

NEW GENERA AND SPECIES OF CARBONIFEROUS FOSSILS
FROM THE FAYETTEVILLE SHALE OF ARKANSAS¹

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The Fayetteville shale is named from its occurrence about Fayetteville in northwestern Arkansas. Its character and distribution in this region are described in detail in the Fayetteville folio,² and only a brief summary will be given here. It is a black, fissile shale containing beds of sandstone and thin limestone, and, in the southeastern part of the Fayetteville quadrangle, it attains a thickness of 200 feet, owing to the development of a sandstone member in its middle portion. The shale rests either directly on the eroded surface of the Boone formation or on some sandy strata of sporadic occurrence which have been correlated with the Batesville sandstone.

The more or less impure limestones of the Fayetteville contain abundant fossils. A rather persistent calcareous bed at the very base of the formation has furnished the new species described below, except for a very few which came from a locality in the Batesville sandstone near the town of Fayetteville. This collection from the Batesville shows, as would be expected, a close relationship with the fauna whose horizon is just above. Geographically, most of the collections studied came from the Fayetteville quadrangle, but a few were obtained beyond its borders, where the typical character and relationship of the formations are maintained.

The Fayetteville shale has usually been referred to the horizon of the St. Louis limestone. A discussion of this point is deferred until the entire fauna of the Fayetteville has been studied.

Michelinia meekana sp. nov.

Zoarium lenticular, attaining a large size, about 85 mm. in diameter and 45 mm. in thickness, more or less. Upper surface irregular. Corallites very variable in size: the large ones reach a diameter of 7 mm., but very few are of this size. The rudimentary septa consist of fine ridges, more distinct in

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² U. S. Geol. Survey, Folio 119. 1905.

some specimens than in others, and are very numerous. They are so fine and obscure that no satisfactory count can be made in the material available. Mural pores apparently are small and regularly disposed. They seem to occur in longitudinal rows near the angles of the cells. Tabulae very closely arranged and irregular. In some instances, they are one fifth to one eighth of a cell diameter apart and seem to extend completely across in parallel plates. In other instances, they are somewhat farther apart, oblique and vesicular. Walls moderately thick.

Menophyllum excavatum var. *arkansanum* var. nov.

Corallum rather small, conical, showing much variation in the rapidity of enlargement and in the amount of curvature. Exterior marked by the usual longitudinal striation, the striae being rather numerous and closely arranged but not very strong. Calice deep. Septa at maturity about 28, fewer, of course, in the earlier stages. Secondary septa present only toward the upper limit of the theca where they appear merely as slightly elevated ridges. Septa and walls much thickened by stereoplasma, so that the interseptal loculi are nearly closed. The three fossulae are often clearly distinguishable, especially in the more mature part of the corallum. Interseptal tissue practically absent, rarely developed about the margins of the calicinal portion.

Palæacis carinata sp. nov.

Corallum much compressed, having flattened sides, narrowly rounded ends and carinated lower portion. The height is less than the breadth, and the ends are considerably lower than the middle. The cell-like cavities in the specimens examined open onto the upper surface. They are few in number, only four or five, and very shallow. The walls which separate them are low and moderately thin. Fine and strong lines cross the external surface. The fine are slightly narrower than the striae and begin near the point of attachment as tubercles, which arrange themselves in rows and become connected into continuous linear elevations.

Fistulipora excellens var. *harrisonensis* var. nov.

Under the present title I am including this zoonid characterized tangentially by the very rather large, closely arranged zoecia with a distinct lunarium. The zoecia average about .28 mm. in diameter, have a well developed lunarium and a conspicuously petaloid shape. They are sometimes in contact, but usually are separated by narrow intervals of about one half their own diameter, occupied by single rows of cells. In or near macular areas, they stand about their own diameter apart and are separated by two rows of cells. When closely arranged, 5 zoecia come in a distance of 2 mm.

In vertical section the zoecia are seen to have between them single columns of subquadrate mesopores, while the diaphragms are rather abundant though verucle standing at about a tube diameter apart.

Fistulipora excellens var. *williamsi* var. nov.

The zoecia occur as thin sheets 1 mm. or less in thickness and of irregular shape. The zoecia are small, about .21 mm. in diameter, with strongly

marked lunarium. They are separated by one or two rows of mesopores and stand at one half or one diameter apart, coming about 5 or more in 2 mm. In longitudinal section, the mesopores are seen to occur in one or more tiers, and the zoecia develop few or no diaphragms.

This form is more closely related to the variety *harrisonensis* than to typical *excellentis*, but it has smaller zoecia which are rather more distantly arranged (since none are in contact) and fewer diaphragms.

Batostomella anomala sp. n.

Zoarium consisting of slender cylindrical branches about 2 mm. in diameter. Cortical zone sharply defined but very narrow, about .25 mm. wide. Zoecial tubes very long and slightly oblique in the median portion of the stem, near the outer end abruptly bent outward to a direction perpendicular to the surface. Where the direction is longitudinal the zoecial walls are thin; where radial, strongly and abruptly thickened. The thickening sometimes has the appearance of two partly fused beads, more often it has only an oval shape without trace of beaklike structure. Occasional slight swellings occur at other points in the wall. Apertures rounded, usually elongated, separated by walls equal to or greater than their own diameter, the longitudinal distance being often a little greater than the lateral. Owing to the thickness of the wall, the diameter of the apertures is unusually small, about 5 cells occur in 2 mm. when they are end to end, and about 7 when they are side by side. Large ananthopores occur at the corners of the cells, but, owing to the thickness of the walls, they do not encroach upon them. There is also developed near the surface a row of small granules through the middle of most of the walls, possibly through all. Mesopores are rare, possibly absent altogether. Diaphragms are also rare, 1 or 2 near the aperture, so many of the zoecia seem of them distinctly perforated.

Batostomella parvula sp. n.

Zoarium in the form of slender, solid branches having a diameter of 2 mm. more or less. Branching irregular, three or four branches being occasionally given off at a time, in which case the stem is very much enlarged, often broadened and relatively compressed. Zoecia thin-walled and longitudinal in the middle of the stem, thick-walled in the aperture zone, which is very narrow. They meet the surface obliquely, or with a very short horizontal portion. The apertures are more or less elliptical to subpolygonal, elongated in the longitudinal direction, of the branch, separated by intervals of about one half their own width, but showing extreme variation. Six or 7 occur in 2 mm. longitudinally, none transversely, although, as the average branch has a diameter of about 2 mm., the number is not readily ascertained in those terms.

Mesopores rather rare, irregularly distributed, but usually apparently absent, in others occurring in groups of two or more. Ananthopores numerous and large, occurring to the angle of the cells, most of the angles being furnished with them. Owing to the thickened walls, the zoecia have a rounded shape, and the ananthopores imbedded in the wall do not indent

them. Where the walls are especially thick, and possibly where thin, there are additional small spines or granules in single rows. Therefore tangential sections vary considerably in appearance. In some, mesopores are rare, in others, abundant; in some again, only the large acanthopores at the cell angles can be made out, while in others, there are smaller spines in addition in varying numbers.

It may be that two distinct types have been confused under this title, but, from the study of weathered specimens, such is thought not to be the case. As a rule, however, only the larger spines are seen on weathered surfaces. Owing to the thinness of the mature portion, the irregularity of growth and the character of fossilization, it has been found extremely difficult to secure satisfactory tangential sections, even such as are correctly oriented being more or less altered and obscured as to structure. The thickening of the walls is not as a rule periodic, but is restricted to the superficial portion. Rare instances of thickening can elsewhere be noticed. The remainder of the walls is probably very thin, but its character is largely obscured in all material by alteration or by secondary deposits. There is occasional evidence, however, of appreciable deposits which are intrinsic, although not at all moniliform. Diaphragms are developed at rare intervals, more commonly near the surface. In so far as my observations extend, they do not show the characteristic perforations of *Stenopora*.

Batostomella? armata sp. nov.

Zoerium ramose, slender, about 4 mm. in diameter, bifurcating or laterally branched. Zoecia longitudinal in the central part, gradually sloping outward, then more abruptly until for a short distance, a radial direction is assumed. Zoecia rounded owing to the thick walls, 6 or 7 in 2 mm. Walls much thickened for a short distance near the surface, either strongly moniliform or fused into a continuous mass. Mesopores (young cells?) rather abundant. Acanthopores numerous and very large, occurring in most of the angles.

In tangential section, the walls appear to be greatly thickened in some areas and much thinner in others. The zoecia are completely rounded or subangular according to the degree of development of this feature. The large acanthopores are imbedded in the thick walls but indent the cells where the walls are thinner. Where the walls are thick, a row of large granules occupies the median line; where thin, the granules are wanting, but a strong, continuous line appears. Diaphragms are developed to a limited extent and chiefly in the cortical zone. Their distribution is rather scattering and far apart, slightly more than one diameter on an average, but varying from about two thirds to nearly 2. Maculae probably present and indicated in thin sections by groups of not conspicuously larger cells, possibly also by the varying thickness of the walls.

Dyscritella subgen. nov.

The two species included in this group are ramose with well-differentiated and rather thick, mature zones. Zoecia, mesopores and acanthopores are all present. The zoecia are rounded in section, circular or oval. Mesopores are fairly numerous, rather more numerous than in typical *Batostomella* and much less numerous than in typical *Lioclema*. The acanthopores are also fairly numerous and in both species of two different sizes. In typical *Batostomella*, the acanthopores are much more numerous and all small. In typical *Lioclema*, the acanthopores are perhaps not quite so numerous and all large. Tabulae appear to be entirely lacking in both mesopores and zoecia. In typical *Lioclema*, tabulae are abundant in the mesopores and rather rare in the zoecia. In *Batostomella*, the diaphragms are remote, delicate and originally perforated. The mesopores are open as in *Batostomella* but closed as in the typical section of *Lioclema*.

On the whole, perhaps, these species are more closely allied to *Batostomella* than to *Lioclema*, but they can hardly be included under either genus without introducing anomalous features.

TYPE.—*Dyscritella robusta*.

Dyscritella robusta sp. nov.

Zoarium consisting of solid cylindrical stems having a diameter of about 8 mm. The stems increase, according to the only specimen examined, by lateral branching, the branches making an angle of about 45° with the main stem. Zoecia are longitudinal in the axial region, those nearer the side leaning slightly outward. By a rather abrupt turn, they assume a radial direction, and at the same time their walls are thickened, and mesopores and acanthopores are introduced. The mature zone occupies one fourth of the width at either end of the axis.

The apertures are small, circular to oval, from 0.83 to .11 mm. in diameter. Mesopores are fairly numerous, varying in number and circular in shape. Rather extensive aggregations of these cells make large maculae, but for the most part, they occur in single rows between the zoecia, or in groups of two or more in the angles between several of the tubes. Occasionally the zoecia are in juxtaposition without any mesopores intervening. As many as 10 or 11 of the zoecia occur in 2 mm. (though straight rows of that length are hard to find), where the mesopores are in normal abundance. In or near a macula, the number is of course much less. The walls are thick, varying from one half the diameter of a zoecium to twice the diameter. Acanthopores are abundant and of two orders, differing greatly in size. The larger ones are extremely large and rather scantily developed, two to four near each zoecium. The smaller acanthopores are very unequally distributed, being rare in some areas and abundant in others. Tabulae seem to be entirely absent from both mesopores and zoecia. The mesopores, however, are hardly discernible in longitudinal or transverse sections, and may be tabulated.

Dyscritella inæqualis sp. nov.

Zoarium ramose, branching freely at intervals of about 16 mm. Branches slender 4 mm. in diameter. Cortical zone well defined, 5 mm. or less in thickness. Zooecia thin walled and longitudinal in the median portion of the stem, rather abruptly changing to a radial direction in the cortical zone, where the walls are considerably thickened. Apertures oval to circular and arranged with some regularity, usually 8 in 2 mm., probably more when the oval apertures are measured in lines passing through their short diameters. The apertures seldom exceed 14 mm. in diameter. Mesopores fairly numerous, of varying size, much smaller than the zooecia, between which they occur as a rule in single rows. Occasionally, however, the zooecia have no mesopores between them (laterally), and occasionally the mesopores are grouped in more than single rows. Acanthopores are fairly abundant and of two sizes, the larger ones perhaps the more numerous. Three or four of the larger and one or two of the smaller occur around each zooecium. The walls are rather thick, their diameter being usually equal to or greater than the short diameter of the mesopores, which are apt to be elongated. They are sufficiently thick so that the larger acanthopores, which are very large, do not indent the walls. Tubule appear to be entirely lacking in both zooecia and mesopores.

Stenopora perattenuata sp. nov.

Zoarium in the form of thin expansions having a discoidal or infundibuliform shape, more or less contorted. Lower surface with a concentrically wrinkled epitheca. The size is large for the thickness, which only measures one half to 1 mm., while the diameter may be 50 mm. or more.

In some sections the zooecia appear to rise directly from the epitheca, but others show that there is a brief prostrate portion. The zooecia are rather regular so that a hexagonal shape and a linear arrangement are locally somewhat conspicuous. In size, they vary, and it is possible that there are maculae of larger cells. Owing to the tendency noted above as to shape and arrangement and the fact that the hexagons are apt to be wider than long, as many as 8 may be counted in 2 mm., when measured through a short diameter, but ordinarily only 6. The zooecial walls are moderately and regularly thickened, but not regularized. A more or less obscure median line, lighter than the rest, can be made out. Diaphragms are irregularly developed, in some cells none at all, in others one or two. Acanthopores and mesopores appear to be altogether absent.

The structure of the *zoarium*, the apparent absence of acanthopores, and the non-articulated condition of the walls distinguish this form from other species of *Stenopora*. In fact, in a general way it is suggestive of *Protobella*, but it fails to show the peculiar characters of that genus.

Stenopora longicamerata sp. nov.

Zoarium apparently massive, hemispherical. The present material consists of a single specimen having an irregularly conical shape. The longest diam-

eter of the upper side is 28 μ m. and the height 22 μ m. (perhaps 30 μ m., when complete). It does not consist of superposed layers, but the cells are continuous and consequently 20 μ m. long or more. They are very irregular in size. Some of the smaller ones are suggestive of mesopores, but may be merely immature cells, the introduction of which was necessitated by the radiating direction of the zoecial structure. There is no conspicuous arrangement into maculae, the very largest and the very smallest being contiguous in many cases. To a certain extent, however, the smaller cells are grouped together (interspersed with others), but there are considerable spaces without them. Even if the very small cells are avoided, the number varies considerably. When a row of large ones is brought under the microscope, a little over 5 occur in 2 mm., while as many as 7 of the smaller or 6 to 6½ of the medium size occur in the same distance. The large ones vary from 28 to 45 μ m. in diameter.

