Broad Top coal field which is described in the following pages. The stratigraphy of this region has been discussed by a number of authors, notably by Ashburner,[1] Stevenson,[2] White,[3] and, more recently, Reger.[4] My own knowledge of the subject is of the superficial sort that is incidental to a brief visit for the purpose of collecting specimens. In this particular province, therefore, I shall restrict myself to an abstract from the work of others; if more detail is desired, the original reports just cited will furnish it.

The Pocono of this region as described by White, consists of "coarse, sometimes pebbly, greenish-gray, characteristically false-bedded, more or less massive sandrocks, interstratified with thinner gray shales, like those of the Productive coal measures but without workable coal beds." In two measured sections the thickness of the Pocono was determined at about 1,150 feet, and the formation was subdivided into an upper division, which contained little or no red shale, and a lower division, which contained considerable red shale, ending below in a massive gray sandstone of great thickness. In its stratigraphic relations the Pocono of this region is underlain by rocks referred to the Catskill formation and overlain by rocks referred to the Mauch Chunk.

The Pocono invertebrates considered in this report were collected at four localities—Shoups Run Gap, Riddlesburg Gap, Great Trough Creek Gap, and Sideling Hill tunnel, more fully described on page 123 under the locality numbers 3547, 3548, 3549, and 5438. The Shoups Run section has been described by White and also by Reger. The Riddlesburg Gap section likewise has been described by White and by Reger. The section in Great Trough Creek Gap has not been described, so far as I am aware, nor am I able to supply the deficiency. The section at Sideling Hill tunnel has been the subject of some controversy, chiefly, however, in the way of harmonizing the observations of different authors. White and Reger both describe it.

The fossiliferous rock in all four sections is a dark, almost black shale, not of the fissile type but hard and blocky. The faunas also, like the rock which contains them, are essentially identical, and it seems probable that all came from a single bed and a common horizon in the Pocono of this region. This is the view of Reger, who collected some of the fossils described in this report. This shale, according to him, has a thickness of 75 feet or more, and in different sections it occurs from 500 to 670 feet below the top of the Pocono.

Although representing but four localities, my collections number no less than nine, for they are the work first of David White, then of myself, and lastly of Mr. Reger. Fossils are abundant as to number but poor as to variety. The collections differ but little save in the abundance or scarcity of certain forms, whether they were made at the same locality by different collectors or at different localities, and it seems probable that the fauna here described constitutes almost the entire Pocono fauna of this region, comprising certainly all the common species and many of the rare ones. The following table shows the occurrence of the known fauna, consisting of 20 species, at the four localities represented by my collections:

Distribution of the Pocono fauna at the four localities represented

	3547 (Shoups Run)	3548 (Riddlesburg)	3549 (Trough Creek)	5438 (Sideling Hill)
Scarphiocrinus kirkianus	×	×	------	------
Spirorbis sp.	×	×	------	------
Stenopora? sp	×	×	×	------
Lingulidiscina newberryi?	×	×	×	×
Rhipidomella huntingdonensis	×	×	×	------
Schuchertella chemungensis	×	×	×	×
Chonetes acutiliratus	×	×	×	×
Camarotoechia aff. C. contracta	×	×	×	×
Cranaena sp	------	------	×	------
Spirifer compositus	×	×	×	------
Nucula aff. N. houghtoni	------	×	------	------
Palaeoneilo concentrica	×	×	×	×
Leda aff. L. spatulata	×	------	×	×
Cypricardinia consimilis	×	×	×	×
Glossites? sp	------	×	×	------
Pleurotomaria aff. P. hickmanensis.	×	×	×	------
Loxonema sp	------	------	×	------
Orthoceras sp	------	------	×	------
Cytherellina? sp	------	------	×	×
Kirkbya? sp	×	------	------	------

[1] Ashburner, C. A., Pennsylvania Second Geol. Survey Rept. F, p. 206, 1878.
[2] Stevenson, J. J., idem, Rept. T_2, p. 62, 1882.
[3] White, I. C., idem, Rept. T_3, p. 77, 1885.
[4] Reger, D. B., Pocono stratigraphy in the Broad Top Basin of Pennsylvania: Geol. Soc. American Bull., vol. 38, pp. 397–410, 1927.

The specimens from the Pocono of the Broad Top coal field are, as I have already had occasion to point out, but poorly preserved. They have been described as fully as their condition would permit and figured so far as figures promised to be of value. Of the 20 species cited in the table, 2 have received no descriptive treatment in the text. These are the ostracodes. These shells are scarcely determinable even generically when they are known only as internal molds, for their distinctive characters are not present on the inside of the shell. Furthermore, in the ostracodes of the present collection, which are both few and ill preserved, even the internal characters are shown less faithfully than they would be in shells which were of larger size, which were preserved in a matrix of finer material or which had not been subjected to compression. Nothing could be said about them that would be sufficiently important or sufficiently precise to deserve record, and even the generic references, which were made at my request by P. V. Roundy, are uncertain.

Synonymic lists are almost an essential part of any work in descriptive paleontology that offers claims to completeness. For the present report, in view of its small size and conservative treatment made necessary by the very nature of its subject matter, it has seemed adequate to cite but a few works—those especially that were in reference to each species authentic and that set up, as it were, the model to which the Pocono shells were thought to conform.

The Pocono fauna listed above is a varied one in the sense that many classes of invertebrate animals are represented in it. It is, however, essentially a brachiopod fauna in the sense that that group is represented overwhelmingly by individuals. The discinoid, the *Rhipidomella*, the *Schuchertella*, the *Chonetes*, and the *Camarotoechia* are all very abundant, though they may be abundant in one collection and relatively rare in another. The only pelecypod that at all rivals these forms, though it rivals them but remotely, is the *Palaeoneilo*, with *Cypricardinia* still farther in the rear. It is notable also that a large gastropod, one of the Pleurotomarias, is by no means rare.

This fauna is somewhat remarkable in that each genus is represented by but a single species. It is true that unless the species of any particular genus were conspicuously unlike, they could hardly be distinguished among these specimens most of which are poorly preserved as molds and have been flattened and deformed by the folding of the rocks wherein they lie; but there is little reason to believe that really distinct species have on this account failed of recognition.

This fauna is far more remarkable for another reason than for the one just mentioned. It is, one can hardly doubt, of Carboniferous age, yet it lacks, all but entirely, two genera that more than any others abound in our Carboniferous faunas—*Productus* and *Spirifer*. A Carboniferous fauna without a single productoid (except, of course, *Chonetes*) and without a single spiriferoid (except a very rare and very peculiar species of *Spirifer*) is indeed an anomaly. This is so true that the Carboniferous age of this fauna, though it is very probable on broader grounds, is but slenderly supported by the evidence of the fauna itself. Except for a few types that have more distinctly Carboniferous affinities, it might almost as well be Devonian. If one were bent on selecting a fauna of cryptic aspect, he could hardly do better than to pick out a discinoid, a *Rhipidomella*, a *Schuchertella*, a *Chonetes*, and a *Camarotoechia* of the generalized, nondescript type that these specimens belong to. The most distinct Carboniferous evidence, perhaps, is found in the *Scaphiocrinus*, the *Palaeoneilo*, and the *Cypricardinia*, and that evidence, such as it is, is in a measure confirmed by the *Rhipidomella*, *Schuchertella*, *Chonetes*, and *Camarotoechia* (more as generic than as specific citations), inasmuch as our early Carboniferous faunas, especially those of eastern type as represented in the Waverly rocks of Ohio, Kentucky, and Pennsylvania, usually abound in shells belonging to those genera and more or less akin to these Pocono species. The same is true, however, though not equally true, of the later faunas of Devonian age. At the same time those late Devonian faunas, no less than the early Carboniferous ones, contain normally a rich and varied representation of spiriferoid and productoid shells.

A scientific paper ordinarily comprises a statement of facts, more or less new, and a statement of inferences derived from them, more or less logical; and papers of the present sort state facts of generic and specific identification and inferences as to geologic age and correlation. Whatever vague inferences I have dared have already been set down, and such value as the present paper may hope to sustain will rest largely on the record of facts appearing in the descriptions and figures that follow. Little—indeed, so far as I know, nothing—has yet been done toward describing our Pocono faunas, especially those of the more northern and more typical extension of the rocks identified as Pocono. As this paper is a beginning, though but a small one, in a subject about which little is known, it can not but have value as a record of fact, and perhaps it could not, without some background, look to going far in the way of inference and conclusion.