The walls are somewhat thickened. In some instances, the median line can be seen, but it is not conspicuous. The acanthopores are small and may be readily overlooked. They do not indent the cells, being determined chiefly by a densification of the material at the junction of the walls. In longitudinal section, the characteristic angular thickenings are almost absent. The diaphragms are situated at irregular, usually long intervals, seldom as close together as the diameter of the cell, sometimes three or even four diameters apart. The maximum interval observed is about 1.5 mm. The diaphragms occur throughout the length of the tubes examined. Their characteristic perforations are clearly shown in many instances.

Stenopora emaciata = *inæqualis* (Girty)

Typical *Stenopora linearis cuta* is based on a form which grows in hemispherical masses and has long zoecial tubes intersected by relatively few diaphragms. Another and much more abundant type occurs in the collection which resembles *laqueamarata* in most of its microscopic characters, but differs in having an explanate node of growth. The thin sheets, which seldom have a thickness of more than 1 mm., are much contorted, in some cases bending around completely so that the edges are confluent and hollow cylinders are formed. The cell walls are thin, with only occasionally a beadlike swelling. Transverse sections show thick as well as thin-walled areas, the thickened walls being probably where the section passes through these swellings. The acanthopores are small and the diaphragms relatively distant.

Stenopora emaciata = *arkansana*

Zoarium consisting of lamellae, 1-2 mm. across, covered by the walls of a wrinkled epithem. The expansions seem to range to 20 μ m. in thickness, but are usually less than 10 μ m. and in many cases much less. Relatively massive bodies are formed by the apposition of successive layers, which are irregular in thickness and in shape, being often much contorted.

Zoecia rather large, very variable in size, aggregations of larger ones forming maculae. The maximum diameter of very large cells is 7 mm., but as a rule, the larger ones are not over 50 μ m. in diameter and the smaller 25 μ m. (even 20 μ m. or less). Thus, about 4 of the larger ones or 5.5 to 6 or 7 of

the small ones occur in 2 mm. Mesopores rare or absent. The walls are thin and the zoecia polygonal. Acanthopores moderately large, developed at the angles of the cells which they often indent, rarely at the sides. Occasionally, a section is so directed that acanthopores seem to be almost absent. In longitudinal section, the prostrate portion is seen to be short and the rest of the zoecium long and straight. The walls are thin, with inconspicuous thickenings which are small in degree and apt to occur at long and rather irregular intervals. For this reason, the walls in cross section appear thin, the cells angular and the acanthopores projecting into them. The diaphragms are thin, often conspicuously perforated, abundant, occurring from one half to two diameters apart. The average is one diameter or less, and the longer intervals are rare, tending to occur simultaneously in several cells.

Stenopora emaciata var. *megastylus* var. nov.

Zoarium explanate, from 2 to 7 mm. thick in different parts. Lower surface covered with a wrinkled epitheca. Distinctly monticulate with large cells on the monticules. Zoecia very variable in size, 6 or 7 in 2 mm., subangular. Walls thin, with gently elongate swellings. In tangential section, thin-walled areas alternate with areas made up of cells having distinctly thicker walls. Acanthopores large, usually on the cell angles, truncating the angles or indenting the cells. Diaphragms closely arranged, from one half to one diameter apart, conspicuously perforated.

Stenopora intermittens var. *harrisonensis* var. nov.

Zoarium in the form of thin expansions less than 5 mm. in thickness. Superficial characters not known. Aggregations of larger and smaller cells rather conspicuous. About 6 occur in 2 mm. In sections transverse to the tubes, their walls show great variation in point of thickness, the thin ones being almost linear and the thick ones in extreme cases one half the diameter of the tube. The cells which are bounded by them are in the one case angular and in the other circular. The acanthopores are extremely large. Where the walls are thin, they indent the cells, although part of the wall is carried around on either side, tending to give the cells a more circular shape, but they are completely imbedded in the walls, when the latter are thick. When such is the case, there is seldom any visible median line, but there are occasional spines in addition to the true acanthopores. In longitudinal section also, two types of thickening can be noted, some of the walls being almost linear with only occasional short but not very strong swellings, while others are continuously and regularly thickened.—some very heavily so. Diaphragms are irregularly distributed, a diameter or less apart in some areas and much more than a diameter in others.

Stenopora miseri sp. nov.

Zoarium consisting of thin expansions covered below by a wrinkled epitheca. The individual sheets are apt to be contorted. They occur singly or superposed, or interlaminated with *Pistillipora excellens*. In combination, they form bodies of considerable thickness, but they are not solid, since relatively

large cavities are left between the contorted layers. The different sheets are seldom over 2 mm. thick.

The zoecial walls are much thickened, but areas in which this feature is developed occur adjacent to others in which the walls are thin. When the walls are thick, the zoecia are more or less circular; when thin, they are more or less angular. They are rather irregular in size and shape. Maculae composed of groups of larger or smaller cells seem to be present, but the difference in size is not great nor are the areas well defined so far as observed. The thickening of the walls is accomplished by means of strong swellings close together or more or less confluent. Typical acanthopores rare or possibly absent. The thickened walls, however, show a strong median line, in some sections appearing as a row of granules, often with a group of granules at the cell angles. The median line is usually observable even where the walls are thin, and it can also be made out in longitudinal sections. About 6 cells occur in 2 mm. The larger ones are from .28 to .35 mm. in diameter (measured from the median line of the thickened walls). Mesopores (young cells?) fairly abundant. Diaphragms scantily developed. In some sections, they seem to be absent; in others, one or two occur in each cell.

Stenopora miseri var. *tubulata* var. nov.

This form resembles *S. miseri* in most of its characters, differing only in the degree in which they are developed. The acanthopores are more numerous, most of the cell angles being occupied by them, but they are for the most part small, not indenting the zoecia. The thin-walled areas are more extensive than in the other. When thickened, the walls usually show a distinct median line and they are marked by fine granules, varying in quantity in different parts of the zoarium. The diaphragms are rather abundant and closely arranged, usually less than a diameter apart. Groups of large cells occur such that only five or even four are found in 2 mm.

Stenopora simulans sp. nov.

This species, in its mode of growth, is like *S. mutabilis*, forming extremely irregular bodies partly ramose, partly explanate or massive, and apparently more or less confluent. The branches are small, 5 mm. in diameter.

The walls vary from thick to thin, in some places changing rather abruptly, and while this may be due in part to the irregularity of growth, in part it must doubtless be assigned to variation at the same stage of development. The cells vary from subcircular to more or less strongly polygonal and occur about 6 in 2 mm. Mesopores are rare. Normal acanthopores (with concentric structure) appear to be absent. At the same time, the walls are beset with large acanthopore-like granules, many of which seem to have a tubular axis about which little dots of denser material are assembled. Where the walls are thick, the dots are more spread out, and where the walls are thin, they are more concentrated. Where the walls are thin, also, the granules sometimes indent the cells. Similar and not conspicuously larger granules occur at the cell angles. The granules are developed in the thin as well as

the thick walls, although they are less numerous in the former. Even where the walls are more attenuated, however, a few can occasionally be distinguished. The mature zone is long and the walls as a rule continuously thickened, though in varying degree. Here and there the characteristic moniliform structure is shown or suggested. Diaphragms are fairly abundant and very irregularly distributed, varying from one half to 2 or more diameters apart.

Stenopora mutabilis sp. nov.

Zoarium in the type specimen in form of a slender cylindrical branch a little less than 3 mm. in diameter, but assuming in other specimens a very irregular growth, partly explanate, partly more massive, very much contorted and sending up from its base short (?) branches of varying size, but probably always small, which appear to inosculate with one another and with the rest of the zoarium, when the irregular mode of growth brings them in contact.

Zoecia small, rounded, about 9 in 2 mm., varying considerably in size, but without conspicuous groups forming maculae. Walls usually thick, measuring about one half the diameter of the zoecia, thin in the central portion, but with a very long mature region. At the same time, the walls vary greatly in thickness (in tangential section) within very short distances and are in places almost linear, in which case, of course, the cells are polygonal. Owing to the very irregular, contorted growth of this form, the variation in the thickness of the walls may sometimes be due to varying distances from the immature region. The thickening of the walls is continuous and not beaded. Mesopores (young cells?) rather rare and in the preservation of my specimens difficult to distinguish from acanthopores. Acanthopores extremely large, in some cases about one half the diameter of the cells, which they strongly indent, except when the walls are thick. Diaphragms numerous and irregularly arranged, from one half to rather more than a diameter apart, somewhat faintly perforated.

Stenopora ramosa var. *fayettevillensis* var. nov.

Zoarium consisting of rather slender, solid, cylindrical stems about 5 mm. in diameter. Zoecia vertical in the median region, rather gradually bending outward to the circumference, only a short portion, however, having a radial direction. Five or 6 apertures occur in 2 mm. Mesopores moderately abundant for the genus, occurring singly or in groups, associated with cells larger than the ordinary. Zoecia and mesopores polygonal with rounded angles. Walls moderately thickened in the mature region, which is narrow, two or three times the diameter of the larger cells. The thickenings are continuous, but swollen and irregular. The division lines in the walls are well defined, in places intermittent or granulose. Acanthopores are of moderate size and abundance occupying nearly all the angles, but not indenting the zoecia. Tabulae are rather abundant in the narrow cortical zone to which they are perhaps restricted; from one half to one cell diameter or more apart.

Stenopora gracilis sp. nov.

Zoarium ramose, consisting of solid branches which have a diameter of 5 mm. or more. The zoecial tubes run lengthwise in the axial region and

bend gradually outward, meeting the surface either somewhat obliquely or with a very short radial portion. The walls are thin throughout, only slightly thickened toward the surface, the thickenings being continuous, but suggesting the moulliform structure by their irregular outlines. Mesopores appear to be few (more abundant in a second specimen than in that from which this description is drawn). Acanthopores nearly absent, but better developed in the second specimen just mentioned. Tabulae few and irregularly distributed. Walls with a fairly distinct median line where thickened. Zoecia 5 or 6 in 2 mm.

Stenopora inermis sp. nov.

Zoarium in the form of rather large, solid, clumsy branches having a diameter of 8 to 12 mm. or more. Surface marked by maculae about 5 mm. apart, often elevated into nonticles, a few of which are prominent. Zoecia thin-walled and vertical in the axial region, gradually bent outward so that the mature portion has a radial direction. Mature region not well defined, one fourth of a diameter on a side or less. Mesopores abundant for the genus, groups of them in conjunction with zoecia of unusually large size forming maculae. Five or occasionally 6 zoecia occur in 2 mm. The walls are often much thickened, but may be fairly thin, strong contrasts occurring close together in the same specimen. Acanthopores are either exceedingly rare or absent altogether. A few doubtful occurrences have been noted in tangential section, but they probably represent the starting point of one of the numerous mesopores. Tabulae appear to be absent in the mesopores, but are abundant in the mature region of the zoecia usually less than a diameter apart and showing the characteristic median perforation. The thickening of the walls is a marked feature, and it is continuous, not moulliform, though occasional suggestions of that structure are presented in sections passing lengthwise through the walls. The median line is strongly marked, in whatever way the walls are cut.

Amphiporella gen. nov.

The term *Amphiporella* is introduced for a type of bryozoan which is related to *Stenopora* and others of the Batostomellidae, to which family it obviously belongs, but differs therefrom in growing in large, tortuous, bifoliated fronds. The Batostomellidae have been described as never bifoliate, and the present type is only bifoliated in a sense. It has a median immature region from which the cells bend outward in two opposite directions and open on surfaces which are relatively parallel to one another, but it does not consist of two colonies growing back to back, and consequently there is no median plate. This growth can therefore be considered as consisting of branches which are greatly expanded laterally, rather than as exemplifying the typical bifoliate structure. Acanthopores are fairly abundant and of very large size in the type species. Mesopores are also fairly abundant and are apt to be grouped together in maculae associated with large zoecia. Their distribution is irregular.

Diaphragms are of the typical perforated sort and are abundant. The cell walls are thickened and strongly moniliform in the mature region.

This type probably begins as a basal expansion of considerable extent and thickness, covered underneath by a wrinkled epitheca, and from this expansion the fronds or flattened branches spring. Organisms having such an expanded growth, but otherwise having all the characteristics of the bifoliate fronds, occur associated with them. *Amphiporella* differs from all the members of the Batostomellidæ in its mode of growth, but seems to be especially related to *Stenopora*. This is shown by the annular thickenings of the walls. It differs in the abundant development of mesopores, the grouping of which is also a peculiar character.

TYPE.—*Amphiporella maculosa*.

Amphiporella maculosa sp. nov.

Zoarium large, consisting of a basal expansion, sending off extensive tortuous bifoliate fronds. The latter seem seldom to exceed 7 mm. in transverse diameter, but may be 80 mm. or perhaps very much more in length. The cell walls are thin in the immature region, which occupies from one fourth to one third the thickness of the frond. In the mature region, the cells are nearly straight and perpendicular to the outer surfaces. Their walls are thick, showing, however, great variability. That is, in tangential sections parallel to the surface, some of the walls are rather thin and others are much thickened. Of course, where the walls are thick, the cells are subcircular and where thinner, proportionately angular. Mesopores are rather abundant, and their distribution is irregular. Occasionally 6 or 8 or more occur together, making a noticeable macula, but usually they are distributed in twos or threes, though considerable areas can be observed in which none are developed at all. The zoecia vary considerably in size, the larger ones usually occurring where the mesopores are most abundant. The macule caused by the groups of mesopores are, however, a much more striking feature than the congeries of cells of larger size. Usually 6 or 7 zoecia occur in a distance of 2 mm.; when unusually large, 5; or when unusually small, 8, the measurements being made where mesopores do not interfere.

The walls are generally divided by a distinct median line of darker color than the rest, and in one or two cases where the walls are especially thick, the slender, solid line appears broken up into a broader band of granules. Acanthopores are numerous and very large. They usually occur at the angles, but occasionally on the sides of the cells, and not all the angles are occupied. Where the walls are thick, the acanthopores do not greatly indent the cells, but where the walls are thin, they do indent them, especially when of large size. When the cells are cut longitudinally, the walls have the characteristic swellings conspicuously developed. They are large, abrupt and closely, though somewhat irregularly, arranged. In this view, also, the walls sometimes show fine, transverse bands of lighter and darker color, as if they were originally composed of alternating layers of varying density. The mesopores appear not to be tabulated, except perhaps very rarely. In the zoecial tubes, the

tabulæ are numerous, usually about a diameter apart, occasionally somewhat less, more often somewhat more, rarely two diameters. They are centrally perforated after the manner characteristic of this group.