DESCRIPTION OF SPECIES

Scaphiocrinus kirkianus Girty, n. sp.

Plate 22, Figures 1, 2

Three specimens of this species are available for study, all preserved as external molds. One specimen comprises part of the dorsal cup and about 1.5 centimeters of column; another consists of a group of well-preserved arms, unfortunately dissociated from the dorsal cup; the third, of which both halves of the mold were

collected, affords views of the crown as oriented from the anterior radius and posterior interradius. A small fragment of the stem is attached, and the ventral tube, as well as portions of the arms, are preserved. This specimen has been chosen as the type, although details of arm and stem structures have been taken from the others.

The crown of the type specimen has a length over all of 46 millimeters, measured from the base of the cup to the tip of the ventral tube. The dorsal cup measures 10 millimeters in height. It is subfusiform in shape, with a maximum diameter at the arm bases of about two-thirds of its height. There is no sign of surface ornamentation on the cup plates. The infrabasals are pentagonal in outline, with a height of 2.6 millimeters and a maximum breadth of about 1.7 millimeters. The basals are relatively large, having an average height of about 4.4 millimeters and a maximum breadth of about 2.8 millimeters. The radials have an approximate average height of 3 millimeters and are about as wide as high. The articulating facets are concentric in outline and take up nearly three-fourths of the upper faces of the radials. Below the facet the radial develops a thickened shoulder. Plate RA is pentagonal in outline, resting on the upper inner faces of the two basals below, abutting to the right on the right posterior radial and to the left on plate X. Above it supports plate rt.

The posterior side of the ventral tube is shown only in its proximal portion, and the distal part is shown in the anterior view. The basal portion of the tube as shown is composed of fairly large plates irregularly alined. They are ornamented by strong radiating ridges. In the distal portion of the tube the plates are arranged regularly in vertical rows so that the juxtaposed raised and rounded median portions of the plates stand out sharply as long, rounded ridges.

The arms of the type specimen are relatively small for the size of the crinoid. This may be due to their having been broken off and regenerated. The arm ossicles are longer than wide and unite with slightly gaping sutures. The arm bifurcates once on the second primibrach. Thereafter long, slender ramules are given off on alternate sides from each second brachial. The ramules in turn bifurcate by regular dichotomy, there being at least three divisions. In the main arms, and in the ramules as well, the ventral groove is covered by two alternating rows of small pentagonal covering plates.

The stem is pentagonal in section, with well-defined nodes and internodes.

Owing to the somewhat loose usage of generic names for American Inadunata it is difficult accurately to assign this species to a genus. It shows nothing, however, that would cause its exclusion from *Scaphiocrinus* as now defined. Within that genus there are no species, however, with which it is closely comparable.

I take pleasure in naming this crinoid after my colleague, Dr. Edwin Kirk, and in acknowledging my indebtedness to him. He furnished the description essentially as it is presented above, but, out of consideration for the bibliographer, requested me not to attach his name to it as author. I regret the request, although I can not but accede to it.

Spirorbis sp.

A number of small coiled shells of the type commonly referred to *Spirorbis* have been observed in some of the collections, and, as they are inconspicuous, others doubtless have been overlooked. Of those observed most were attached to *Cypricardinia consimilis*, but some to *Rhipidomella huntingdonensis*. The specimens occur as molds and have been completely flattened. The larger ones have a diameter of almost 2 millimeters. The surface is smooth so far as can be seen.

Stenopora? sp.

This form, which is rather rare, has an incrusting growth and is found especially on *Lingulidiscina newberryi* and *Cypricardinia consimilis*. The colonies are of small extent and in thickness somewhat less than 1 millimeter as a maximum. They are preserved as molds, the fossil itself having been dissolved away and only the mud-filled chambers remaining. To judge by the rounded shape of the minute columns representing the zooecia and by their distances apart, the walls were rather thick; and to judge by the general appearance of the columns the zooecia were without diaphragms and the walls were marked by constrictions. The shape and spacing of the columns somewhat suggest that we have here a *Leioclema*, or even a *Fistulipora*, and, indeed, doubtful evidence of mesopores has been noted. The shape of the columns (round instead of petaloid), their spacing, and their annulated markings would seem to indicate that the species, if not a *Stenopora*, is more likely to be a *Leioclema* than a *Fistulipora*.

Lingulidiscina newberryi (Hall)?

Plate 22, Figures 3–15

1867. *Discina newberryi* Hall, New York Geol. Survey, Paleontology, vol. 4, p. 25, pl. 1, figs. 10a,b; 11a–e. Waverly group, Cuyahoga Falls and Akron, Ohio.
1892. *Orbiculoidea newberryi* (Hall). Hall and Clarke, idem, vol. 8, pt. 1, p. 130, pl. 4F, fig. 18. Waverly group, Cuyahoga Falls, Ohio.
1897. *Lingulidiscina newberryi* (Hall). Schuchert, U. S. Geol. Survey Bull. 87, p. 261.

Numerically at least discinoids play an important part in the Pocono fauna of the Broad Top coal field, and they occur in especial abundance at station 3547. In their present estate their characters are these:

In size they reach a diameter of 27 millimeters, though many are considerably smaller. In outline they range from nearly circular to strongly elliptical.

The brachial valve ranges from low to rather high in convexity and the apex may almost overhang the posterior margin or be well forward from it, perhaps as much as one-half of a radius. The anterior side is commonly somewhat inflated so that the apex appears to point backward.

The pedicle valve varies in outline like the brachial valve, from circular to elliptical. It is nearly flat except for a strongly introverted cicatrix.

The surface markings consist of the usual widely spaced narrow, threadlike lirae, of which about 10 occur in a distance of 5 millimeters. These are, however, confined to the more central parts and give place on the outer parts to striae of growth which are rather strong and rather regular but quite different from the spaced lirae. This change appears to be more marked in the brachial valve.

It is obvious at once that these specimens have been distorted by compression and that much of the existing variation must be ascribed to that cause. It seems safe to infer that the original outline was essentially circular instead of elliptical, as in so many of the specimens. The elevation of some of the brachial valves must have been high, for it is fairly high even in their present condition and could scarcely have been lower originally. In many of these specimens the lower part of the shell on the posterior side spreads out abruptly from a steep descent above, as if through compression this side had buckled and been doubled inward. The effect of this process would be to make the height of the valve appear lower and the apex more nearly marginal than it was originally. On the other hand, compression might affect this valve in a different way so as to flatten it out, with the result that the height would seem lower and the apex more central in position, while radiating cracks would appear in it. This condition also has been observed, and it seems not improbable that much of the variation shown both in the height of the valve and in the position of the apex can be attributed to the different ways in which the shell yielded to compression or the different directions in which the compression was applied. It can hardly be denied, however, that part of the variation may have been original. Originally, according to my estimate, the height of this valve was rather great, the apex was situated one-fourth of a diameter more or less in front of the posterior margin, the slope from the apex forward was rather convex, and the slope from the apex backward was flat or gently concave.

The effect of compression on the pedicle valve, except as it changed the outline, would be less pronounced, because this valve was more nearly flat originally, and less important, because the specific characters reside chiefly in the other valve.

In its original condition this species must have had much the configuration of *L. newberryi*, although in some specimens the height of the brachial valve appears to have been greater. The apex is at present much more nearly marginal in many specimens, and it may have been originally so in some. *L. newberryi* attained an equal size, some specimens being over 25 millimeters in diameter.

I at one time identified this form as *Oehlertella pleurites* Meek, and if no allowance is made for distortion, certain specimens resemble that species rather closely. Even in its present condition, however, the brachial valve is more highly convex, and if it were restored as I should restore it, the convexity would be much greater and the apex considerably farther from the posterior margin. I can hardly imagine a shell having the configuration shown by Meek's figures so transformed by any process of distortion as closely to resemble most of the shells in my collection. These differences do not exist to the same extent if other illustrations are consulted than those given by Meek, for Hall and Clarke figure two brachial valves whose apices, though equally close to the posterior margin by projection, appear to rise higher above it than in the figure given by Meek.

A generic difference even may exist between the Pocono form and *Oehlertella pleurites*, inasmuch as I refer my form to *"Orbiculoidea,"* whereas Meek's has been made the type of the subgenus *Oehlertella*. The smaller characters of the pedicle valve are not well shown by my specimens, but I believe that they did not possess a marginal notch for the passage of the pedicle, as in *Oehlertella*. The compression which all these specimens have undergone seems to have caused many of the pedicle valves to part along the line of the pedicle scar, which appears like a narrow crack penetrating the shell from its circumference well toward the center. Other specimens show the deep cicatrix with edges joined even to the circumference; still others show the pedicle scar in the usual form, but with a slight marginal deflection.

It would seem to me quite natural that the disturbance or irregularity caused in *"Orbiculoidea"* by the development of the pedicle tube and the great cicatrix which it produced superficially should be expressed in some specimens by a deflection at the margin of the valve. The essential point is not whether such a deflection existed, but whether it served as a pedicle opening. The great pedicle scar of *"Orbiculoidea"* would seem to be connected with the development of this pedicle tube and its very oblique direction. I should expect a much less striking manifestation if the pedicle issued from a notch on the margin, and the presence of a deep cicatrix may in my judgment

be taken as indicating the presence also of an oblique pedicle tube, if no contradictory evidence appears. Although the details are not shown by my specimens, the structure indicated seems to be that of "*Orbiculoidea*," but naturally nothing positive can be said on this point.

Some of my specimens also resemble *Discina connata* of Walcott, but Walcott's species resembles Meek's rather closely, and the Pocono form did, I believe, present much the same differences in its original condition from the one as from the other.

Rhipidomella huntingdonensis Girty, n. sp.

Plate 22, Figures 16–23

Shell rather large, though mostly under 37 millimeters in width. Shape broadly subcircular, with the transverse diameter distinctly greater than the longitudinal.

Pedicle valve of rather low convexity, being nearly flat over most of its surface and owing its capacity in large measure to the inflected parts along the cardinal border; more or less depressed down the middle. Hinge line about one-half the greatest width. Cardinal area rather low, suberect.

On the interior this valve has a rather large, deeply impressed flabelliform muscular area reaching about halfway, or a little more, to the anterior margin. The muscular area is divided into two lobes (the diductors) by a median ridge which is a continuation of the ridges defining the muscular imprints, and in its backward course this median ridge itself divided about halfway to the beak so as partly to inclose a small heart-shaped scar formed by the two adductors.

The brachial valve is more convex than the other, though it is by no means gibbous. It appears to have a distinct median sinus which is narrower than the broad, gentle deflection of the pedicle valve.

The muscular imprints of the brachial valve are scarcely appreciable. Where best seen they take a multilobate, probably a quadrilobate form. A pair of grooves (ridges on internal molds), one on each side and some distance apart, define a central area having a vaguely cordate shape, and these are sharply reflexed toward the side at the posterior end. The most obvious internal feature is a low rounded ridge which extends about half the length of the valve and becomes stronger toward its posterior end, where through a general thickening of the shell near the cardinal margin it coalesces with the cardinal process and the dental sockets.

The surface is marked by the usual fine radial lirae, of which about three, measured from crest to crest, occur in 1 millimeter at the anterior margin of mature shells. In addition to the punctae, these shells had pores (spines?) of two sizes. Those of the larger size are confined to the crests of the lirae and resemble overarching scales or the bases of spines that have been broken off. They extend obliquely backward from the outer surface but do not completely penetrate the shell except possibly in the marginal region. They commonly emerge at intervals along the varices of growth, but they occur elsewhere as well, and on the cardinal angles of the pedicle valve they are especially large and closely arranged. In that region they resemble large tubules piercing the shell obliquely. My specimens do not show the fact conclusively, but these groups of large pores are apparently confined to the pedicle valve and do not occur upon the cardinal angles of the brachial valve. The small pores are much more numerous than the large ones, much more thickly and more indiscriminately strewn, for they occur on the sides as well as on the top of the lirae. The surface is also marked by fine, regular incremental striae and by rather numerous but not very strong or regularly arranged varices of growth.

I have not been able to locate this form satisfactorily in any described species. *R. oweni* at once suggests itself in this connection but is also at once dismissed. Not only are the muscular imprints of that species much smaller, but the shell is generally somewhat wider, and the pedicle valve rarely shows those tubules, or so many or so large, that I have described as occurring near the cardinal border of the present form.

R. pennsylvanica Simpson appears to be similar in many ways (though it is not very satisfactorily known), and it invites comparison because of its geographic distribution. It is, on the other hand, said to belong with a fauna apparently different from this one and also somewhat older. It does not reach so large a size and is apt to be relatively narrower. *R. pennsylvanica* is described as having a slight fold down the middle of the pedicle valve, corresponding to a slight sinus in the brachial valve, whereas no such elevation is present in the Pocono shell, which instead shows a broad, shallow concave deflection from side to side. This character, however, and some of the others are more or less inferential, as the Pocono specimens are all deformed by pressure to a greater or less extent. Specimens from northwestern Pennsylvania, supposed to belong to *R. pennsylvanica*, show a larger and less deeply impressed scar in the pedicle valve and somewhat coarser liration.

R. burlingtonensis is likewise a similar species, but aside from its remote geographic position and its association with a fauna very unlike the Pocono fauna, even if possibly of the same geologic age, it appears to show some proper differences. Owing to their different preservation, however, these shells can not be satisfactorily compared in several details. The beak of the pedicle valve in *R. burlingtonensis* is not only more elevated but it projects well beyond the hinge line. In the present form, on the contrary, the umbonal region is much less gibbous and projects scarcely at all, even if allowance is made for the effects of compression. Nor does one find among specimens of *R. burlingtonensis* as many individuals that are wider than long or

any that are relatively as wide as one finds in the specimens from the Pocono fauna.

The species most likely to prove similar to or even the same as this is *R. pulchella* of Herrick. Herrick's description is too general to permit comparisons in a number of important characters, and the specimens of *R. pulchella* in my collection are equally unfavorable. They are preserved in sandstone, and the original shell has been reduced to an ocherous film so that it is possible to make out neither the character of the muscular imprints nor the details of shell structure and sculpture.

These appear to be the most closely related of our Mississippian species, and the Pocono form can not be exactly identified with any of them. Differences of a similar nature and equally pregnant can be found if Devonian shells are brought into comparison. The two Hamilton species, *Orthis vanuxemi* and *O. penelope*, are more comparable than are the orthoids of the Chemung fauna, and of the two mentioned, *O. penelope* more than *O. vanuxemi*. If it is necessary to distinguish the present form from *R. penelope*, the most conspicuous difference perhaps is the tubular character of the lirae in that form which gives them the interrupted appearance mentioned by Hall.

Schuchertella chemungensis Conrad.

Plate 22, Figures 24–28

1867. *Streptorhynchus chemungensis.* Hall, New York Geol. Survey, Paleontology, vol. 4, p. 67, pl. 10, figs. 1–26. Chemung group, New York.

1892. *Orthothetes chemungensis.* Hall and Clarke, idem, vol. 8, pt. 1, p. 255, pl. 10, fig. 9; pl. 11A, fig. 14. Hamilton group, western New York, Chemung group, southwestern New York.

Shells belonging to the genus *Schuchertella* are very abundant in the Pocono formation of Huntingdon County, but like the other fossils found there they have suffered much from distortion, so that some characters desirable or even necessary for close identification can not be determined with precision.

Some specimens are as wide as 45 millimeters, or even wider, this dimension being much greater than their length. The cardinal angles appear to have been rounded and the general shape more or less elliptical.

The pedicle valve is of low convexity and owes its elevation chiefly to the height of the cardinal area, the upper surface being almost flat. In many specimens this surface is gently concave, especially over the posterior half, but, on the other hand, the parts adjacent to the beak may be somewhat inflated. The cardinal area probably had a slight backward inclination from the hinge and in some it slopes backward rather strongly; in still others, however, it is at present nearly perpendicular to the plane of the shell edge. In height the cardinal area measures on the average about 5 millimeters (along its surface) in mature specimens but sometimes distinctly more. Compression may have modified the original height and slope considerably. The width of the delthyrium is generally about 5 millimeters, but this dimension has suffered change from compression that is difficult to allow for. From what has been said it will be apparent that this valve varies not a little in its configuration, some specimens being distinctly irregular and distorted, others quite regular, and some having a moderately high area, others a distinctly higher.

On the inside this valve developed no median septum and no well-marked dental plates, though the margins of the delthyrium are thickened into stout dental pillars. The muscular imprints must originally have been faint, and at present scarcely any trace of them remains.

The brachial valve is of rather low convexity, in some specimens very low indeed, though the umbonal region is apt to be slightly inflated and the parts adjacent to the cardinal angles rather broadly depressed.

On the interior this valve is without any appreciable muscular scars. Two short, thin socket plates are directed outward from the umbo at a very acute angle to the hinge margin and are connected with the cardinal process, which extends somewhat backward but chiefly upward.