To this species I have also referred some specimens which occur associated with the types and agree with them in microscopic peculiarities, but differ in being uniserial expansions, one side of which is covered by an epitheca (?). The growth is very irregular and attains a thickness of 15 mm. or more, appearing to consist of several successive layers in some cases. Sections through such specimens transverse to the zoecia show the rather characteristic groups of mesopores with extra large zoecia associated with them. The walls manifest great diversity in thickness, being exceedingly thin in some areas and much thickened in others nearby. Acanthopores are somewhat sparsely developed, but are very large, strongly indenting the chambers when the walls are not too thick. In some cases, where the thickness is very great, there seem to be a number of granules distributed along the median line instead of one large acanthopore situated at the angle. Sections cutting the walls longitudinally show them to be thickened in the mature region and annulated, the annulations being strong, abrupt and frequent. The diaphragms are rather closely arranged, a diameter or less apart, but, in the younger region and also near the outer surface, occasionally much more. The early prostrate portion appears to be, in some cases at least, very long and very slender. Owing to irregularities of growth, such areas of slender, non-tabulated cells occasionally recur in the midst of the more mature conditions. In some cases, if not all, the zoecia, after they leave the prostrate position and are of more nearly mature size, are thin-walled and non-tabulate for a longer or shorter distance, after which the annulations and tabulæ begin to appear. In the explanate specimens, the tabulæ are sometimes quite closely arranged over considerable areas, one half a cell diameter apart, more or less.

Cæloclemis subgen. nov.

Of this variety of structure, only one species is known and it is therefore taken as the type. It comprises small, irregular, hollow, dichotomous branches lined with an epitheca. The zoecia are naturally short, as the central cavity of the branches is large and the bounding zoarium thin. They are prostrate and thin-walled in the immature portion, erect and thick-walled in the mature. The amount of thickening varies much from point to point, and it is regular and not moniliform. Maculae and monticules are present, but are neither well marked, abundant nor regularly arranged. Tabulæ may be present (in the prostrate portion) but

they are rare. Acanthopores are large and moderately numerous. Mesopores absent.

This type belongs without much question to the Batostomellidae but can not be placed in any of the groups there recognized as at present defined. The mode of growth is that of *Anisotrypa*, but the structure is otherwise different. The structure is that of some not quite typical species of *Stenopora* (not typical because of the rarity of the diaphragms and the continuous or fused thickening of the mature wall), but the mode of growth is distinct from that of *Stenopora*.

To some extent, the mode of growth seen in this group appears generally to be regarded as a generic character, and probably the present type can with propriety be assigned to subgeneric rank on that account.

TYPE: *Cœloclemis tumida*.

Cœloclemis tumida sp. nov.

Zoarium consisting of hollow stems lined with an epitheca; irregularly branched and with swollen portions, monticules (?), etc. Cross sections generally circular, just preceding bifurcation, compressed. The largest diameter observed is 9 mm., but the average is about 5 mm., while the smallest noted is 3 mm. The thickness of the wall, that is the thickness of the zoarium, is from .5 to 1 mm. or more.

The zooecia appear to have a rather long prostrate portion from which they bend outward strongly to a radial direction. The presence of tabulae has not been definitely determined. If developed at all, they appear to be rare and restricted to the prostrate portion. The walls are as usual thin in the immature zone. At the surface they vary—certain areas being thin and others thick-walled. The thick-walled areas are sometimes, though not always, associated with prominences (monticules). The zooecia vary in size, there being occasional groups of large cells, though there are considerable areas upon which the cells appear to be undifferentiated in that way. The apertures are angular, with rounded corners where the walls are thick. Five or 6 occur in 2 mm. Acanthopores are fairly abundant, situated at the angles where developed, but not all the angles are filled. Where the walls are thin, the acanthopores indent the cells; otherwise they are imbedded in the walls without deforming the zooecia. In addition to the large acanthopores, the walls where thickened have many small spinules distributed through them. Though especially abundant there, these are not restricted to the median line, which is well defined by a continuous dark band. The median line is also shown when the walls are quite thin. When cut lengthwise, the walls are thin in the immature and usually much thickened in the mature region. This thickening begins abruptly and is continuous.

Pycnopora subgen. nov.

This name is introduced in a subgeneric sense for a bryozoan type whose affinities are clearly close with *Lioclema*. The type species grows

in a thin lamellar expansion, a type of growth also possessed by another species which can with propriety be placed here (*Liolema? avanicum* Ulrich). It has rather numerous mesopores and rather rare and small acanthopores. Diaphragms are fairly abundant in the zoecia, and they are centrally perforated. The walls are thickened in the mature region. All these characters belong also to *Liolema*, from which the present type is distinguished by the degree of their development. It differs from *Liolema* in the greatly reduced number of mesopores and the much smaller acanthopores. The difference is so marked as to deserve separation into a distinct group, probably of subgeneric importance.

TYPE. *Pycnopora canaliculata*

Pycnopora regularis sp. nov.

Zoarium consisting of a thin expansion, one side of which is covered with a wrinkled epithea. Thickness .5 to 1 mm. Zoecia circular, usually in contact, the interspaces occupied by mesopores, generally 2 or 3 in a group. Eight zoecia occur in 2 mm. The walls of the mesopores are of equal size with those of the zoecia, and the mesopores are often not distinctly angular. Acanthopores are rare and small and imbedded in the rather thick walls so that they do not indent the cells. The zoecia vary considerably in size, and there are maculae at rather wide intervals formed by groups of mesopores of various sizes with which are usually associated a few large zoecia. The average diameter of the apertures is 17 mm, but the larger ones measure 22 mm. The tubes are prostrate for a short distance, later becoming erect and the walls are somewhat obscurely moniliform. Tabulae are fairly abundant, considering the length of the cells, and they are in many cases incomplete when seen in longitudinal section, owing to the central perforation. They seem to be restricted to the zoecia, none having been observed in the mesopores.

Pycnopora bella sp. nov.

Zoarium in the form of a thin extension. The zoecia are at first slender and prostrate for a considerable distance, later erect. Near the surface, the walls are somewhat thickened and the apertures are rounded. The apertures occur about 8 in 2 mm. They have a diameter of 17 to 21 mm, the average being nearer the smaller size. In spite of the rather thin walls, the zoecia are usually but obscurely polygonal owing to occasional mesopores and the numerous acanthopores. Mesopores are scantily developed and small, more abundant on some areas than on others. Acanthopores are rather abundant and rather large, more or less strongly indenting the cells. They are strikingly tubulate. In addition to the acanthopores, the walls in some cases have small granules along their margins. Diaphragms are rare and appear to be restricted to the prostrate portion of the zoecia.

This form resembles *P. hirsuta*, from which it is distinguished by its larger and less numerous acanthopores and thinner walls.

Pycnopora hirsuta sp. nov.

Zoarium in the form of a very thin expansion. Thickness .14 mm.

Zoëcia prostrate and thin-walled below for a short distance, thick-walled and erect at the surface. The apertures are rounded, more or less elongated, rather regularly arranged in quincunx, about 7 or 8 in 2 mm. (7 in the direction of their longitudinal diameters). They are about .21 mm. long and from .11 to .14 mm. wide. The mesopores are small, rounded, distributed one or two at a time in the angles between the zoëcia. Walls thick, the intervals between the zoëcia being from one fourth to one half the shorter axis of the latter or about as thick as the average mesopore. Acanthopores very numerous, imbedded in the walls, occasionally indenting the cells, to which they then give an irregular and undulating outline, medium-sized to large, often 10 or 12 around a zoëcium. In some areas, the acanthopores are much larger than in others, and I believe that this is not due to distance from the surface. Tubulae very rare in the zoëcia and absent from the mesopores.

Stenocladia subgen. nov.

Zoarium in the form of bifoliate fronds which branch and perhaps inoscullate. A median plate is probably lacking. In no instance can the presence of such a structure be demonstrated, and usually there is no trace that could be so construed.

Zoëcia elongated, slender and longitudinal in the median portion of the frond; considerably larger and perpendicular to the surface at maturity. The walls are thin in the immature zone, thickened near the surface. Mesopores fairly abundant, variable in distribution, occasionally forming large groups or maculae. Acanthopores moderately abundant, small, not greatly indenting the cells. Zoëcia and mesopores thin-walled and angular to near the surface, where the deposit of sclerenchyma closes the mesopores completely or in large part and gives the zoëcia a circular or oval shape at the same time diminishing their caliber. The acanthopores also are metamorphosed nor do they project as spines. The walls at the surface appear to be marked by granular dots of several sizes, the larger ones distributed down the center of the walls, the smaller ones more marginal. The acanthopores have conspicuous tubular axes which proceed in straight lines to the surface. In addition to these structures, the walls in sections at right angles to the surface show many fiber-like lines of denser material which appear to curve and divide, seldom being normal to the surface. There are thus three fairly distinct zones on each side: an axial zone, a superficial zone in which all the structures are modified by sclerenchyma and an intermediate zone in which the zoëcia, acanthopores and mesopores have their more usual characters.

TYPE.—*Stenocladia frondosa*.

Although presenting many analogies to the type of structure which I have included under *Diaclema*, it seems probable that this must be regarded as having widely different affinities. The most marked resemblances are found in the wall structure, with its inosculating fibers and granulose, strikingly tubulated acanthopores. On the other hand, we

have the mode of growth, bifoliate in the present type and ramose in *Idioclema*, the entire absence of any structures resembling the hemisepta seen in the latter, and the presence of a stage with numerous angular mesopores and normal acanthopores which is not found in *Idioclema*.

On the whole, and chiefly because of the stage with distinct angular mesopores and normal acanthopores, I am including this form as a subgenus under *Lioclema* in which a group of species is also known having a superficial sclerenchymatose deposit. In some respects, this form suggests *Intrapora* (cf. *I. basalis*) and some analogies can be drawn, but the absence of hemisepta in the present form and of acanthopores in *Intrapora* seems to show widely different affinities.

***Stenocladia frondosa* sp. nov.**

Zoarium in the form of rather extensive though thin bifoliate fronds which are considerably flexed or distorted and which divide and perhaps anastomose, being considerably thickened at such points. Normal thickness .5 mm. to 2 mm.

Zoecia small, longitudinal and thin-walled in the median portion of the frond, considerably expanded toward the surface, near which they are directed outward and have thick walls. The apertures are rounded and generally somewhat elongated, .17 to .2 mm. in longest diameter. Eight or 9 apertures occur in 2 mm. and they are separated by about one half their own diameter. Cortical and mesial zones sharply and strongly marked. The cells are oblique and the walls thin in the mesial portion; the cells perpendicular to the surface and the walls thick in the cortical portion, the changes being effected very abruptly. The mature zone is of varying length in different specimens, relatively narrower in the narrower specimens, ranging from about one third to one sixth of the width on each side. Acanthopores and mesopores are present in abundance, but they are obscured near the surface by a deposit of sclerenchyma, so that sections present remarkably different aspects, according as they pass through different levels. Apparently in the young part of the mature zone, the mesopores are numerous and rather large, very variable in numbers in different areas of the zoarium. They form rather extensive aggregations or maculae in some areas. In others the zoecia are in contact, with the mesopores distributed in groups of two or three, while in still others the zoecia are separated by single rows of mesopores. Acanthopores are fairly numerous and small, but nevertheless they indent the cells more or less by reason of the extreme thinness of the walls. Diaphragms are very rare and appear to be non-perforated. They are confined to the zoecia. At the surface, the mesopores are closed by a deposit of sclerenchyma, and the acanthopores also seem to be modified to some extent. The surface namely appears to be without spines and often without mesopores, though, when slightly weathered, and perhaps here and there when not, the mesopores are clearly to be seen in varying numbers as described above. When the mesopores are not visible, the interspaces between the zoecia appear to be thick and structureless. Thin sections just at the surface show few, if any, mesopores. Acanthopores are numerous. Whereas below the surface they appear as small

dense bodies having, however, a tubular axis, in the thickened mature portion they are much larger and more nebulous, apparently composed of many little fibers. Rows of large ones range down the middle of the thickened walls, and smaller ones occur more marginally. A little deeper, the walls appear to be thin, the zoecia larger, and angular, more or less numerous, mesopores appear, while the acanthopores are less numerous and smaller. In some tangential sections, instead of distinct acanthopores of two sizes, the wall appears to be intersected by numerous small uniform granules or fibers. In sections cutting the walls longitudinally, the tubular axes of the acanthopores can be seen passing completely through the thickened walls, which are, in addition, more or less speckled with the granules mentioned in the description of the tangential appearance.

Syringoclemis gen. nov.

Zoarium consisting of hollow cylindrical branches lined with an epitheca (?). Zoecial apertures somewhat elongated, irregular, ovate or subpetaloid. Mesopores abundant, subangular. Acanthopores scantily developed, of two sizes in the typical species, the larger very rare, the smaller much more abundant but reduced to mere granules. Mature region narrow. Walls thin below, much thickened in the cortical zone to which the mesopores are confined. Diaphragms apparently lacking.

TYPE.—*Syringoclemis biserialis*.

The affinities of this form are somewhat doubtful. In some respects, it is suggestive of the Rhabdomesidæ or Cycloporidæ. It is provisionally placed with the Batostomellidæ, although the thin layers of which the zoarium is composed, together to some extent with its growth as hollow branches, joined with the character of the zoecia with their raised peristomes, are not characteristic of that group. *Syringoclemis* differs from typical *Lioclema* in several particulars, especially in its mode of growth, since none of the species referred to that genus form hollow branches. The narrow mature zone, the absence of diaphragms, the obsolescence of acanthopores and the open mesopores are all characters which are alien to typical *Lioclema*. The mode of growth is, of course, like that of *Anisotrypa*, but the other characters are different.

In a general way, this is similar to the form which I have called *Callocladia* but that type possesses hemisepta, has a vestibulum, etc., and probably belongs to an altogether different group. In some respects, it resembles *Dyscritella*. It differs markedly in the mode of growth, the shortness of the zoecial tubes, their elevated peristomes and the great abundance of mesopores.

Syringoclemis biserialis sp. nov.

Zoarium consisting of hollow, dichotomous branches having a diameter of 5 mm or less. The zoarium itself is less than 1 mm. in thickness and lined with an epitheca. Apertures with a slightly projecting peristome and an

irregularly oval or slightly petaloid shape. Variable in size and outline, usually from .18 to .21 mm. in longest diameter, rarely .28 mm. Irregularly arranged, rarely in contact, more often with one or even two rows of mesopores intervening. Mesopores irregular in size and arrangement. The largest are of about half the diameter of the zoëcia, but it is rare to find them so large. They are subangular and of regular shape, usually separating the zoëcia in a single row, less often two rows, rarely three. Six or less of the zoëcia occur in a linear distance of 2 mm. There are rare maculae consisting of mesopores or small cells. Acanthopores are of two sizes. One kind is very large and very rare, developed in the walls of the zoëcia, which they indent. The other is much smaller, developed as rows of granules along the middle of the walls of the zoëcia, occasionally in the mesopore walls. Both kinds are, however, scantily developed and considerable areas occur in which no acanthopores can be seen at all.

When the cells are cut lengthwise, they are seen to be slightly oblique, very rapidly expanding, with a short prostrate portion, perhaps strictly vertical only in the mature region, which is quite narrow (.14 to .28 mm.). The cortical zone is abruptly and greatly thickened, the mesopores being confined to it, so that the zoëcia are much larger below than near the surface. Tabulae, so far as observed, are entirely lacking both in the zoëcia and the mesopores.

Polypora mesleriana sp. nov.

Zoarium apparently rather small for the genus, very irregular in growth, with the surface contorted and the branches often strongly bent. Owing to this irregularity, the measurements and relations vary greatly. There are 5 branches and 4 rows of fenestrules in 5 mm., but 4 branches and 3 rows may occur on the same specimen. The branches are relatively slender when first introduced and about twice as broad before division, to which circumstance and the fact that they sometimes diverge rapidly the difference in measurement noted above may be ascribed. Longitudinally, from 2 to 2.5 or even 3 fenestrules occur in 5 mm. They are usually elongate, nearly twice as long as they are wide and subrectangular to subelliptical in shape, but they vary considerably in proportion. The branches range from one half to nearly twice the fenestrules in width in extreme cases, but the average is intermediate. They are rounded when narrow and flattened when broad and are very much broader than the dissepiments which are slender (on the reverse) and somewhat depressed. On this side, the branches are marked by fine but sharp and regular longitudinal striae, which, in some instances, swing off onto the dissepiments. Over the older portions, these markings appear to be lost, but they are apt to show when exfoliated, indicating that they are structural as well as superficial. There is some evidence that they are marked by fine granules or spines.

On the obverse, the apertures usually occur in 4 rows (more rarely 3 or 5). They are situated in grooves, which lie between rather strong ridges. The crests of the latter seem to have a zigzag course and bear strong spinules which have a regular arrangement alternating with the aperture. Of the latter, 5 to 7 occur opposite a fenestrule. They are oval in shape with sharply elevated peristomes and appear to be covered in some cases at least with centrally perforated opercula.

Septopora pustulifera sp. nov.

Zoarium probably small, very irregular in growth. Four rows of fenestrules and 3 branches to 4 rows and 5 branches, occur in 5 mm. Three and one half to 4 fenestrules occur in the same distance longitudinally. The branches and dissepiments are usually about equal in size, both more or less expanded at their juncture. Fenestrules subquadrate to subcircular, irregular in size and shape. Dissepiments sometimes oblique, sometimes forming zigzag lines, rarely meeting in an angular or curved figure, as is rather characteristic of the genus. On the obverse, the zoecia are in two rows separated by a carina (?), and the dissepiments also show two rows. The reverse is marked by rather numerous, large, conspicuous pustules or accessory pores. These often look like spines which have been broken off, but probably are crater-like openings with raised edges. There are also (in one specimen) smaller pointed elevations like low papillæ. Liræ are likewise present, but they are discontinuous. Infrequently a median lira is found, which causes the back to have a more or less carinated appearance, while there are finer, less persistent liræ lateral to it. The pustules occur on both branches and dissepiments, but the liræ appear to be restricted to the branches.

Rhombopora persimilis var. *miseri* var. nov.

Zoarium ramose, bifurcating at frequent but irregular intervals. Branches about 1.5 mm. in diameter. Apertures regularly arranged in longitudinal and oblique rows of which there are about 16 lengthwise around the stem. The oblique series intersect at angles of about 30° longitudinally and 60° transversely. The apertures are strongly elongated and separated by thick angular walls. Longitudinally, 4 apertures occur in a distance of 2 mm. One or two large tubercles are developed in the long distance which separates the top of one aperture from the bottom of the one above in the longitudinal series, and a row of smaller spinules occupies the crests of the dividing ridges laterally.

This form is known chiefly from thin sections, and such statements as relate to superficial appearance are based upon few observations. In transverse sections, the thickened portion seems to be narrow, often not more than one sixth or one eighth of the whole at either end of a diameter. The bounding ridges appear as elliptical bodies with their long axes in a radial direction when the section cuts through a cell. When it passes between two cells, the thickenings of course coalesce, and when it passes through a spinule, it terminates in a strongly projecting point. Each thickened mass shows a median line of darker color which has of course a radial direction.

None of the longitudinal sections examined probably passes quite through the middle of a branch. The blocks of thickened tissue have a rectangular shape and are much longer than in the transverse section, but they are somewhat similarly modified as they cut different portions of the zoarium. The zoecial tubes are without tabulæ.

In tangential section, the zoecia are seen to be elliptical in section, not quite twice as long as wide. The intervals laterally are slightly less than the width of the tubes. Longitudinally, the distance is more than the length of the long diameter, but occasionally less and occasionally also twice as great. A large acanthopore-like spine occurs near the end of each aperture, while a row of smaller ones traverses the middle of each wall. The smaller spines are more superficial than the large ones, and fewer of them show in proportion as the section is cut farther from the surface, so that in some cases they appear to be well-nigh absent.

Streblotrypa nickelsi var. *robusta* var. nov.

Zoarium in the form of long, cylindrical stems which are sometimes more or less bent and but seldom branched. Diameter a little less than 1 mm. Apertures in alternating linear rows, about 12 to the circumference. They are ovate, broader and more truncated on the posterior side, surrounded by a distinct peristome which is confluent with the raised longitudinal lines that divide the rows of apertures. The longitudinal lines are somewhat sinuous, contracting downward from the base of one aperture to the top of the next. Spaces between the zoecial apertures in the same row twice or more the length of the apertures themselves, somewhat depressed, occupied by about 12 pores, variable in number and in size. Usually they are arranged in 2 rows, 5 or 6 pores in each, while the widening of the interzoecial areas toward the top leaves room for an additional intermediate incomplete row of 2 or 3. There are 4 apertures and 4 interzoecial areas in 2 mm. longitudinally. The zoecial tubes are long, gradually diverging rather abruptly turning outward when near the surface. Hemisepta about as in *S. nickelsi*.

Cæloconus tuba sp. nov.

Zoarium in the form of a gradually enlarging cone, more or less contorted, attaining a length of at least 13 mm. and a diameter of 3.5 mm. Usually the fossil appears as a mold of the interior, partly embedded in rock, the zoarium itself adhering to the external rather than to the internal matrix. In this condition, it appears to be marked by more or less closely arranged, regular constrictions or by fine sharp annulations. In one specimen, the constrictions are much coarser and more irregular. There are also fine concentric striae and obscure linear longitudinal markings. Some of the specimens taper gradually to a point, while others contract suddenly, so that the lower end appears truncated and rounded. These differences may be indicative of different species, but my material is so scanty that it has seemed inexpedient to sacrifice it to ascertain this fact by sectioning.

As the specimens examined show no external characters beyond those mentioned, which are probably not truly specific in value, the essential part of the description is based on thin sections. The walls of the zoarium are 28 μ m. in thickness. The basal plate is thin. The partitions extend obliquely upward; the ends bend somewhat inward into hook-like hemisepta, while the outer surface is abruptly and strongly thickened, forming more or less

quadrate blocks when seen in longitudinal section. The inferior hemisepta have not been observed. Tangential sections show the cells to be circular or slightly elongated and arranged rather regularly in quincunx, so as to form oblique rows as well as longitudinal ones. About 7 cells occur longitudinally in 2 mm. The walls are thick, those separating laterally adjacent cells being about one half the width, and those separating longitudinally adjacent cells about one half the length of the cells. The central line of the walls is occupied by a row of spinules outlining a hexagon having perhaps 2 spinules to a side and one on each of the angles, although such an arrangement is by no means constant.

Idioclema gen. nov.

The following description is based upon the only species known, and it may therefore have to be modified when other related forms are brought to light. The name *Idioclema* is then introduced for a Bryozoan type having solid, straight, probably branching stems of small diameter. There is a well-defined cortical zone in which the zoëcia are radial and have greatly thickened walls, and an inner or immature region in which the zoëcia have thin walls and for a long distance preserve a longitudinal direction. On the interpretation of structure adopted here, mesopores are absent, but acanthopores of abnormal type are abundant. In fact it would appear that the cortical zone, in which alone these structures occur, was dominated by them and that they formed the walls by which the irregularly oval or even tortuous zoëcial tubes are separated, by becoming confluent with one another as they come in contact. Each acanthopore is as thick as the entire wall, and by uniting laterally they form inosculating bands. The constituent unit can often be made out as (in tangential section) large circular bodies having a tubular axis and a row of elongated granules about the margin. The granules are perhaps oblique inosculating fibers and show conspicuously when the tubes are cut longitudinally. They appear to be irregular in direction and do not make continuous lines for any considerable distance. Tabulæ appear to be absent. Hemisepta are, however, developed just within the cortical zone. One projects upward and somewhat obliquely inward from the proximal portion of the wall at the commencement of the thickened zone and about at the point at which the tubes turn into a radial direction. A second projects upward and somewhat obliquely outward from the opposite wall a little farther down the tube.

The affinities of the form are very much in doubt by reason of the very unusual character of the wall structure. The presence of hemisepta, however, is a diagnostic character and seems to forbid placing the genus with the *Batostomellidæ*, to which it shows some points of resemblance.

While forced to conclude that *Idioclema* cannot rightly be referred to the Batostomellidæ, I am none the less in doubt as to where it should properly be placed. Provisionally I am including it in the Rhabdome-sidæ. It may form the nucleus for an independent family, the Idio-clematidæ.

TYPE.—*Idioclema insigne*.

Idioclema insigne sp. nov.

Zoarium in the form of freely branching stems, more or less circular in cross section, but expanded and compressed at points of bifurcation. Diameter ranging to 5 mm., usually less, and averaging about 3 mm. Superficial characters not known.

Cortical zone strongly marked and very variable in thickness, probably according to age, ranging from one third to one sixth of the diameter of the stem on each side. Zoœcial tubes long and straight in the axial region where they are .008 to .14 mm. in diameter, then slightly inclined to the surface and later abruptly turned to a radial direction. Diaphragms appear to be wanting, but hemisepta are well developed. There occurs an incomplete partition projecting inward and upward from the lower wall of each tube just as it turns into an axial direction. A second incomplete partition projecting obliquely upward and outward frequently occurs a little farther down the tube on the opposite wall, where it has a slightly inclined direction.

The structure of the walls is difficult to describe, and the terms used depend largely upon whether the appearances in section are interpreted as much modified acanthopores with large tubular axes or as mesopores without true acanthopores. The walls are thin in the axial region and strongly and abruptly thickened in the cortical zone. In tangential section, the zoarium appears to consist of tortuous, anastomosing bands which leave between them the openings for the zoœcia. The bands, representing the walls, seem to maintain a rather regular width, but the tubes between are irregular in size and shape, subcircular, oval, or even more or less tortuous. The structure of the walls is peculiar. In places, they are represented by what may be considered very large abnormal acanthopores, having a circular shape in section and a diameter about that of the entire wall. In the center is a relatively large tubular axis and about the circumference a few fairly regularly arranged granules which are slightly elongated and radially arranged. It appears to be the fusing of these acanthopores (?) that produces the continuous walls, which are intersected by similar granules, especially about the margins, and have distributed down the centers a row of similar axial tubes. When the zoœcia are cut longitudinally, the structure of the cortical zone appears to be more regular, consisting of the tubular cavities of the zoœcia alternating with bands of varying width representing the walls and separable into units by the tubules of the acanthopores. These large straight persistent tubular axes are a striking feature, and there are in addition granules like those of the tangential section, circular or elongated and either without conspicuous agreement in direction or directed more or less obliquely downward toward the tubular axis, showing that, if they are continuous fibers, the granules must run irregularly through the acanthopore-like mass.

There can hardly be a doubt that the unit of which the walls is constructed is the cylindrical body with small tubular axis and oblique fibres or granules. This structure may be interpreted as a small mesopore (the tubular axis) and a wall beset with granules, but the interpretation here tentatively adopted seems to be the more likely. Stellate acanthopores, somewhat comparable to these, are figured by Ulrich in *Bactropora simplex*.

Callocladia gen. nov.

This type forms hollow cylindrical branches with the walls made up of one or more layers. The walls of the zoecia are thin in the immature region, much thickened in the mature region, with angular crests on the external surface. Acanthopores are fairly abundant, showing clearly on the exterior, rather obscure in thin sections unless the latter cut the walls where they are thin, in which case the acanthopores are striking and indent the cells. Mesopores are abundant, usually in groups of two or more. Hemisepta are present.

The superficial appearance of this organism is extremely suggestive of *Intropora* (*I. basalis* and *I. undulata*), but the mode of growth, not bifoliate but in the shape of hollow cylinders, and the undoubted presence of acanthopores, etc., debars it not only from that genus but from the same family. The mode of growth, the presence of acanthopores and presence of hemisepta suggest a relationship with *Caloconus*, in the Rhabdomesida, but the presence of abundant mesopores debars it from that genus and all but debars it from that family.

If the structures the nature of which is not clear but which are suggestive of hemisepta can be interpreted as perforated diaphragms, this form could find admission into the Batostomellidæ with the relationship probably closer to *Stenopora* than to the other members of the family. The mode of growth as small, hollow, cylindrical branches having very thin walls is rather alien to *Stenopora*, as is also the shortness of the zoecial tubes and the increase by superposed layers, rather than by the extension of the tubes themselves. Mesopores are abundant—much more so than in any species of *Stenopora*. Tabulæ appear to be wanting or extremely rare, which is also uncommon in *Stenopora*, while the walls are strongly thickened in a solid mass, instead of by annulations. On the external surface also, they have an angular crest which gives the cells an appearance of being vestibulate. Acanthopores are rather more sparingly developed than in most species of *Stenopora*.

If the structures which suggest hemisepta have really that nature *Callocladia* would clearly be debarred from the Batostomellidæ and would probably find place among the Rhabdomesidæ.

TYPE.—*Callocladia elegans*.

Callocladia elegans sp. nov.

Zoarium in the form of hollow tubes which vary in size in different specimens, the largest, however, rarely exceeding 5 mm. in diameter. The walls contract and expand more or less irregularly in the same specimen. Inner surface lined with an epitheca. Zoarium thin, 1 mm. more or less in thickness, made up of one or more layers each of which is from .43 to .70 mm. in diameter.

The zoecia are oblique for a short distance, when they bend abruptly to a radial direction, increasing rapidly in size. The walls are thin where oblique and strongly and abruptly thickened where they have a radial direction. The appearance in fact is as if there were two distinct walls, the inner one thin and oblique, to which just back of its extremity is attached another, very much thicker and almost at right angles to it. The projecting end of the inner wall makes a structure like a hemiseptum, and there is evidence of another on the opposite side answering to it. On the external surface, the walls have an angular crest from which a slope descends on either hand to the rounded tubes. In thin section, they show a median line which is more or less distinct. The apertures are rather regularly arranged in oblique rows and come about 5 in 2 mm. Maculae and monticules are absent. Owing to the thick walls, the zoecia are subcircular or obscurely polygonal. The average diameter is .28 mm., but it varies from .21 to .35 mm. Mesopores are abundant, 2 or 3 occurring in the angles where three cells meet. In some cases, a row of mesopores separates a cell from that which lies above or below it on the branch, but laterally the zoecia are in contact. The mesopores are of various shapes and sizes, their naturally angular outline being modified by the thick walls. Acanthopores are fairly abundant on the external surface, projecting as small granules from the angles of the cells. In thin section, they are rather obscured in the thick walls, with which they merge to a greater or less degree. Just below the thickened portion, however, they are again conspicuous and indent the cells. The occurrence of projections resembling hemisepta seems to be rather regular, one to a zoecium, and they must be interpreted as perforated diaphragms. If this genus is to be admitted to the Batostomellidae.