The surface is marked by slender radial lirae separated by interspaces of about the same width. The lirae are subequal or, as new ones are introduced, obscurely alternating, and about 10 occur in 5 millimeters. This number, however, is subject to variation, originally through introduction of new lirae, subsequently through compression, which has spread out some specimens and pressed together others. The usual concentric crenulations are also present, but on the specimens seen they show more clearly between the lirae than upon them.

In so far as I have been able to determine, these shells can not be adequately distinguished from *S. chemungensis*, and, but for their faunal association, might as well be cited under that species as under any other. They may belong to *S. fernglenensis* or to *S. ruber*, which have the disadvantage as compared with *S. chemungensis* of coming from a remote area and a different fauna, though a fauna perhaps not very different in geologic age. Of the forms occurring in the Waverly group of Ohio, some probably belong to the same species as this, but *S. desiderata*, from the Cuyahoga shale of Medina County, is apparently distinct by reason of its much more gibbous brachial valve. Some of these Waverly forms have been identified as *Hemipronites crenistria* Phillips and others (or possibly the same ones) were at one time said by Hall to be identical with *S. chemungensis*. As typical *crenistria* belongs to a different genus from these common Waverly shells, being indeed taken as the genotype of *Schellwienella*, it is no longer possible to accept an identification which had little to recommend it but

the weight of authority. Thus a reference of the Pocono form to *S. chemungensis* is not only probable but represents almost the only practicable course, except introducing a new name for a type which in its present preservation is hardly if at all distinguishable from that species.

Chonetes acutiliratus Girty, MS.

Plate 23, Figures 1–4

Shells belonging to the genus *Chonetes* are extremely abundant in the Pocono formation of the Broad Top coal field, but their proper disposition is difficult because in characters vital to a close identification few of the associated forms have suffered more than these. The specimens, which occur as molds in shale, have been considerably deformed by compression, which has affected not only their shape and convexity but also the details of their sculpture. The sculpture has been still further obscured where the matrix happens to have been of a sandy character and also where the surface has been covered by a ferruginous deposit, as it has been in many specimens. The characters here set down, therefore, are more or less inferential.

Some specimens are rather large, as much as 17 millimeters in width, but a space of 10 to 14 millimeters covers most of them. The original shape appears to have been deeply semicircular, with the length rather more than commonly great in proportion to the width; in some specimens at present it even exceeds the width, but this is clearly due to distortion. The sides are long and subparallel, in direction nearly perpendicular to the hinge line, with cardinal angles very slightly extended perhaps in some specimens and possibly rounded in others.

The pedicle valve appears to have been rather highly arched for the genus; the curvature of the brachial valve, on the other hand, seems to have been rather low. The cardinal spines are slightly oblique and rather numerous; eight or nine to a side can sometimes be counted on internal molds, but only five or six were functional—that is, projections from the shell and not merely tubes embedded in it.

The radial costae appear to have been angular, with relatively broad, rounded striae between. They number about 10 to 13 in 3 millimeters, usually 11 or 12. No character, perhaps, has been more modified by fossilization than this, for specimens that have been flattened by pressure from above present too few lirae in a measured distance, and those that have been squeezed together by pressure from the side present too many. Some specimens which appear to come under the former category present only eight or nine costae in 3 millimeters. Some external molds show distinct though fine concentric striae, which appear to be in the nature of growth lines rather than crenulations. Varices of growth also are there, but they are neither numerous nor conspicuous.

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The angular character of the costae, the broad intercostal spaces, and the concentric markings of growth lines rather than crenulations are apparently significant characters of this form and tend to ally it with a *Chonetes* which I have described in manuscript under the name *Chonetes acutiliratus* and of which the types were found in the Bedford shale of Ohio. Most of the other characters are also in agreement except the spines, which appear to be more numerous in the Pocono shell; they are not, however, well shown in the Bedford one. With the characters which it appears to possess, this form can not belong to *C. illinoisensis*, or any of its allies, much less to *C. logani* or any species allied to it. Nor does it belong to *C. michiganensis*, with characteristic specimens of which it has been compared, though the two are certainly related. Material such as is furnished by these beds, however, is not susceptible of satisfactory identification.

Camarotoechia aff. C. contracta (Hall)

Plate 23, Figures 5–8

1867. *Rhynchonella (Stenocisma) contracta.* Hall, New York Geol. Survey, Paleontology, vol. 4, p. 351, pl. 55, figs. 26–39. Chemung group, New York; Meadville and Bradford, Pa. Waverly group, Licking County, Ohio.

1892. *Camarotoechia contracta* (Hall). Hall and Clarke, idem, vol. 8, pt. 2, p. 192, pl. 57, figs. 28–32, 49. Hamilton group, Cardiff, N. Y. Chemung group, New York.

Rhynchonellas belonging to the genus *Camarotoechia* are extremely abundant, but though almost innumerable specimens are contained in my collections, very few of them show the characters necessary to their identification. The full number of costae can but rarely be ascertained, and still more rarely their distribution upon the sides of the shell and on the fold and sinus. The total number of plications can sometimes be computed if not counted in full, and if the brachial valve is taken as a standard, the total number appears to range from 12 to 24, with the number 18 recurring more often perhaps than any other. Even if the total number can be counted, however, the specimens are mostly so distorted by compression that the limits of the fold and sinus are not determinable. Nevertheless, the facts can still be ascertained in some cases, and the following combinations occur: Four plications on the fold with four on each side; five on the fold with five on each side; and six on the fold with six on each side, this perhaps being the combination most commonly met with. Still other combinations occur, such as four on the fold and seven on each side; five on the fold and six (or seven) on each side; or eight on the fold and five on each side. It will be remarked that combinations making a total of 18 are especially common. Individual counts may be in error owing to the character of the fossils, but the general statement foregoing is probably not far afield. As to size, a few very large specimens have a length of 17 millimeters,

but most measure from 10 to 15 millimeters. The shape, as now exhibited, varies almost indefinitely, but originally to all appearances it offered no unusual features and was subtriangular, subovate, and subquadrate in different specimens, with the width greater than the length. In their general appearance the specimens at present show the greatest contrasts, for if they have been pinched together laterally the shape is much elongated and the plications are thin, crowded, and high, whereas if they have been flattened out the shape is very wide and the plications large, broad, and low.

The variation in original characters which is suggested rather than shown by these specimens is greater than I would wish to assign to a single species, though not greater than has sometimes been assigned to species of this genus. A subdivision of the specimens, however, would have to be carried out along quite arbitrary lines and would leave most of them undetermined and most of the remainder determined with doubt. On the whole, this form seems to stand rather close to *C. contracta*, which is not only common in the Chemung but has also been identified by Hall in the Waverly group of Ohio. The total number of plications in *C. contracta* is given as 16 to 20, with commonly 4 on the fold. Some of my specimens would in their original state hardly be distinguishable from *C. contracta*, but the more persistent condition seems to be represented by shells with 6 plications on the fold and 6 on the sides, so that the less common arrangement here is the prevailing one in *C. contracta* and vice versa. The identification suggested is unsatisfactory, but for the present it must rest at that. If the basic arrangement of the plications for this form is taken as 6 on the fold and 6 on the sides I know of no Mississippian species which approaches it as closely as *C. purduei* var. *agrestis*. Though characters proper to the shells themselves may suggest such an identification, considerations of regional development and faunal association seem much opposed to it. The same objection holds against *C. elegantula*, the number and arrangement of whose costae can apparently be duplicated in some at least of my specimens.

Cranaena sp.

This type is represented by a single specimen flattened in shale. It is small, measuring but 11 millimeters in length and 7 millimeters in width, and of an ovate shape, widest below the middle. The apparent outline may not be the true one, however, for a pronounced sulcus due to interrupted growth seems to indicate a greater width and a more pentagonal shape. The shell structure is punctate. Internally septal plates are lacking in the brachial valve, but there is a suggestion of a hinge plate supporting crural arms after the manner of the genus *Cranaena*.

Spirifer compositus Girty, n. sp.

Plate 23, Figures 9–11

Shell small, strongly transverse. Cardinal angles rounded so that the greatest width occurs somewhat anterior to the hinge line. Of the few specimens observed none are much over 20 millimeters in width.

Pedicle valve subconical. Cardinal area rather high, rather well defined, gently arched, and somewhat inclined backward from the hinge line. Foramen triangular and unusually wide, apparently occupying nearly a third of the hinge line. Sinus broad and fairly well defined. Surface marked by rather coarse, strong plications, of which about 10 occur on the lateral slopes and 2 in the sinus. In the interior 2 thin strongly diverging dental plates can be seen, but no transverse plate across the open delthyrium.