Cystodictya pustulosa var. *arcta* var. nov.

Zoarium growing in flat bifoliate branches which have a width of about 2.5 mm. and a thickness of about 5 mm. There is considerable variation in both these measurements, the width ranging from less than 2.5 mm. to 3 mm. or a little more, and the thickness from somewhat less than 5 mm. to nearly 1 mm. The branches divide frequently but irregularly, bifurcations occurring close together in some examples and far apart in others. My material, though abundant, is too much broken up to show the range of this variation, but 6 mm. is perhaps the average length between divisions. The zoecia often appear to have no regular arrangement either longitudinally or diagonally. In some instances they occur in two oblique, intersecting series. Rarely they are developed on short, oblique ridges near the margin of the branch. The longitudinal order is perhaps less conspicuous than the oblique, and it is difficult to determine the number of longitudinal rows in which the zoecia occur.

When determinable, from 6 to 8 seems to be the number, which varies according to the width. In parts of some specimens, the zoecial openings seem to occur in rows which are neither longitudinal nor transverse but slightly inclined from a strictly longitudinal direction. The apertures are circular or slightly elongated, and, when not worn down, their margins are elevated in such manner as to give the surface a strongly pustulose appearance. Longitudinally about 4 apertures and 4 interspaces, or 5 apertures and 4 interspaces occur in 2 mm. They are separated on an average by intervals which are about equal to their own diameters (about .17 mm.), but vary from considerably less to double the diameter. The intervals between the apertures are smooth. Of longitudinal furrows or ridges there is no trace. In fact, the irregular distribution of the apertures would hardly be correlated with such superficial markings.

Orthotetes subglobosus sp. nov.

Shells attaining a rather large size, maximum width about 50 mm. Shape semicircular, transverse. Cardinal angles often rounded so that the greatest width is a little in front of the hinge.

Ventral valve generally flat or slightly concave, moderately elevated posteriorly, rarely distorted. Cardinal area nearly perpendicular to the plane of the margins. Pseudodeltidium narrow, higher than broad with a sulcus down the middle. Upon the inside, a long median septum unites with the two dental plates, thus forming with the pseudodeltidium a small chamber.

Dorsal valve convex. Often highly inflated, especially in the umbonal region.

Surface marked by thin, sharp radii separated by relatively broad, flat interspaces, crossed by rather strong, coarse, crenulating liræ. The radii are often strikingly and regularly unequal. In number and appearance, they vary greatly owing to the number of intermediate ones that happen to be present. In some specimens, only about 7 large subequal liræ can be counted in 5 mm., having broad interspaces between; in others, 7 with alternating small ones occur; and in still others, 13 or 14 rather fine subequal ones; but in still others, the latter number can be observed alternating with very fine initial liræ. As new liræ are not interpolated with absolute regularity, the count varies much within the broad limits indicated, depending not only upon what liræ are actually present, but also upon how many are regarded as primary and secondary, or even are sufficiently well developed to be counted at all.

Orthotetes subglobosa var. *protensa* var. nov.

This variety is based upon a single specimen distinguished principally by having a more elevated and distorted ventral valve than the normal. The height of the pseudodeltidium must have been about 11 mm. and a width below of 7 mm. The area is rather strongly inclined to the plane passing through the margins of the shell.

This specimen was found associated with a ventral valve having the low area and regular growth of the typical form, of which it will prob-

ably be best to regard it as a distinct variety. In addition to the typical specimen, several other examples have more or less doubtfully been assigned to this group.

Chonetes sericeus sp. nov.

Shell of medium size, a width of 16 mm. being about the maximum observed. Frequently rather transverse with somewhat extended hinge line; some specimens with proportionately greater height and more quadrate shape.

Convexity of ventral valve moderate. In some specimens, this valve is only slightly convex with an inconspicuous beak and presumably a rather high area. Occasionally in specimens of this type, the chief convexity lies towards the margins. In other specimens, the umbonal region is moderately vaulted and the beak fairly prominent. The cardinal spines are rather slender, strongly oblique, and there are probably four or five on each side.

Dorsal valve like the ventral in shape, varying from flat to gently concave.

Surface marked by fine radiating liræ of which some 13 to 15 occur in a distance of 2 mm. They are rather sharply defined and crossed by strong, somewhat irregular striæ of growth, which over some areas are prominent and sinuous. They are also specially noticeable on the cardinal angles, where the radii are apt to be faint or lacking for a considerable distance.

Strophalosia subcostata sp. nov.

Shell small, productiform. Ventral valve strongly arched; umbo flattened by attachment. Ears strongly depressed and rather spreading. Sculpture consists of moderately strong, coarse striæ of growth, of large spines upon the ears, which spring directly from the surface, and of interrupted costæ or elongated spine bases which end abruptly with the formation of a small spine at the anterior end.

Dorsal valve unknown.

Productus inflatus var. **clydensis** var. nov.

Shell rather small, often much produced and deeply enrolled. Fold and sinus more or less evanescent. Ears small, subquadrate.

Surface marked by fine, rigid liræ, about 16 in 10 mm. In specimens which are much produced, they seem to become evanescent anteriorly. In the ventral valve, a cluster of large spines occupies the ears, while a considerable number of smaller ones are scattered over the surface. The visceral area is crossed by transverse wrinkles which tend to be coarse, faint and irregular.

Productus inflatus var. **coloradoensis** var. nov.

? 1890. *Productus boliviensis* (non d'Orbigny). Nikitin. Com. Géol. [Russia]. Mem., vol. 5, No. 5, p. 57, pl. 1, figs. 4a, 4b, 4c.

Gschelstufe: Near Moscow, Russia.

? 1902. *Productus inflatus* (non McChesney). Tschernychew. Com. Géol. [Russia]. Mem., vol. 16, No. 2, p. 261, pl. 28, figs. 1-6.

Gschelstufe: Ural and Timan Mountains, Russia.

1903. *Productus inflatus* (non McChesney). Girty, U. S. Geol. Survey, Prof. Paper 16, p. 359, pl. 3, fig. 1-1b, 2, 2a, 3.
 Hermosa formation: San Juan region and Ouray, Colorado.
 Weber limestone: Crested Butte and Leadville districts, Colorado.
 Carboniferous: Glenwood Springs, Colorado.
1904. *Productus inflatus* ? (non McChesney). Girty, U. S. Geol. Survey, Prof. Paper 21, p. 52, pl. 11, figs. 5, 6.
 Pennsylvanian (Naco limestone): Bisbee quadrangle, Arizona.

In 1903, I referred to McChesney's *P. inflatus* a group of shells from the Pennsylvanian of Colorado, expressing at the time a certain doubt whether they were actually identical with it. For this group I would now suggest the varietal name *coloradoensis*. The western variety is of different geological age and associated with a very different fauna from typical *Productus inflatus*. Intrinsicly it is larger and broader and marked by much larger spines.

The Arkansas shells provisionally referred to the same variety are associated with *P. inflatus* in the Fayetteville shale and probably intergraduate with it. They are chiefly distinguished by being larger and broader, though, as the specimens thus far obtained are neither numerous nor perfect, other differences may develop with closer knowledge. I have observed, upon most of the specimens sufficiently preserved to show this character, a diagonal line of spines about where the ear may be said to join the body of the shell. This feature occurs in *P. inflatus* rarely, if at all, but I have called attention to a similar thing in *Productus semi-atticulatus* var. *animasensis*. There are few specimens about which one would hesitate whether to refer them to *P. inflatus* or to *P. inflatus* var. *coloradoensis*, and perhaps there would be fewer still if the specimens themselves were more perfect.

These Arkansas shells simulate typical *P. inflatus* var. *coloradoensis* rather closely. Much of the Arkansas material is broken or exfoliated, but I believe it does not have as numerous or as large spines as that from Colorado. The sinus is also deeper.

***Productus arkansanus* sp. nov.**

The shells included under this title present so many variations that it is difficult to frame a general description of them. They attain a size which may be called medium or even rather large, but many of the specimens actually handled are small. In the young (small) stages, the shape is subquadrate and rather transverse, while in a mature condition the length is sometimes greater than the breadth. Nevertheless, the transverse shape is in certain instances retained to the mature condition while, on the other hand, the tendency to elongate is sometimes mani-

festated at an early stage. The outline usually contracts toward the hinge, and the ears are small and inconspicuous.

Ventral valve strongly convex with gradually enlarging umbo. Of course, in the narrow specimens the umbonal angle is more acute than in the broader ones. Ears small and depressed. There is usually a broad, shallow, sometimes indistinct median sinus.

In the dorsal valve the shell is gently concave over the visceral area, more strongly flexed around its border. A median fold is usually present. The ears are small and indistinct.

The costæ vary greatly in character. They are usually rather irregular, with relatively broad striæ in between. At rather frequent and regularly increasing intervals they give off small spines and are swollen and elevated at the spines and constricted and depressed just in front, so that in some cases the surface looks as if marked less by continuous costæ than by elongated spine bases which terminate rather abruptly at the anterior end with the development of the spine which gave rise to them. This effect is more marked in some specimens than in others, and also in some specimens the costæ are finer and more closely arranged than in others. Toward the front, the costæ tend to be more regular and continuous. Distinct striæ of growth usually show upon well-preserved specimens, to which are in some cases added transverse wrinkles more or less irregular and obscure, except on the ears. In some cases, also, there are well defined, regularly arranged transverse bands. The arrangement of the spines is more regular in some specimens than in others, and occasionally they appear to occur in transverse rows, especially in connection with the sub-lamellose bands just mentioned.

In the dorsal valve, the sculpture is the reverse of that described. In the most strongly characteristic specimens, the external mold appears to be marked by sharply defined regular spine bases with prominent spines. In others, the appearance is more that of continuous costæ. Regularly concentric sub-lamellose bands frequently occur, and spines are developed on this valve, as well as on the other.

***Productus arkansanus* var. *multiliratus* var. nov.**

One or two localities have furnished a phase of this species which seems to warrant discrimination as a distinct variety. It is characterized by being unusually large, broad and with very fine continuous liræ and small spines. The dominating form at these two stations, it is yet even there associated with examples which can most appropriately be referred to the original species, while with the latter an occasional specimen is found which, by reason of its finer markings, might perhaps be referred to the variety *multiliratus*. Because of this intergradation, more or less complete, the present form could hardly be considered more than a variety.

***Diaphragmus* subgen. nov.**

This name is introduced for *Productus elegans* Newbold and Fratten, a specific name for which Worthen later substituted *cestrien*. The

general aspect of this species is that of *Producti* of the *semireticulatus* group, only somewhat abnormal in that the typical *semireticulati* are broad, subquadrate shells and marked by numerous regular concentric wrinkles passing across the visceral area from one large ear to the other. *P. elegans*, however, has a narrow, more gradually expanding shape; the ears are small and the concentric wrinkles few and irregular. The costæ are strong and subequal, but tend to be discontinuous over the visceral parts and to have the appearance of appressed spines. While not one of the typical *semireticulati* in expression, *P. elegans* is at least typical *Productus*. The diagnostic character is internal and consists of a partition passing completely across the interior of the shell. This structure appears to be an outgrowth of the dorsal valve from the geniculation, where the flattened visceral area abruptly joins the lateral areas. It lies in the same plane with the visceral area and appears, as it were, an extension of it.

This structure frequently forms a plane of dehiscence when specimens are broken out of the rock, the visceral area of the dorsal valve, the visceral area of the ventral valve and the diaphragm remaining on one piece, while the lateral and anterior extensions of both valves (which are almost in contact), together with the mold of the diaphragm and of the visceral area of the dorsal valve, remain on the other. The diaphragm and visceral area of the dorsal valve, while essentially on the same plane, are readily distinguishable, being separated by a slight ridge (or groove) and marked by different sculpture, the regular strong costæ of the external shell being replaced on the diaphragm by fine radiating striae.

There is no doubt that this type should be distinguished from true *Productus*, but there may be some question as to whether it is not already covered by Waagen's genus *Marginifera*. Waagen's description reads as if *Diaphragmus* might be an extreme example of *Marginifera*, but there can hardly be a doubt, I believe, that *Diaphragmus* is something distinct from *Marginifera splendens*, the typical species of *Marginifera*. Indeed, I am inclined to suspect that Waagen, who apparently did not have access to specimens of the American species and was working from the literature alone, may have been led to misinterpret the figures and descriptions of *N. splendens* so as to imagine that the bevel of the dorsal valve was an internal feature exposed by fracture rather than an external feature which is shown on the outside of all perfect, well-preserved specimens. However this may be, it seems to me that *Marginifera* must adhere to the characters shown by *M. splendens*, and that that species is clearly a distinct type of structure from *Diaphragmus*.

TYPE.—*Diaphragmus elegans*.

Camarotoëchia purduei sp. nov.

Shell rather large, a length of 15 mm. being about the maximum. Length and width nearly equal, the one being greater in some specimens and the other in others. Outline variable, subtriangular, subpentagonal or subovate, the greatest width being sometimes nearer the anterior end and sometimes about midway. Beak of the ventral valve small, suberect and somewhat flattened. Fold and sinus strongly elevated and sharply defined.

Surface marked by subangular plications reaching backward to the beaks. As a rule, 4 of these occupy the fold and 3 the sinus, but in many instances the fold has 3 and the sinus 2 plications. Rarely are 5 developed on the fold. When 3 are present, sometimes they are of equal size, but sometimes the median one is larger and more elevated so that the fold and sinus are pointed. In some cases, 3 of the mesial plications are equally elevated, while the fourth is developed on one side of the fold or on the other. In a few cases, there are 3 mesial plications and an additional one on either side, making 5 altogether. As a rule, the 4 plications are of equal size and elevation. The lateral plications number 5 usually, but occasionally 6 and sometimes 4 or even 3. The plications vary in different specimens in size and angularity. Some specimens are more tumid than others, and in some the front is rounded downward, thus obscuring the fold, which is usually highly and abruptly elevated.

Although from this it will be inferred that specimens might be selected to present rather widely different expressions, as a whole these shells make up a fairly uniform group.

Camarotoëchia purduei var. *laxa* var. nov.

In a few instances, there have been obtained specimens which seem to deserve recognition as a distinct variety, though their relationship to *C. purduei* can not be doubted. They have about the same number of plications similarly arranged, their chief claim to distinction resting on the fact that while in the typical variety the plications are rather angular, in the present one they are obsolescent, depressed-convex and separated by narrow, shallow striæ. The plications in this condition appear to be somewhat coarser, but apparently they are not so, as the number remains about the same.

Harttina brevilobata var. *marginalis* var. nov.

The shells referred to *H. brevilobata* are only two in number. Our collection contains, however, a series of specimens rather numerous, which are of the same general type as the others, but differ in being, though larger, much less convex and marked by less deep fold and sinus and less distinct lobation. Even the examples in which these characters are most marked are evidently inferior in their development to the speci-

mens upon which Swallow bases his description of *Terebratula brevilobata*. In the smaller examples, of course, the convexity is still lower, and no trace of lobation is to be seen.

While recognizing the relation of these faintly plicated shells to the two examples which more closely agree with Swallow's description, it has seemed to me from the evidence at hand that it would be well to recognize them as representing a distinct variety.

Harttina anna var. **graciliformis** var. nov.

Under this title, I am including two specimens which I at first, though really against the evidence in hand, provisionally identified with *Dielasma gracile*. Their size is much smaller, but their shape is almost exactly that of the larger shell, elongate and subpentagonal, with the greatest width near the middle or a little below. No fold or sinus appears to have been developed. The ventral valve has the usual dental plates and the dorsal a median septum.

Harttina indianensis var. **exporrecta** var. nov.

Associated with examples which have been referred to *Harttina brevilobata* var. *marginalis* and to *H. indianensis*, I have in several instances found shells more or less closely resembling them, but distinguished by having a broader, rounder shape. Neither valve has a distinct sinus, but traces of a sinus can sometimes be noticed in both valves.

So far as observed, the specimens referred here have only the median septum of *Harttina* without the lateral plates and platform of *Dielasma*.

Dielasma formosum var. **whitfieldi** var. nov.

This species is abundant at two or three localities almost to the exclusion of other types of *Terebratula*. It is one of the poorly characterized forms, having a broadly ovate shape and nearly obsolete fold and sinus. The greatest width is usually below the middle, and the outline in front is often somewhat flattened. The sinus, when present, is developed only toward the front, where it is shallow and undefined. Ventral beak small. The convexity varies from rather low to rather high. There is also variation in the width, some specimens being wider than others.

Dielasma formosum var. **seminuloides** var. nov.

This form resembles *D. formosum* var. *whitfieldi*, except that it is much more spreading. Though the variety *whitfieldi* manifests a tendency to pass into these rotund forms, some of them could not, I think,

with any propriety be included immediately with the typical specimens or with the variety *gracile*. Nevertheless, it is difficult to establish any line between them, partly, no doubt, because of imperfect material, whose real characters must be more or less estimated, but partly also because of intermediate specimens. The specimen selected as the type has both valves of nearly equal convexity. It has a subpentagonal shape with a distinct, though ill-defined, sinus in the ventral valve. Another example is still more rotund.

Dielasma planiconvexum sp. nov.

Shape broadly subovate or spatulate, length but slightly in excess of the width. Outline regularly rounded. Ventral valve moderately convex longitudinally and transversely. Dorsal valve nearly flat, slightly convex in a transverse direction. Fold and sinus practically absent, although the anterior portion of the ventral valve is flattened out and slightly bent upward, causing an almost imperceptible deflection of the margin.

This species is described from an imperfect specimen.

Ambocœlia planiconvexa var. *fayettevillensis* var. nov.

Shell small, subcircular and transverse. Width probably always slightly in excess of the length and in some specimens considerably so. Cardinal angles rounded; hinge much shorter than the width below. Greatest width occurs about the mid-length or a little posterior to it.

Ventral valve only moderately convex for the genus and rapidly expanding. Beak rather small, not strongly elevated, inclined backward, or incurved. The area is not very distinctly defined, and it is intersected by a moderately broad delthyrium, much higher than broad, which occupies from one fourth to one third of its width at the cardinal line.

Dorsal valve gently convex to subplanate, with a fairly distinct though narrow sinus developed near the front of mature and half-grown specimens.

The shells of this genus vary so little that the greater portion of a detailed description of the present form would apply to most of its species.

Spiriferina subelliptica var. *fayettevillensis* var. nov.

Shell small, rarely exceeding 12 mm. in width, transverse. Cardinal angles rounded with the greatest width a little anterior.

Dorsal valve moderately convex.

Ventral valve strongly convex with a high, well-defined area which is considerably narrower than the greatest width. Area slightly convex and strongly oblique to the plane of the valves. Foramen rather broad. Beak strongly projecting and moderately incurved.

The surface is marked by rather few very strong, high, rounded plications. The fold and sinus are simple and distinctly larger and higher (especially the

latter) than the lateral plications. The sinus is flattened or perhaps very obscurely elevated along the median line, but no median plication is developed in it, and no corresponding sulcus has been observed along the fold. The lateral plications number from 5 to 7 on either side of the sinus. The sculpture consists of regular, transverse, imbricating lamellæ.

Hustedia multicostata sp. nov.

Shell rather large, a length of 13 mm. being about the maximum observed. Shape regularly ovate, broad in some specimens, narrow in others. Convexity moderate to high, about equal in both valves.

The ventral valve has a distinct though undefined sinus and a beak moderately projecting and incurved.

The dorsal valve is without a distinct fold. Its cardinal line is short.

The surface is marked by from 25 to 32 gradually enlarging costæ. When unexfoliated, these are high and narrow and separated by striae of about their own width. When exfoliated, the ribs are narrow and abruptly elevated from broad, flat interspaces.

Composita subquadrata var. *lateralis* var. nov.

The shells included under this title are rather large with a subquadrate shape and strongly elevated fold and sinus. The sides are extended and sharply rounded.

In the ventral valve, the sinus begins as a narrow depression and remains so until the shell is about half grown. Then it becomes the median line of the real sinus, which then develops with rapid increase of width and depth. The fold is developed with equal rapidity, when it once begins to appear, being defined by two strongly diverging grooves, which curve downward, and, if it were not for the fact that they appear to bend backward at their posterior end, are so directed that they would intersect some little distance in front of the posterior margin.

Composita acinus sp. nov.

Under this title is subsumed a group of diminutive shells which have in spite of their size, characters indicating maturity. They are elongate, ovate and highly convex. The ventral valve has a fairly prominent incurved beak and a moderately deep, narrow sinus. The dorsal valve does not develop a distinct fold to correspond to the sinus of the ventral, the effect of which is often to produce an emargination of the anterior outline, an effect which is in some instances enhanced by the circumstance that the dorsal valve not only does not develop a fold but sometimes develops a median sulcus of its own.

Cliothyridina sublamellosa var. *atrypoides* var. nov.

Shell rather small, a length of 17 mm. being about the maximum. Length and breadth nearly equal; sometimes one is observed to be distinctly greater and sometimes the other. The greatest width is usually about midway, but occasionally it is posterior to the middle, the shell having rather prolonged cardinal slopes which join the lateral outline in more or less distinct shoulders.

The ventral valve is moderately convex with a rather small, not strongly incurved beak. A fairly deep, though undefined, sinus is a constant feature in mature shells.

The dorsal valve is apt to be gibbous at maturity. A moderately strong fold is present, though seldom conspicuous except along the front margin. Sometimes it is quadrate and comparatively well defined, sometimes rounded and scarcely distinct from the general convexity, very rarely low with a faint median sulcus.

The surface has the usual spinose lamellæ, which are apparently rather crowded. Most of our specimens, however, are exfoliated and the sculpture is obscure. In this condition, the surface is apt to appear nearly smooth; sometimes with more or less crowded but regular concentric ridges; sometimes with more or less discontinuous radiating costæ and sometimes with both, so that a cancellated effect results. The shell appears to be thick and not pearly.

Cliothyridina elegans sp. nov.

Shell rather small, probably not exceeding 17 mm. in width. Regularly, though not strongly, transverse. Greatest width posterior to the middle. Often the hinge is extended, and the greatest width is just in front. Shape lenticular.

The ventral valve is transversely subelliptical with a small, not very strongly incurved beak. The convexity is low. A rather narrow, shallow, undefined sinus is developed toward the front.

The dorsal valve is transversely elliptical, gently and regularly convex. Instead of a fold, there is usually a shallow, linear, median depression, creating with the ventral sinus an emargination of the anterior outline.

The surface is marked by fine, sublamellose liræ, a few of which are more prominent than others.

Solenopsis nitida sp. nov.

Shell of medium size, linguliform, very transverse. Width nearly three times the greatest height. Convexity low, compressed posteriorly. Beak very small and inconspicuous, situated posterior to the front margin by one half or one third the height. Anterior end apparently gaping, especially above. Upper and lower margins subrectilinear and parallel over the median portion, curving together symmetrically toward the posterior extremity, and abruptly rounded at the end. Anterior extremity broadly and regularly rounded.

Surface marked by concentric striæ and very fine concentric liræ.

Sanguinolites simulans sp. nov.

Shell rather small, very transverse, subelliptical. Convexity moderate. Umbonal ridge not very prominent, but very distinct. Post-cardinal slopes compressed. Beaks small, strongly incurved, situated near the anterior extremity. Cardinal line long, apparently over two thirds the entire width, nearly straight. Lower border gently convex, nearly parallel to the hinge, bending upward more strongly behind. The short anterior end is strongly rounded beneath the beak. The posterior outline is doubly truncated, the lower truncation being nearly vertical and the upper slightly oblique, so as to make an obtuse angle with the hinge. There appears to be a small but distinct lunule, while the shell back of the beaks is sharply inflected so as to form an elongated escutcheon the entire length of the hinge line.

The shell is thin, and the surface is marked by strong, regular, subequal, concentric plications, extending from the front to the umbonal ridge. At the umbonal ridge they abruptly cease, the post-cardinal slope being marked by much finer, less conspicuous striae, which are, however, stronger and coarser than growth lines. The umbonal ridge is an angular plication. A second somewhat similar radiating line divides the post-cardinal slope about midway. It is scarcely distinguishable as an elevation, however, though very noticeable as a line along which the striae and the posterior outline abruptly change direction.

Sphenotus branneri sp. nov.

Shell small, transversely subovate, strongly contracting toward the front. Greatest width about twice the greatest height or a little more. Convexity strong. Umbonal ridge indistinct. A constriction more or less pronounced passes across the shell, meeting the lower border a little anterior to the middle. The beak is small, strongly depressed and almost terminal. The cardinal line is nearly straight or gently convex, about three fourths of the entire width. The lower border converges with it toward the front, having a slightly sinuous course. The posterior outline is strongly and rather regularly rounded, sometimes more or less straightened or obliquely truncated above. The anterior outline below the almost terminal beaks is narrow and strongly rounded.

The surface is marked by radiating plications or costae, which are confined to the posterior portion back of the constriction. The highest of the plications marks an inflection of the shell near the hinge to form a long, rather broad escutcheon. Below and anterior to this, there are about nine regularly disposed costae, diminishing in strength toward the front. Where well preserved, the surface shows traces of fine radial liræ intermediate with the costae. In most specimens, these and all but three or four of the costae are obscured. There are also numerous concentric striae and sharp, regular, concentric liræ.

The internal characters are unknown, save that some specimens show a large anterior scar.

Sphenotus washingtonense sp. nov.

Shell of medium size, subquadrate, very transverse. Greatest width distinctly more than twice the greatest height. Cardinal line straight, somewhat longer than half the greatest width. Lower margin subrectilinear and par-

allel with the hinge, curving up rather strongly in front. Anterior outline concave above for about one third the height, rather strongly convex below, more abruptly rounded near the emarginate portion. Posterior outline somewhat obscurely truncated in a broken line. The upper truncation, which covers about one half the height, is very oblique, while the lower is nearly perpendicular to the lower margin. No distinct angles are formed where the lines join. The convexity is high. The beak, rather small and strongly incurved, is situated but a short distance posterior to the margin. The umbonal ridge is strongly elevated and angular. A second distinct, though not very prominent ridge divides the post-cardinal slope longitudinally, and the shell is abruptly inflected near the cardinal line to form a large, long escutcheon with sharply angular outlines. The post-cardinal slope is somewhat compressed, as is also the anterior portion. A broad, shallow constriction occurs just in front of the umbonal ridge.

The surface is marked by regularly arranged, moderately fine and deep concentric striae, which toward the front and back, and possibly all over when the preservation is good, are separated by rather thin, high, concentric liræ. Traces of fine radial liræ have been seen on the post-cardinal slope of one or two small specimens.

There is a large subcircular anterior scar.

Sphenotus dubium sp. nov.

Shell small, transverse, subquadrate. Greatest width twice the greatest height. Beak about one fourth the width posterior to the margin, small, strongly incurved. Convexity high, somewhat compressed posteriorly. Umbonal ridge rounded. Mesial portion, or the portion just anterior to a line from the beak to the middle of the base, somewhat flattened or slightly depressed into a broad, shallow constriction. Anterior extremity bent inward and downward to form an elongated lunule with very sharply defined, angular border. A long narrow escutcheon is similarly formed along the margin behind the beak. The post-cardinal slope descends somewhat abruptly and is divided longitudinally by a more obscure ridge.

The hinge line is straight nearly three fourths the entire width of the shell. The lower margin is gently convex, straightened through the middle, subparallel to the hinge, but bent upward behind, so that this end is distinctly narrower than the other. Posterior extremity truncated by a nearly straight outline very slightly oblique, making a distinct cardinal angle somewhat greater than 90°. Anterior outline abruptly truncated by the nearly straight oblique line formed by the flexure of the shell which produces the lunule; sharply rounded below.

Surface marked by rather strong, more or less irregular and unequal concentric striae, which are distinctly weaker over the post-cardinal slope, and by fine papillæ which tend to have a radial arrangement.

Sphenotus? meslerianum sp. nov.

Shell rather small, subovate, transverse. Greatest height a little less than half the extreme width. Strongly convex; umbonal ridge subangular distinct. Post umbonal slope somewhat compressed. A slight constriction de-

finer the anterior third of the shell. The beak is about one third the width back from the front margin, small, strongly incurved. The anterior extremity is nasute. The hinge is straight, about one half the entire width. The lower margin is gently and regularly convex. The posterior outline is gently convex, truncating the shell with a slight obliquity such as to make the posterior superior angle somewhat obtuse and the posterior inferior angle somewhat acute. The anterior outline is abruptly rounded and concave under the beak.

The surface is marked by very fine subequal concentric striae.

Edmondia equilateralis sp. nov.

Shell very small, transversely elliptical. Width slightly less than one half the greatest height. Hinge line straight, about one half the width. Basal margin gently convex. Anterior and posterior outlines strongly and regularly curved, nearly equal, gradually merging with the outlines above and below. Convexity rather high and regular. Umbonal ridge indistinct. Beak small, depressed, scarcely projecting beyond the hinge line, only slightly posterior to the margin.