The brachial valve corresponds in character to the pedicle valve as described, being strongly transverse, rounded at the hinge line, and of low convexity. The fold is broad, sharply defined, and moderately elevated. The plications are rather large and fairly strong. Ten or 11 occur on the lateral slopes, and 3 on the fold.

The surface is marked by concentric striae, which are rather coarse, rather regular, but not very sharp. Covering the whole is a sculpture of fine, regularly arranged elongated papillae, creating an appearance almost exactly like that characterizing the genus *Syringothyris*.

This species is represented by but few specimens and the preservation of these is adverse to an accurate description. Some of the characters noted above are therefore of doubtful authenticity. The description of the pedicle valve was drawn up from one specimen and that of the brachial valve from another, each from a different collection. Should any question arise as to the two valves being conspecific, the pedicle valve may be considered the typical one.

This pedicle valve, though even now rather highly convex, has been compressed from above and somewhat obliquely from the right. The effect has been to reduce the height of the cardinal area and cause it to be more arched and more tilted backward. To some extent the definition of the cardinal area and the unusual width of the delthyrium may have been affected by this general deformation. The limits of the sinus are also not altogether clear, because the shape of the valve and the height of the plications have been altered unsymmetrically owing to the oblique direction of compression. As determined by the strength of the plications in the median region, the sinus is of moderate width and contains but two costae, which is the number that it should contain in order to agree with the brachial valve referred to the same species. This does not, however, check up exactly with evidence furnished by the disposition of

the dental plates, which are, one may suppose, symmetrically placed and consequently available for determining corresponding plications on opposite sides of the median line. On this evidence the sinus might contain four plications instead of two, and they would be of unequal size.

Although this pedicle valve is an internal mold, it clearly shows the character of the surface markings, except in the umbonal region. These consist of minute elongated pustules arranged quincuncially so as to lend the surface the "twilled-cloth" sculpture exemplified in the syringothyroid shells. The brachial valve, though also an internal mold, does not show these markings at all. A small piece of the external mold, however, does preserve them, though with not quite the same appearance. The linear arrangement of the pustules is more apparent, though their independent character is shown by the presence of small spinules represented by minute rounded punctures in the matrix.

Spirifer compositus is remarkable in several ways. As is well known, the Spirifers of the Carboniferous are in a broad way distinguished from those of the Devonian by having a plicated fold and sinus. Now, the plications in the fold and sinus of every species that I can recall follow a uniform course of development. The fold and sinus begin as simple deflections of the shell along the median line; then the fold gradually becomes divided by a median groove at the same time that a median rib develops in the sinus. Other ribs are added symmetrically, so that those within the sinus always make up an odd number and those upon the fold always an even number. In this species the plan is reversed, the fold showing an odd number of plications and the sinus an even. The sculpture also is paradoxical for the normal Carboniferous Spirifers. Normal Carboniferous Spirifers having a plicate fold and sinus almost invariably show finely reticulate surface markings composed of delicate radial lirae crossed by delicate lamellose transverse lirae. One set of markings may strongly predominate, but rarely if ever is the other wholly indistinguishable. In this species apparently we find a quite different type of sculpture, one which is very common among Devonian Spirifers and which has been brought over into the Carboniferous especially by the syringothyroid shells. It is so alien to the ordinary Carboniferous Spirifers, however, as to be almost a generic character of *Syringothyris*. Sculpture comparable to that of *Spirifer compositus* is not entirely unknown even among our Carboniferous Spirifers. I figured as *Reticularia subrotundata* a shell from the Madison limestone, which of course I now know to belong to an altogether different group of Spirifers that has a surface in general effect extremely similar to this, though the two species are very different in configuration. That form has the configuration of *S. rostellatus*, or, indeed, of the species to which it was originally referred. Another form that possesses somewhat similar surface characters is one from the Leadville limestone of Colorado, which in my report upon those faunas I distinguished merely by the formula *Spirifer* sp. *b*. *Spirifer* sp. *b* outwardly resembles the early Mississippian Spiriferinas, such as *Spiriferina solidirostris*, but it does not possess a median septum in the pedicle valve nor probably a punctate shell structure. The surface is thickly covered by fine spinules; in this it resembles *Spirifer compositus*, as it does also in general configuration, although it differs conspicuously in having the fold and sinus incompletely divided, and divided in the customary way with an even number of plications on the fold and an odd number in the sinus. In configuration, of course, *Spirifer* sp. *b* is widely different from the form that I identified as *Reticularia subrotundata*. Thus apparently this rare type of surface marking is manifested in several distinct groups of Carboniferous Spirifers as determined by their configuration. Whether this sculpture, though similar in appearance, is really identical in plan is a matter for further verification. Though the effect is much the same, the surface of *"R. subrotundata"* when closely examined appears to be covered with minute indentations which must be a feature of the superficial layer alone, inasmuch as the shell is impunctate. Little indentations, however, must be separated by minute projections, and little spinules must be separated by minute indentations, while the spinules, if torn off with the matrix, would tend to leave little pits. With specimens that are indifferently preserved the distinction just made, which is so easily visioned, is in fact very difficult to recognize.

Nucula aff. N. houghtoni Stevens

1858. *Nucula houghtoni* Stevens, Am. Jour. Sci., 2d ser., vol. 25, p. 262. Marshall group, Battle Creek, Mich.

1855. *Nucula houghtoni* Stevens. Hall, New York Geol. Survey, Paleontology, vol. 5, pt. 1, Lamellibranchiata, pt. 2, p. 323, pl. 45, figs. 29–31. Waverly group, Newark and Richfield, Ohio; Battle Creek and Hillsdale, Mich.

The identification of this species is probably more precarious than that of any other cited in this Pocono fauna, for not only are the specimens few and ill preserved, but one can hardly doubt that when the early Mississippian Nuculas of the Michigan-Ohio area are carefully studied there will be much shifting of synonymy and of nomenclature. The species that must be considered here are *N. houghtoni* Stevens, *N. sectoralis* Winchell, and *N. stella* Winchell, all from the Marshall sandstone of Michigan, and *N. iowensis* White and Whitfield, from the Kinderhook group of Burlington, Iowa, which is regarded by Hall as a synonym of *N. houghtoni*.

N. sectoralis may be dismissed as soon as mentioned. Under that species Winchell included shells belonging

to both *Nucula* and *Schizodus*, and unfortunately the type specimen of *N. sectoralis* is of the latter genus. Stevens did not figure *N. houghtoni*, and his description is of such a character as to require close study for the identification of his species among the Nuculas of the Marshall fauna, even if it can be satisfactorily identified at all. I suspect that the *Nucula* content of *N. sectoralis* should actually come under *N. houghtoni*. As so much legitimate doubt surrounds the interpretation of *N. houghtoni*, it is unfortunate that Hall went so far as to place *N. iowensis* in synonymy. Hall seems to have interpreted *N. houghtoni* on the basis of specimens from Ohio, especially from Newark. His identification is quite possibly correct. Its status is, perhaps, such that, while the confirmatory evidence is by no means strong, the negative evidence is still weaker. Regarding the identity of *N. iowensis* with *N. houghtoni*, as understood by Hall, there may well arise some question. Weller has figured two of the original specimens of *N. iowensis*, and at first sight one would be inclined to say that both did not belong to the same species. It must be borne in mind, however, that the fossils figured by Weller are internal molds and that the shell of *Nucula* is thick and massive along the hinge border, so that if this thickness happened to be included in the outline of one drawing but not in that of the other the disparity that is at present so striking could be in large measure discounted. Specimens of *N. iowensis* from the original locality, in my possession, are largely intermediate in shape between Weller's two figures. As to the identity of *N. iowensis* with *N. houghtoni*, then, as interpreted by Hall, the marked difference in size (*N. iowensis* is much the smaller) and the pronounced difference in faunal association create an a priori improbability. On the other hand, Hall's figures differ from one another sufficiently and Weller's figures differ from one another sufficiently so that by selection the two species might be made to appear quite similar or quite different, according as one might wish. The differences between favorable specimens of the two species are, I would judge, less than the differences between the two typical specimens of *N. iowensis*. Hall may have been correct both in identifying his Ohio shells with *N. houghtoni* and in regarding them at the same time as referable to *N. iowensis*. No contradictory judgment, at all events, seems at present justified.

Now, Herrick has identified three species of *Nucula* in the Waverly rocks of central Ohio—*N. stella*, *N. houghtoni*, and *N. iowensis*. It is difficult to see any material difference between his figures of *N. iowensis* and *N. stella*, but his *N. houghtoni* appears to be something distinct from either. One would be inclined to say that his *N. stella* and *N. iowensis* belong to one species and *N. houghtoni* to another, and that his *N. houghtoni*, in spite of its much smaller size, is the same as Hall's *N. houghtoni* from the same region. If Herrick's *N. iowensis* is distinct from his *N. houghtoni*, as seems probable, the identification with *N. iowensis* is in contradiction to Hall's conclusion that *N. iowensis* and *N. houghtoni* are the same. Neither of Herrick's forms, not even the one he identifies as *N. stella*, is seemingly referable to that species, for *N. stella* is a much broader form with subcentral beaks.

The Pocono shells here considered, some of which may not be Nuculas at all, have characters of size and shape that ally them with typical *N. iowensis* and with *N. houghtoni* as that species is represented by Herrick's figures, but they are much smaller than the figures of *N. houghtoni* given by Hall or than the dimensions given in Stevens's description. Even were *N. houghtoni* and *N. iowensis* to prove distinct, it would be impossible to determine which the present shells more closely resemble.

Palaeoneilo concentrica (Winchell)

Plate 23, Figures 12–18

1862. *Cardinia concentrica* Winchell, Acad. Nat. Sci. Philadelphia Proc. for 1862, p. 413. Marshall group, Jonesville, Mich.

1865. *Sanguinolites concentrica* Winchell, idem for 1865, p. 128. Marshall group, Hillsdale, Mich.

These shells are rather abundant in the collections studied; nevertheless, they have been so deformed by pressure that they can be described or identified only in a broad way. Some are two and one-half times as long as they are high, while others, apparently belonging to the same species, are only one and one-half times; the one form is, of course, very transverse, the other much more compact and strikingly different in appearance. These differences, however, are largely accidental and it seems clear that this form belongs to a rather well-defined group of Palaeoneilos, of which the Hamilton species *P. emarginata* is a good example. It is characterized by being elongate transversely, by having a deep emargination in the lower part of the posterior outline, and by showing rather strong, lamellose, regularly spaced concentric costae.

Though apparently belonging to the same group of Palaeoneilos, the Pocono species appears to differ regularly from *P. emarginata* in having a shallower sulcus on the postumbonal slope and in having the umbonal ridge more rounded, that structure in fact never becoming sharp and angular as it does in *P. emarginata*. The Pocono shell is apparently more nearly related to one from the Marshall sandstone which Winchell described as *Cardinia concentrica*. Winchell later cited the species under *Sanguinolites*, and Herrick may have intended to transfer it to *Palaeoneilo*, where it really belongs, for he figured but did not describe a "*Palaeoneilo concentrica* var.," which bears, however, no close relationship to *P. concentrica* unless, as may actually be the fact, he was dealing with a young specimen. Winchell published no figures of *Cardinia concentrica*, but an unpublished

figure, not to mention the type specimen and other specimens available for study, show very clearly where the species belongs. A decision as to whether or not the Pocono form is actually and closely identical with *P. concentrica* would depend in large measure upon one's estimate of the original shape from the present distorted specimens. No one, however, can doubt that the relationship is close.

This type of *Palaeoneilo* has not often been cited from our Mississippian rocks, though it is probably more common there, at least in the Waverly rocks of Ohio and Pennsylvania, than this fact would suggest. *P. parallela*, which was described by Hall and Whitfield, but unfortunately never figured, apparently belongs in this group, and so may also some of the shells figured by Hall as *P. sulcatina* Conrad. *P. sulcatina* itself is clearly a different species. If one may form an opinion from Hall's figures alone, without examining a series of specimens, he has included more than one species under *P. sulcatina*, his Figure 43 with its pronounced sinus being of the present group, the others more like true *sulcatina*. His *P. truncata* also is a species closely related to *P. concentrica*. Herrick makes *P. truncata* a synonym of *Sanguinolites marshallensis*, but *S. marshallensis* is quite a different thing, probably a *Sphenotus*. Consequently, *P. truncata* appears to be a valid species, at least so far as *S. marshallensis* is concerned, and Herrick's citation of *P. marshallensis* belongs with *P. truncata*, or at least with the present group of *Palaeoneilo*. Herrick has in fact figured a number of forms mostly as distinct species or varieties of *Palaeoneilo* that seem to be on the border line of this group. They may prove to be young or imperfect or abnormal specimens of some known species, or they may not belong to *Palaeoneilo* at all. In fact, young specimens of the form here under consideration (as at locality 5438) are broadly rounded behind, lacking a strong sulcus posterior to the umbonal ridge as well as a pronounced emargination in the lower part of the posterior outline corresponding to it. The shape of these young specimens resembles that of *P. concentrica* var. or *P. curta* or *P. elliptica*, all of Herrick. The size is comparable to that of *P. curta* or to that of the small figure of *P. elliptica*, for the length is less than 10 millimeters. Another specimen from the same locality, still young but larger than the last (it is 15 millimeters long), has the sulcus and the sinus well developed, and the growth lines show that it had much the same shape at a stage considerably younger. The younger specimen especially referred to has been compressed, although the fact is not at all obvious.

Leda aff. L. spatulata Herrick

Plate 23, Figures 19, 20

1888. *Nuculana (Leda) spatulata* Herrick, Denison Univ. Sci. Lab. Bull. 3, p. 79, pl. 9, fig. 11. Waverly group, Licking County, Ohio.

1888. *Leda saccata.* Herrick, idem, p. 108, pl. 9, fig. 12. Waverly group, Licking County, Ohio.

1888. *Nuculana* sp. Herrick, idem, p. 107, pl. 7, fig. 35. Waverly group, Licking County, Ohio.

These specimens are few as well as imperfect, and they might be compared with several other species belonging in other geologic periods as aptly as with *Leda spatulata*. Some of the specimens are more slender and transverse than Herrick's figure, but they have clearly been compressed in such a manner as to produce that effect. On the other hand, one specimen is much less transverse and much more compact, without showing evidence of compression. However, a specimen of *Cypricardinia consimilis* on the same slab and oriented in the same direction is so much deformed as to be almost circular, and the great contrast between the associated *Leda* and others can be accounted for by the same process.

These shells might equally well be compared with *Leda similis* Herrick, and indeed it is difficult to see wherein any difference lies between *L. similis* and *L. spatulata*. Herrick suggests that *L. similis* is the same species that Hall figured under the name *L. pandoriformis* Stevens. This seems, indeed, very likely, as the two figures agree in shape almost to a hair. We do not at present know and perhaps never shall know what species Stevens wished to designate by *L. pandoriformis*, as his description lacks precision on many points. To avoid possible confusion, inasmuch as we already have another name available, it would seem wise to discontinue *L. pandoriformis* until something more definite is known as to its characters.

Cypricardinia consimilis Hall

Plate 23, Figures 21, 22

1885. *Cypricardinia consimilis* Hall, New York Geol. Survey, Paleontology, vol. 5, Lamellibranchiata, pt. 2, p. 486, pl. 79, figs. 18–21; pl. 96, fig. 3. Waverly group, Licking and Medina Counties, Ohio; Warren, Pa.

These shells, though abundant, have been quite as much deformed by pressure as those referred to *Palaeoneilo concentrica*, and quite as definitely they do not yield to close identification. The variation which they show in the proportion of length and width is at present very great, but it can be ascribed largely to distortion by pressure.

This is a large species for the genus and belongs to a rather well-marked type, distinguished perhaps more by its robust size than by characters of greater moment. Many specimens in the present collection equal though but few exceed a width of 20 millimeters. The shape must have been very similar to that of *Cypricardinia consimilis*, though the size is considerably less, Hall's figures showing a width of 30 millimeters.

The most conspicuous and in many specimens the only surface marking consists of rather strong concentric striae disposed at fairly regular intervals. These are very different from the striae of the associated

Palaeoneilo concentrica, as they are not connected with the development of lamellose ridges but instead define somewhat imbricating plates. My specimens also show, though none distinctly, fine radiating striae that are interrupted by the concentric ones but are continued outward from one band to another in the same general direction. These markings appear sometimes as raised lines separated by wide interspaces, sometimes as rounded lirae separated by incised lines, but one can hardly doubt that they were originally essentially the same.