Surface marked by fine, strong, sharp, subequal concentric liræ. The internal structures are not known, and the reference to the genus *Edmondia* is therefore provisional.

Cardiomorpha inflata sp. nov.

Shell of medium size, the largest specimen having a length along the umbonal ridge of 29 mm. Convexity high, equal in the two valves. Upper and lower margins gently convex, somewhat converging toward the front. Posterior margin subrectilinear, strongly oblique, merging with the cardinal border in a gentle curve and with the inferior border in an abrupt turn. Anterior end subtruncate. Beaks nearly terminal. Inferior-anterior angle sharply rounded. Convexity high, especially along the broad, undefined umbonal ridge, from which the shell descends abruptly to the hinge anteriorly and more gently posteriorly. A distinct, though ill defined, sinus passes diagonally across the shell just in front of the umbonal ridge, meeting the lower margin about midway.

Surface marked by numerous closely arranged subequal lamellose lines.

Leda stevensiana sp. nov.

The size is small, a larger specimen when complete having a width of 10 mm. and a smaller a width of only 7 mm. The greatest height is one half the width. The beak is situated about one third the width back from the anterior outline. The lower margin is gently convex, the posterior extension long and subangular, the anterior end symmetrically rounded. The upper posterior border is gently concave. The convexity is moderate and the surface marked by very fine, somewhat inosculating liræ.

Of this species, our collection contains but two specimens, both right valves, one of them complete but small and failing to show the sculpture, the other larger and retaining the sculpture, but imperfect at the anterior end.

Paleoneilo sera sp. nov.

Shell small, attaining a width of 12 mm., transverse, subovate. Greatest width about 1.5 times the height. Beak about one third the width back from the anterior extremity. Lower margin strongly convex, straighter toward the posterior (longer) end. Cardinal line nearly straight, strongly converging with the lower border. Posterior extremity narrow and abruptly rounded. Anterior extremity broadly and regularly curved. Convexity rather high; umbo small and strongly incurved.

The surface is marked by regular and closely arranged concentric lines.

Cypriocardia fayettevillensis sp. nov.

Shell small, attaining a width of 10 mm., which is about twice the greatest height. Shape subrhomboidal. Cardinal line straight, about one half the entire width. Ventral border straight in the middle, rounding upward at the ends, more rapidly at the anterior end. Posterior extremity obliquely truncated with a broad, rounded posterior inferior angle and a distinct posterior-superior angle of about 150°. Anterior extremity strongly and regularly rounded under the nearly terminal umbo which is large and strongly incurved. Convexity high. Umbonal ridge rounded, undefined. A distinct constriction passes across the shell, meeting the ventral margin a little in front of the middle.

Surface marked by a few (about 9) strong, regularly arranged striae which give the shell a lamellose appearance. No trace of radial sculpture has been observed.

Conocardium peculiare sp. nov.

Shell small, highly convex, triangular. Length along the umbonal ridge distinctly less than the width along the hinge. Umbonal ridge broad, well defined on both sides, prominent, moderately oblique. Beaks subcentral, nearer the anterior end. Umbonal ridge sharply defined from and elevated above the posterior portion. On the anterior side, the shell is strongly compressed.

The sculpture is different on the three portions of the shell thus defined. On the anterior side, the liræ are rounded, separated by angular striae and rapidly decreasing in size toward the extremity. They do not conform to those of the umbonal ridge which is defined by an unusually large rib on the anterior side, but run obliquely, so that new ones are introduced at intervals toward the ventral margin. On the umbonal ridge itself, the costæ are rather smaller than on the anterior portion and separated by broad, flat intervals, about twice the width of the costæ. Two or three of the latter are crowded together near the anterior boundary of the ridge. The costæ on the posterior portion are broader than those on the anterior, flat-topped and separated by narrow, rather flat striae. The whole surface is crossed by fine, equally spaced, lamellose, concentric lines.

Cancella? peculiaris sp. nov.

Shell small, the largest specimen referred here having a length of 13 mm. Equivalve, oblique, the axis sloping slightly backward. Hinge line nearly as

long as the greatest width, much longer behind than in front. Outline broadly and regularly rounded below and in front, curving strongly inward toward the hinge, where it is slightly straightened. On the posterior side, it is convex below and concave above, sloping strongly outward in a gentle curve below the broad posterior wing. Convexity moderately high. Anterior wing small and undefined. Posterior wing large, triangular, usually though not always abruptly depressed and distinctly defined.

The sculpture consists of fine regular concentric undulations or striae and fine radiating liræ. The undulations are shallow and rounded, and they are broad in comparison with the angular ridges which separate them and which are lamellose at least toward the sides. The radial sculpture is on a finer scale than the concentric, subordinate to and more or less interrupted by it. The radii are very fine and slender with relatively broad interspaces. They seem to die out toward the posterior side of the left valve and to be replaced by a few of larger size on the posterior wing of the right valve.

Aviculipecten squamula sp. nov.

Shell small, the largest specimen referred here having a length of 7 mm.: length and width about equal; slightly oblique, somewhat inclined backward. Hinge line but little shorter than the greatest width. Outline gently contracted below the hinge, then widening again. Lower extremity broadly rounded. Convexity low. Wings broad and undefined, the posterior one having perhaps for its boundary a low, narrow fold extending obliquely from the umbo to the posterior margin not far below the hinge line.

The sculpture consists of fine, regular, concentric striae crossed radially by fine irregular costæ so obscure that they are made out with more or less difficulty. They are interrupted and obscured to some extent by the concentric markings.

Aviculipecten jennyi sp. nov.

This form resembles *A. squamula*, having a subquadrate shape, a hinge nearly as long as the width below, and subparallel sides with scarcely any deflection defining the wings. The convexity is low. The umbo small and inconspicuous and the axis nearly perpendicular to the hinge line. In one specimen, the posterior wing has a fold as in *A. squamula*.

The sculpture consists of somewhat irregularly distributed costæ with relatively broad, flat interspaces. The costæ, though low and rounded, are well defined, but they do not extend onto the wings. There are also very fine, equal, closely arranged, concentric liræ and numerous stronger incremental striae, especially conspicuous over areas near the hinge where the costæ are not developed.

Aviculipecten multilineatus sp. nov.

Shell small and subquadrate, about as in *A. squamula*, which is closely related. Convexity moderate; hinge long, but little shorter than the greatest width, which is about equal to the greatest length. Umbo moderately elevated. Axis but slightly oblique, inclined backward. The wings are large, subquadrate and poorly defined either upon the surface or by any deflection

in the outline. The posterior one is bounded by a fold which in fact appears to be double.

Surface marked by very numerous, fine, sharply elevated, radiating liræ, which decrease in size and definition toward the sides and are not developed at all on the posterior wing. The intervening striæ are about equal in size and shape to the liræ. There are also many closely arranged, more or less irregular and unequal concentric striæ, finer than the radiating liræ and subordinate to them. Occasional varices of growth sometimes deflect the liræ and give them a wavy appearance.

Aviculipecten morrowensis sp. nov.

Shell small, a length of 11 mm. being about the maximum observed. Length and breadth nearly equal, or the breadth a little in excess. Hinge long but considerably shorter than the width below. Axis slightly inclined backward, with a greater development of the shell behind than before. Wings broad, undefined either by being abruptly depressed or by a sinus in the outline which is nearly straight and slightly oblique on the anterior side, slightly concave and strongly oblique on the posterior side. The lower part of the outline is regularly rounded. The anterior wing is larger than the posterior. The convexity is low and the umbones small and inconspicuous.

The surface is crossed by numerous exceedingly fine liræ which are scarcely visible without a lens. These are sharply elevated, rounded, with interspaces of about their own width, and they are in some cases slightly wavy. They bifurcate occasionally and thus tend to form groups or fascicles which in one specimen are visible to the naked eye as very obscure, regularly arranged costæ, of which there appear to be six or seven. The radii are also more or less alternating. They are crossed in some cases by regular, fine, sublamellose, concentric liræ, which are differently arranged in different examples. In one specimen, they are much farther apart than the radiating liræ; in another, only slightly farther apart. In most examples, they do not appear at all, the concentric markings consisting of fine, incremental striæ, of which a few at irregular and distant intervals are stronger than the rest. On the wings, the radii become very obscure, while the concentric striæ are intensified and conspicuous. In some specimens, the radii are sharp and strong; in others, possibly by exfoliation, they are more obscure. It may be owing to the same causes that the lamellose concentric liræ appear to be absent.

Aviculipecten inspeciosus sp. nov.

Shell small, a length of 16 mm. being about the maximum observed; length and breadth nearly equal. The hinge is rather short, about one half as long as the greatest width. The axis seems to be curved so that the greater development of the shell is on the anterior side. The posterior wing is small and not defined by a sinus in the outline. The latter contracts strongly as it approaches the hinge, near which, however, it appears to be somewhat straightened on the posterior side. On the anterior side, it rounds strongly inward to the base of the anterior wing, where it changes direction, becoming nearly straight and sloping gently inward (from below) so as to meet the cardinal line at a slightly obtuse angle. The convexity is rather high. The posterior

wing is small, depressed, oblique and undefined; the anterior wing larger, more abruptly depressed and therefore more sharply defined.

The sculpture consists of rather indistinct, subequal, radiating costæ, becoming finer and fainter toward the sides, which, with the wings and umbonal portion, appear to be uncostate. The costæ are relatively broad and flat and the striæ between them narrow and shallow. Concentric markings are indistinct or absent.

Cypriardella subalata sp. nov.

Shell small, subquadrate, transverse. Width about 1.5 times the height. Beak prominent, about one third the width posterior to the margin. Hinge line straight, two thirds of the width. Lower margin gently convex, nearly parallel to the hinge. Posterior outline almost vertically truncated, the posterior cardinal angle being if anything rather acute than obtuse. Lower margin bends up strongly in front to about one half the height, from which point, by an abrupt change of direction, the outline becomes concave to the beak.

The convexity is moderate to low. There is no distinct umbonal ridge. The post-cardinal portion is, however, somewhat compressed, and a faint constriction crosses the shell to about the middle of the base. Probably there is a well-defined lunule beneath the beak.

The surface is marked by relatively coarse, deep, regular striæ, separated by thin lamellose ridges. In the type, this sculpture dies out along the line where the umbonal ridge should lie, and the post-cardinal slope is crossed only by very fine striæ, but in other specimens it appears to be persistent to the hinge line.

Euconospira disjuncta sp. nov.

Shell of medium size. Maximum diameter 23 mm. Height 20 mm. Volutions about 7, gradually enlarging. Umbilicus small, open (?). Peritreme section very transverse, subrhomboidal, gently concave on the upper interior side, nearly straight on the upper exterior side, gently convex on the lower exterior side and strongly convex on the lower interior side. The upper interior surface slopes gently downward; the upper exterior surface slopes strongly downward in the opposite direction, and the lower exterior surface slopes gently downward. The periphery is therefore acutely angular and carries a narrow slit band defined by sharply projecting edges. The volutions do not embrace quite to the slit band, so that the conical shape of the shell, as a whole, is broken into steplike descents. The peripheral portion on which the slit band occurs is rendered more or less carinate by two relatively narrow sulci, one above and one below, of which the latter is the more conspicuous, because of being more distinctly defined on its outer side, where there is a fairly distinct shoulder. It is up to this shoulder that each volution embraces the preceding one.

The surface is marked by regular transverse striæ having a gently convex curvature and a strong backward direction. On the lower surface of the peritreme, they have a sigmoidal curve, concave toward the band and convex toward the umbilicus. They also have a strong backward sweep, so that the aperture is very oblique. In crossing the slit band, they make strong, regular crenulations, which do not extend onto the elevated edges of the band. Traces of revolving lines are present also, especially on the lower surface.

Bembexia lativittata sp. nov.

Shell small, subglobose, consisting of three or four rather rapidly expanding volutions. The largest specimen seen has a diameter of about 5 mm. The height is equal to the greatest diameter or a little greater. The spire is about one third the entire height. The sutures are deeply depressed. The peritreme section is very nearly circular except for the impressed zone, somewhat flattened above, regularly rounded below. The slit band is very broad, situated on the periphery, defined by thin elevated edges.

The sculpture consists of fine growth lines which are fasciculated at regular intervals, producing transverse costæ. These are more distinct above the band than below, and near the suture they are apt to be especially strong, forming little elongated nodes. They slope backward gently from the suture to the band and are curved, presenting the convex side toward the aperture. On the band, they are distinct and rather strongly concave, but assume the convex curve below and are nearly transverse.

Patellostium lævigatum sp. nov.

Shell rather small, rapidly expanding. At maturity, the growth appears to be rather straight than involved, and the widely expanded lip extends completely around the aperture and is continuous, though with a slight emargination, on the inner side. Umbilicus small. Slit band not elevated above the general curvature, except toward maturity, when it is raised into an angular ridge.

Surface without radiating striæ. It would appear, and with only fine incremental lines. These indicate that the aperture has a slight median indentation, with a shallow notch where the band occurs.

Oxydiscus venatus sp. nov.

Shell small, subenticular. Whorl section helmet-shaped. Sides somewhat flattened, strongly rounded inward at the broad (?) umbilicus, regularly converging to the periphery, which is keeled, the keel being defined on either side by a slight though distinct groove and bearing a median ridge down its center. The sculpture consists of costæ which have a transverse direction for one third the distance across the side and then are strongly and abruptly bent backward. This angular change of direction taking place at a corresponding point causes the surface to appear broken into a distinct band about the umbilicus, an appearance which is enhanced by the fact that after the backward turn, the costæ abruptly become much finer, and some of them bifurcate so that the median portion of each side is more finely and more closely costate than the band near the umbilicus. Over the broad, carinated portion, however, the costæ again become coarser, stronger and more distant, some of them dying out to allow this transformation to be effected.

Anomphalus? discus sp. nov.

Shell rather large, discoidal. Diameter 10 mm. Height 3.5 mm. Spire flattened. Volutions probably 4 or 5 in number, rather rapidly expanding. Peritreme section transversely elliptical with slightly pointed ends; flattened

above, subangular on the periphery, about one third of the upper surface depressed by contact with the preceding volution. The volutions are embraced up to the keeled periphery, so that the top of the shell is nearly flat. Suture scarcely depressed. Umbilicus probably closed. Surface without ornamentation.

Platyceras subelegans sp. nov.

Shell small, rapidly enlarging, completing about one half a turn, more strongly curved at the apex, but very slightly spiral, broad on the outer side, contracting toward the inner, so that the section is subtriangular; marked by numerous longitudinal plications, especially by a narrow peripheral carina defined by two deep sulci and more persistent toward the apex than the others. Surface crossed by lamellose concentric lines whose direction is made very sinuous by the plications.

Orthonychia compressa sp. nov.