That this form is more than probably identical with *C. consimilis* could hardly be maintained with distorted specimens such as these; equally would it be impossible to show that this was a different species. Furthermore *C. consimilis* appears to be the only species known from the same general faunal province and the same general geologic age which this one closely resembles.

Glossites? sp.

Plate 23, Figure 23

This form is rare, only three specimens having been collected, and even these lack assurance of belonging to the same species. They constitute a rather large species (over 30 millimeters in length) of an elongate-ovate shape, widest back of the middle and with beaks strongly anterior yet by no means terminal. In one specimen an oblique and fairly distinct sulcus defines a lobe anterior to the beak. This configuration is less well marked in the others. The umbonal ridge is broadly rounded and does not form a distinct feature

The surface in general effect is nearly smooth. It is, however, marked by innumerable fine incremental striae, among which here and there occur others more pronounced, due to intermittent growth. One specimen especially but all three in some degree have the appearance of being finely pitted or finely papillose, especially in the umbonal region.

The generic position and still more the specific relations of this form are conjectural only. It might apparently be included under *Glossites* or under *Spathella* without running counter to any of the facts at present known. It resembles Hall's figures of *G. amygdalinus*, from the Kinderhook group at Burlington, Iowa, and also his figures of *G. lingualis* and *G. depressa*, from the Chemung group. It likewise resembles the figures of *Spathella ventricosa*, from the Kinderhook group at Burlington, given by the same author. The dual expression of the Pocono shells thus suggested is attributable to their more or less distorted condition, which has lent them a diverse appearance.

Pleurotomaria aff. P. hickmanensis Winchell

Plate 23, Figures 24–26

1869. *Pleurotomaria hickmanensis* Winchell, in Safford, Geology of Tennessee, p. 445. [Maury shale], Hickman and Maury Counties, Tenn.

1870. *Pleurotomaria hickmanensis* Winchell, Am. Philos. Soc. Proc., vol. 11, p. 257. Waverly group, Hickman County, Tenn.

This pleurotomarioid is not rare in the Pocono collections if all the specimens referred here are of one species, although on this head their very diverse appearance warrants some doubt. All are preserved in the same way, merely as partings in the shaly matrix, the shell itself having totally disappeared, together with the cavity which would have been left by its dissolution. Some specimens appear to show only the internal characters and are entirely smooth; one or two exhibit external markings, crisply expressed; but most show external markings in a subdued and modified form. The sculpture has furthermore been more or less disguised by compression, which has tended to obscure some features and exaggerate others. The same process has also distorted the shape, and all the specimens are otherwise more or less imperfect.

The shell is a rather large one, and the diameter of the final volution must in some specimens have been as much as 25 millimeters, or even more. The shape as a whole was probably subglobose or somewhat ovate, with the height of the spire less than that of the body whorl. The whorls were apparently well rounded and not deeply embracing, so that the suture was much depressed. The curvature of the volutions was interrupted by a pronounced though not high carina, situated above the middle. The slit band is located on or rather forms the carina. It has projecting edges and is marked by strong, regular lunettes which are apparently (in the best specimens, at least) intersected by a revolving line traversing the middle of the band. The surface of the volution above the band and also below it is reticulated by a series of relatively strong, coarse transverse and spiral lirae. The revolving lirae are irregular in size and distribution; small ones here and there lend a conspicuously alternating effect. Some of the lirae are wider and others narrower than the interval between. The transverse lirae have the appearance of being fascicles of growth lines. They are not quite as strong as the revolving ones and not quite as far apart, but they are more regularly disposed. Their course is almost direct, but they are gently curved both above and below the band, with the convex side toward the aperture. The intersections of the two sets of lirae form nodes, which in certain lights are conspicuous.

The surface characters just described are taken from a well-preserved fragment in lot 3549. Another specimen has similar sculpture but fainter and apparently finer. This specimen has been compressed laterally, however, so that the revolving lirae would be brought closer together.

Some of the characters above ascribed to these specimens are open to more or less question, and the identification of the species is correspondingly qualified. Comparisons may fairly be limited to species that are of similar character and that occur in the same faunal province. *P. hickmanensis* may not be regarded as coming from the same faunal province, but it appears to be closely comparable in many of its own characters. The differences that can be discovered (from Winchell's description alone) may be accidental or not particularly material. The slit band on his species is well defined without forming a distinct carina; on mine the band forms a distinct though not strong carina on the best specimen, though on others the carina is more or less suppressed. *P. hickmanensis* is said to be marked by revolving lines. Transverse lines are not mentioned, but the revolving lines are described as nodose, suggesting that transverse lines may originally have been present. In the Pocono form the transverse lines are present and they produce nodes at their intersection with the revolving ones, although this sculpture varies in appearance with the conditions of preservation. *P. vadosa* (from the limestone of Kinderhook age (Rockford limestone) at Rockford, Ind.) can hardly be regarded as of the same faunal province, except that Winchell, in Michigan and Ohio, and Herrick, in Ohio, have identified specimens under that name. Hall's description without a figure and Herrick's figure without a description (especially as Herrick's identification is quite questionable) do not afford an adequate basis for comparison. My form may perhaps be compared with either of those others in size and shape, but not in sculpture. *P. huronensis*, though probably a *Pleurotomaria*, is a quite different species, suggesting the Pennsylvanian *P. carbonaria* but having the revolving ridges fewer, coarser, and more widely spaced. *P. textiligera* (which I do not regard as the same as *P. mississippiensis*) is a similar though not the same form. The whorls of the Pocono shells are apparently more rounded, the suture more depressed, and the sculpture on a larger scale.

Loxonema sp.

The single specimen here under consideration is of the type commonly referred to *Loxonema*, though the characters that would verify the reference or assign the specimen to some quite unrelated genus are not shown. In brief, this is a good-sized shell, composed of many volutions which have but a narrow contact zone and form a very elongated cone. The specimen is so much compressed that the whorls are strongly oblique and the largest, measured obliquely, is over 10 millimeters in diameter. No surface characters are shown, and the whorls may have been marked by the sigmoidal lirae of *Loxonema* or, on the other hand, by revolving lirae, as in the genera *Cyclonema* and *Aclisina*.

Orthoceras sp.

This type, which is represented by a single very poor specimen, deserves only passing notice. The upper end probably shows part of the chamber of habitation; the lower end is apparently divided into shallow chambers. The partitions are represented on the macerated and flattened specimen by grooves, so as to create a certain resemblance to the genus *Cycloceras*, although the features are really reversed, the constrictions being narrow and the annulations broad. About five chambers occur to the diameter, which was about 7 millimeters where the measurement was made, but the specimen appears to have been compressed in the direction of its axis, this process shortening its length and producing irregular transverse wrinkles. The original dimensions, therefore, were probably somewhat different.

REGISTER OF LOCALITIES

3547. Pocono formation. In cut of the Huntingdon & Broad Top Mountain Railroad, on the west side of Shoups Run, 1½ miles southeast of Saxton, Pa.

3548. Pocono formation. In cut of Huntingdon & Broad Top Mountain Railroad, east side of Raystown branch of Juniata River, about 2½ miles north of Riddlesburg, Pa.

3549. Pocono formation. Great Trough Creek Gap in Terrace Mountain, 4 miles east of Marklesburg, Pa.

5438. Pocono formation. South end of Sideling Hill tunnel of East Broad Top Railroad, Huntingdon County, Pa.

PLATES 22–23

PLATE 22

Page

FIGURES 1, 2. *Scaphiocrinus kirkianus* Girty, n. sp 112

1. Squeeze made from an impression in shale. Station 3547.
2. Squeeze made from the counterpart of the same impression.

FIGURES 3–15. *Lingulidiscina newberryi* Hall? 113

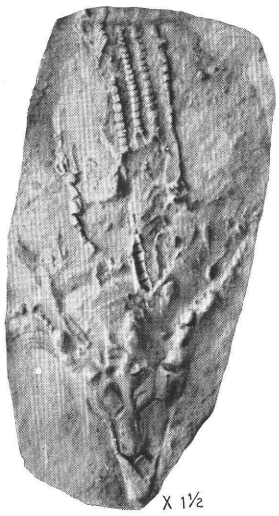
3, 4. Two views of a small brachial valve somewhat compressed and considerably exfoliated. Station 3547.
5, 6. Two views of a small brachial valve which probably retains much of its original shape. Station 3547.
7, 8. Two views of an internal mold of a crushed specimen. Station 3547.
9. Impression of a pedicle valve. The concentric lamellae which are well shown, stand at somewhat wider intervals than in typical specimens. The pedicle scar apparently occurs at the break that passes inward from the lower left-hand margin. Station 3548.
10. A pedicle valve, crushed and exfoliated. Station 3547.
11. Another pedicle valve compressed in the opposite direction. Station 3547.
12, 13. Two views of a large brachial valve, distorted and exfoliated. Station 3547.
14, 15. Two views of an exfoliated brachial valve. It appears to have been compressed vertically so that the original outline is unchanged, but the height is reduced. Station 3547.