Shell of medium size, oblique, conical, compressed, nearly complanate or bilaterally symmetrical, very rapidly enlarging and slightly bent, making one half a volution or less. Cross section subelliptical, very much longer than broad. Surface nearly smooth, marked only by obscure sublamellose growth lines. No costæ or spines.

Two specimens have been included in this species, each having certain individual peculiarities. The larger contracts distinctly toward the outer or convex edge of the shell, while the smaller is more nearly symmetrical, if anything, has the external side somewhat broader and marked by an obscure carina defined by two faint grooves. In this specimen also, the aperture appears to have been rather strongly oblique, one side projecting considerably farther than the other.

Paraparchites nickelsi var. *cyclopea* var. nov.

This species is represented primarily by an extremely large specimen, which agrees with *P. nickelsi* in most characters, except that it is very much larger than any of the associated fossils referred to that species, and the shell is much more coarsely pitted or punctate. The left valve has the base of a well-developed spine, but the right seems to be without a spine. This specimen clearly shows a small subcircular, undefined muscle (?) spot, situated near the center of the shell. It is characterized by being slightly depressed and by being smooth, without the punctæ with which the rest of the surface is covered. Traces of a similar spot have been observed also upon specimens referred to *P. nickelsi*.

Primitia fayettevillensis sp. nov.

Shell small, transverse, subquadrate. Lower margin gently convex, converging anteriorly with the long, straight hinge line. Anterior extremity

strongly rounded. Posterior extremity obliquely truncated, projecting. Convexity high. Umbilical pit deep, elongated but not continued to the hinge, posterior to the middle.

Primitia seminalis sp. nov.

Shell small, transversely subovate. Cardinal line straight or nearly so, converging strongly toward the front with the gently convex lower margin. Anterior end sharply rounded. Posterior end broadly and rather regularly rounded. Post-cardinal angle distinct. Convexity moderately high, with a flattened band about the margin. This band is narrow and sharply defined around the posterior portion of the shell, broad and not well defined at the front end, narrow and ill defined along the middle of the dorsal and ventral borders. Central pit rather large, subcircular, poorly defined, situated very near the middle of the convex portion, slightly above and distinctly posterior to the middle of the entire shell.

Halliella? retiferiformis sp. nov.

Shell small, subrhomboidal. Dorsal border long and straight. Ventral border gently curved along the middle, strongly curved at the ends, converging anteriorly with the cardinal line. Anterior extremity strongly rounded. Posterior extremity more broadly rounded, subtruncate. Convexity high and inflated at the anterior end, more gentle across the broad posterior end. A deep, somewhat elongated pit is situated a little above and distinctly posterior to the middle. It lies near the dorsal border without apparently extending to it. The shell posterior to the pit is elevated into a sort of low tubercle.

Surface rather coarsely reticulate.

Kirkbya Jones

The genus *Kirkbya* has for its type the species *K. permiana*, which is distinguished by having somewhat the shape of a parallelogram, but with the posterior end higher than the anterior. The obliquity is backward. There is a subcentral muscular pit. The surface is reticulated, and the free margins are provided with one or two flanges. The right valve is larger than the left and overlaps it on the ventral border. With this species were associated in the same genus other forms presenting very considerable differences in sculpture and general expression.

A number of species more or less resembling the English ones have been found in the lower Fayetteville fauna, but they present differences from one another which make it undesirable, in my judgment, to include them all in a single genus. Three groups of generic or subgeneric rank can in fact be distinguished. One of these seems to have the essential characters of typical *Kirkbya* and includes *K. lindahli* var. *arkansana*, *K. oblonga* var. *transversa*, *K. reflexa* and *K. simplex*. Another group which it is proposed to call *Amphissites* has the two valves equal, neither

overlapping the other. The surface is reticulate, but is also marked by prominences and projecting lamellæ. Only one species belongs to this group, *A. rugosus*. A third type has the surface marked by relatively very coarse, oblique, inosculating costæ and has the two valves unequal, but the left overlapping the right, just the reverse of typical *Kirkbya*. This group, *Glyptopleura*, includes *G. inopinata* and *G. angulata*.

I have not been able definitely to ascertain to what family it has been the practice to refer the Kirkbyas, but I have the impression that they have been considered as belonging to the Beyrichiidae. It seems to me a question deserving careful consideration whether these shells do not constitute an independent family, the Glyptopleuridae. Indeed, the differences between *Glyptopleura*, on one hand, and *Kirkbya* and *Amphisites*, which are doubtless more closely allied to one another than to *Glyptopleura*, on the other, are such as to suggest that careful revision might even prompt the erection of a third family, the Kirkbyidae.

Kirkbya lindahli var. *arkansana* var. nov.

The general appearance and sculpture are like those of *K. lindahli*, though the size is much smaller and the width proportionately greater. The shape is subrhomboidal, narrowing slightly toward the front, and with a distinct backward swing. The surface is finely checkered as in *K. lindahli*, and there is a subcentral pit. The right valve overlaps the left on the free margins. The double rim shown by Dr. E. O. Ulrich's figures seems to be lacking, and the ventral border of the left valve is rather abruptly infolded for a short distance toward the middle. Because of its smaller size, its lack of marginal bands and its infolded margin, I am disposed to regard this as varietally distinct from *K. lindahli*.

Kirkbya oblonga var. *transversa* var. nov.

Our collection contains but a single specimen of this species, which is so similar to the form which Dr. Ulrich identified as *K. oblonga* that I am a little doubtful whether the varietal distinction here suggested is altogether justifiable. The shape is strongly transverse, the dorsal border being straight and extending very nearly the entire width. The ventral border is nearly straight along the middle, more strongly rounded toward the ends. One cardinal angle of our specimen is nearly quadrate, the other is imperfect, but I believe was slightly extended. There is a well marked flange separated from the ventral and lateral borders by a sulcus and defined also upon its upper side by another sulcus. The remainder of the shell is moderately convex, somewhat pinched together near the middle with a subcentral pit a little below the median line. The surface is finely reticulated.

Kirkbya reflexa sp. nov.

Shell rather large, strongly transverse. Dorsal border straight, very nearly as long as the greatest width. Ventral margin gently convex across the middle, more strongly curved toward the ends. Ends very nearly symmetrically formed. Cardinal angles almost equal, the anterior being slightly more acute than the other. A deep groove surrounds the ventral and lateral borders, the marginal portion of the shell being bent upwards in a broad border or flange. The remainder rises gradually and regularly to the middle of the dorsal border, and this portion of the shell would have the shape of one half of a spreading cone. If it were not that the posterior (?) half of the cone is somewhat compressed, which makes the most elevated portion into a curved oblique ridge.

The surface is finely and deeply reticulated, the apertures increasing in size toward the reflexed border, upon which they are prolonged into relatively large, transverse grooves, so that the border looks fluted or perforated, though having the margin entire.

Kirkbya simplex sp. nov.

Shell small, transverse. Dorsal border long and straight, converging anteriorly (?) with the gently convex ventral outline. Ends nearly equally rounded, the anterior being narrower and more strongly curved. Convexity moderate, chiefly marginal, regular, without sulci or tubercles. Surface strongly and finely reticulate, except marginally, where the shell seems to be smooth and dense. Position of median pit not determined.

Amphissites gen. nov.

A number of ostracod shells in the fauna of the basal Fayetteville shale belong to types which have been loosely referred to the genus *Kirkbya*, but they really appear to represent three generic or subgeneric groups. *Kirkbya* itself is described as having the right valve larger than the left and overlapping it. This is the condition of *K. lindahli* var. *arkansana*. The shell described below as *Amphissites rugosus* has the two valves equal, meeting each other along a line, neither one overlapping the other. It is furthermore distinguished by having the surface marked by a number of tubercles in addition to the fine reticulations. On both these accounts, it seems that this form can readily and advantageously be distinguished from *Kirkbya* proper. The third type is represented by *Glyptopleura inopinata* which has the left valve overlapping the right. Conjoined with this difference in configuration is one of sculpture, the sides being without knobs or plications, but ornamented with oblique, inosculating costae instead of the fine reticulations and flanges of the other types.

TYPE. *Amphissites rugosus*

Amphissites rugosus sp. nov.

Shell small, subquadrate, with the two ends nearly symmetrically formed, so that it is difficult to distinguish which is anterior and which posterior. The dorsal and ventral margins are straight and parallel. The ventral is curved upward at the ends, which are regularly rounded; the posterior is slightly oblique and projecting. Cardinal angles rounded.

The convexity is rather high, developed especially about the margin. The surface is modified in a rather complicated manner, there being four flanges or ridges, while the median portion of the side is occupied by a large knob or boss. The margins of the base and sides are slightly thickened and projecting, making what may be called the first flange. The second is just above, separated by a narrow, deep groove, and it projects beyond the true margin. The third lies considerably within the second and does not conform to it, since a broader space is left at the inferior angles (especially the anterior one) than along the ventral border, while it meets the dorsal margin at the cardinal angles. The fourth flange or ridge is less distinct than the others, tending to become obsolete ventrally, becoming much thicker and more elevated anteriorly, so that where it terminates abruptly at the dorsal border, it forms in the cardinal view a large flat triangular area. The median pit is small and situated just below the inflated umbonate median portion of the shell. The surface is finely reticulated, except along the flanges, which are dense and smooth.

Glyptopleura gen. nov.

Shell rather small, subquadrate, with a backward swing, the posterior end being higher than the anterior and somewhat truncated. Inequivalve; the left valve is much the larger and overlaps the other all around save along the distinct straight hinge. There is a subcentral pit. The surface is marked by inosculating costæ.

TYPE.—*Glyptopleura inopinata*.

This type has the general appearance of certain species referred to *Kirkbya*, but it is distinguished from *Kirkbya* by the fact that the left valve is larger than the right—the reverse of *Kirkbya*—and that it overlaps the right strongly and throughout the circumference save along the hinge. This difference, of course, depends partly upon the orientation of the shell. In the *Beyrichiidae* and in *Kirkbya* itself, the shape is subrhomboidal, and the higher, truncated, more projecting end is called the posterior. If the same criteria are applied to the present species, the left valve is the larger and overlaps the right as described above. In the contrary interpretation, the overlapping of the valves in the present shell would more nearly correspond with *Kirkbya*, though more pronounced, but the other data of orientation would be reversed. It seems to be more probable that the configuration is the same as in *Kirkbya* and the *Beyrichias*.

Glyptopleura inopinata sp. nov.

Shell rather small, transverse, subquadrate. Width about 1.75 mm., which is distinctly less than twice the height. Hinge line nearly as long as the greatest width. Lower margin gently convex over the median portion, more strongly curved in front and behind, convergent anteriorly with the dorsal border. Posterior outline distinctly truncate and oblique, so that the post-cardinal angle is distinct and obtuse. The anterior extremity is acutely rounded above. The convexity is moderately high and obscurely constricted across the middle, with the anterior portion more inflated than the posterior. A small, deep, circular pit forms a depression a little above and a little posterior to the center. The sculpture consists of large curved, inosculating ridges which cross the surface transversely and more or less obliquely. There is a smooth, finely striated border which surrounds the shell everywhere, save along the hinge.

The two valves are distinctly unequal, the left being the larger. The left valve thus overlaps the other on all sides save along the hinge, at the ends of which this arrangement appears to produce a primitive sort of articulation.

Glyptopleura angulata sp. nov.

Shell small, transverse, subovate. Hinge line straight, nearly as long as the entire width, converging anteriorly with the gently convex lower border. Anterior end strongly rounded. Posterior end more broadly rounded, not much produced beyond the hinge extremity. Convexity high, chiefly centered along a diagonal ridge, extending obliquely from near the upper anterior angle to the lower posterior angle. As the lower margin also is oblique, the descent to this margin is abrupt and regular, while that to the post-cardinal angle is long and gradual. Anterior extremity of the ridge very prominent and embellished with a little knob.

Median pit situated above the middle (above the ridge) and near the middle transversely or a trifle posterior to it.

Surface marked by a few rather coarse, strong, angular lines, more or less transverse and inosculating.

Bairdia attenuata sp. nov.

Shell rather large, very transverse. Lower margin nearly straight across the median portion, strongly and equally turned upward at the ends, which are pointed and slightly lower than the middle. Upper margin strongly convex across the median portion, slightly concave near the ends. The point of greatest convexity, and therefore of greatest height, is distinctly posterior and the outline is more concave near the posterior than the anterior end. Convexity moderate, compressed at the ends. Surface smooth. Left valve slightly overlapping the right at the hinge; elsewhere neither valve seems to extend beyond the other.

Bairdia cestriensis var. *granulosa* var. nov.

This form is very closely related to *B. cestriensis*, of which Ulrich figures two specimens, a large and a small. It is a more slender shell

than the larger specimen and larger than the other—larger even than the larger of the types, from both of which it appears to be distinguished by having the surface conspicuously roughened over the convex portion but smooth about the margins. The shape is extremely similar to that of the smaller of Ulrich's specimens. This is a highly convex little shell, rather strongly compressed at the ends.

Griffithides mucronatus sp. nov.

Head: glabella large, inflated, considerably narrower behind; basal lobes triangular, small, strongly defined. Neck ring defined from the glabella by a deep sulcus, strongly arched in the middle with moderately long lateral projections. Eye lappets small, oblique. Border anterior to the glabella, moderately narrow, depressed, slightly convex, defined by a groove. Surface of glabella granulose, much more finely in front than behind. Median portion of neck ring and projecting end of eye lappets also marked by coarse granules. Outer margin of anterior border with fine parallel raised lines. The remainder of the surface, including the more depressed portions, finely pitted.

Free cheek with a wide, gently convex border defined by a strong groove. Eye large, prominent, many faceted, bounded below by a curved ridge. Genal angle much produced into an elongated spine. Surface finely pitted, outer margin marked by regular, fine, parallel liræ.

Thoracic segments nine, strongly lobed, axial portion a little less than one third of the whole. Longitudinally furrowed.

Pygidium semi-elliptical or shield-shaped, length and breadth about equal. Border broad and gently convex or nearly flat. From its well defined inner margin, the main portion of the pygidium rises abruptly, the axis being also abruptly and strongly elevated above the pleural areas. At its anterior end, the axial and pleural portions are about equally broad, and the border about one half as broad as the three other divisions. In old specimens, the border is relatively narrower. The segments are defined by deep angular grooves. There are 16 on the axis and 9 or 10 on the sides. The lateral segments are sometimes partly divided by indistinct furrows. Besides the number given above, there is a small articulating segment at the front end of the axis, and the anterior of the lateral segments is made double by a groove which divides it into two parts, the posterior having the normal size, the anterior being somewhat smaller. The surface of the lateral segments is rather coarsely granulated, and sometimes the granules are segregated along a raised line. Each of the axial segments is marked by a row of still larger granules. The border is traversed by a few delicate, inosculating lines and is finely roughened.

This species is abundant in the basal limestone of the Fayetteville shale zone and somewhat doubtfully identified in the Batesville sandstone below