FIGURES 16–23. *Rhipidomella huntingdonensis* Girty, n. sp 115

16. Impression of a pedicle valve showing the large flabelliform diductor scars surrounding the small cordate adductors Station 3549.
17. Internal mold of a brachial valve, distorted by pressure. Station 3547.
18. A pedicle valve retaining the shell but somewhat crushed. Station 3549.
19. Dorsal view of a large specimen retaining both valves. Station 3549.
20, 21. Dorsal and ventral views of a specimen in which the two valves are retained pressed together. Station 3549.
22. Part of an external mold showing minute surface characters. The small elevations are the plugs of matrix that filled the tubules or "spines," which are not to be confused with the finely punctate shell structure. It has not been practicable to represent these plugs in the drawing in quite the number and diversity of the original. Station 3549.
23. Internal mold of a brachial valve showing some details of structure, ×2. Station 3548.

FIGURES 24–28. *Schuchertella chemungensis* Conrad 116

24–26. Three views of an internal mold of a pedicle valve. Station 3547.
27. Internal mold of a small pedicle valve which has an uncommonly high cardinal area strongly inclined backward. This configuration is probably in large part original. Station 3549.
28. Impression of a brachial valve. Station 3547.



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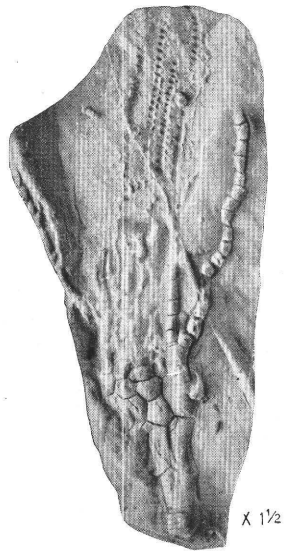

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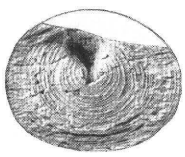

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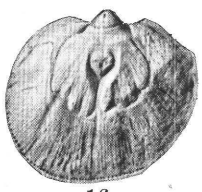

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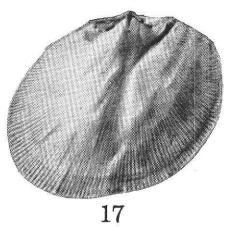

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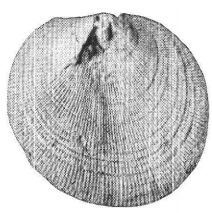

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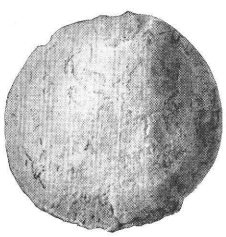

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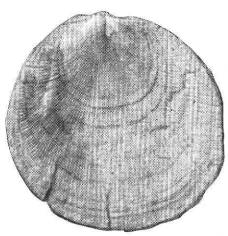

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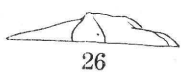

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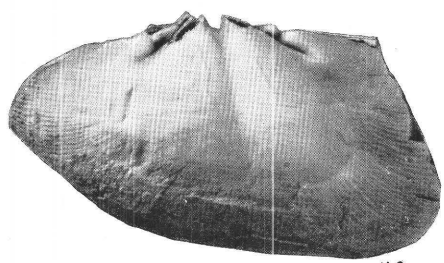

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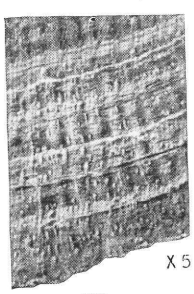

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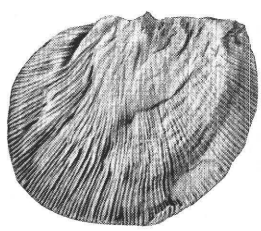

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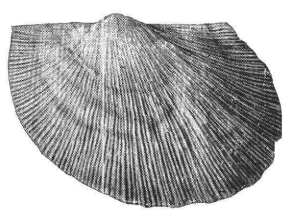

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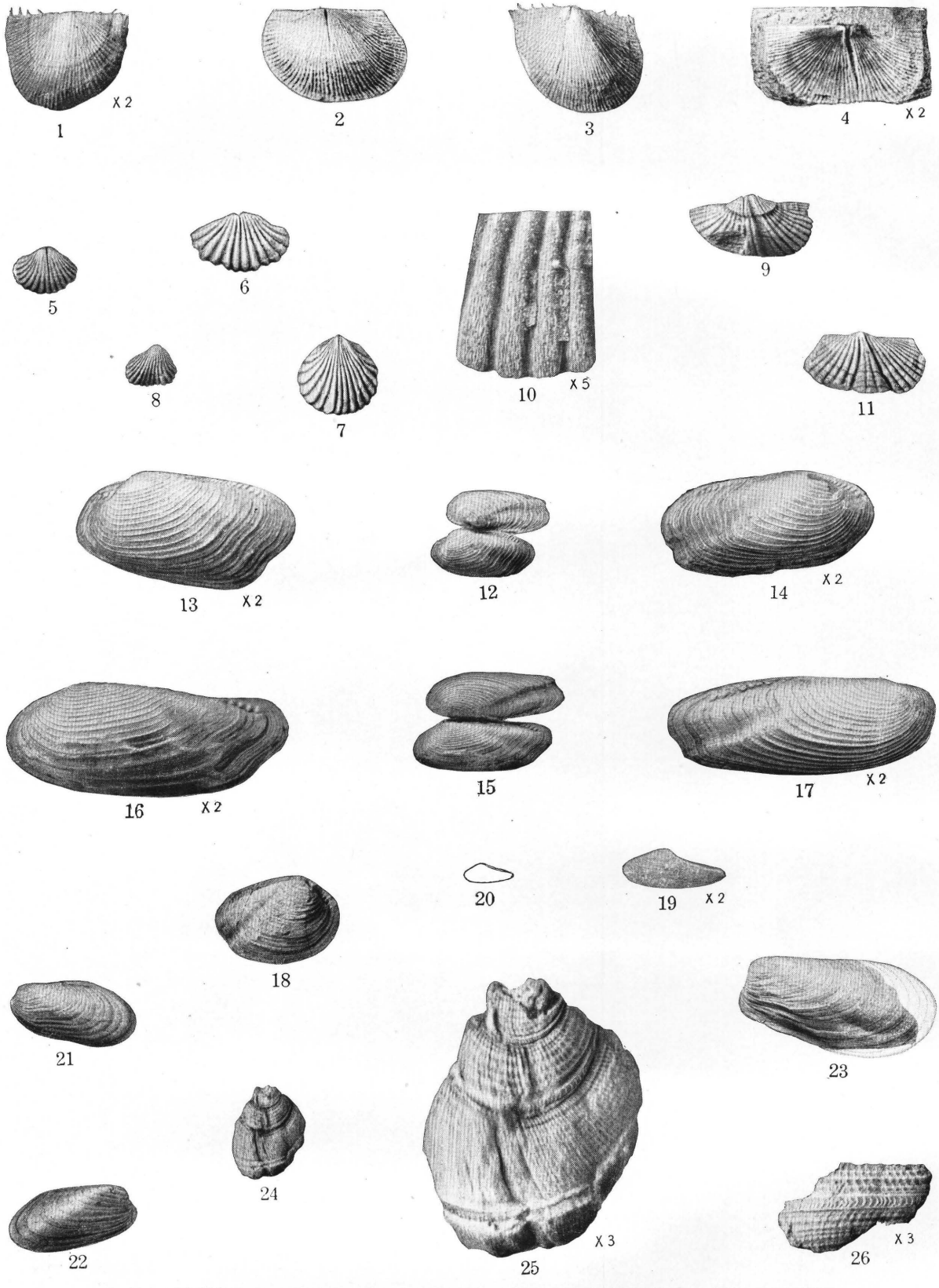
FOSSILS FROM THE POCONO FORMATION OF THE BROAD TOP COAL FIELD, PENNSYLVANIA



FOSSILS FROM THE POCONO FORMATION OF THE BROAD TOP COAL FIELD, PENNSYLVANIA

PLATE 23