

SMITHSONIAN MISCELLANEOUS COLLECTIONS

VOLUME 57, NUMBER 2

CAMBRIAN GEOLOGY AND PALEONTOLOGY

II

No. 2.—MIDDLE CAMBRIAN MEROSTOMATA

WITH SIX PLATES

BY

CHARLES D. WALCOTT



(PUBLICATION 2009)

CITY OF WASHINGTON
PUBLISHED BY THE SMITHSONIAN INSTITUTION
APRIL 8, 1911

The Lord Baltimore Press
BALTIMORE, MD., U. S. A.

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CONTENTS

	PAGE
Introduction	18
Cambrian Merostomata	19
Classification	19
Relations to pre-Cambrian Merostomes.....	21
Sub-order Limulava, new sub-order.....	21
Family Sidneyidae, new family.....	22
Genus <i>Sidneyia</i> , new genus.....	22
<i>Sidneyia inexpectans</i> , new species.....	24
Cephalo-thorax	24
Abdomen	24
Ventral appendages	25
Cephalo-thorax	25
Abdominal	26
Genus <i>Amiella</i> , new genus.....	27
<i>Amiella ornata</i> , new species.....	27
Cephalo-thorax	27
Abdomen	28
Surface	28

ILLUSTRATIONS

PLATE	PAGE
2. <i>Sidneyia inexpectans</i>	30
3. <i>Sidneyia inexpectans</i>	32
4. <i>Sidneyia inexpectans</i>	34
5. <i>Sidneyia inexpectans</i> and <i>Amiella ornata</i>	36
6. <i>Neolenus serratus</i> and <i>Sidneyia inexpectans</i>	38
7. <i>Sidneyia inexpectans</i> and <i>Beltina danai</i>	40

INTRODUCTION

During the field season of 1910 the study of the Cambrian strata of the section of the Rocky Mountains adjacent to the main line of the Canadian Pacific Railway was continued and special attention given to the Stephen formation. Its outcrop was carefully examined for many miles along the mountain sides with the hope of finding a locality where conditions had been favorable for (a) the presence of life during deposition of sediments, (b) the subsequent changing of sediments into rock, and (c) the preservation of the rock during the vicissitudes consequent on mountain building, so that the preservation of the life of the epoch would be as complete as possible. The famous trilobite locality on the slope of Mount Stephen above Field had long been known and many species of fossils collected from it, but even there the conditions had not been favorable for the presence and preservation of examples of much of the life that, from what was known of older faunas and the advanced stage of development of the Upper Cambrian fauna, must have existed in the Middle Cambrian seas. The finding, during the season of 1909, of a block of fossiliferous siliceous shale that had been brought down by a snow slide on the slope between Mount Field and Mount Wapta, led us to make a thorough examination of the section above in 1910. Accompanied by my two sons, Sidney and Stuart, every layer of limestone and shale above was examined until we finally located the fossil-bearing band. After that, for thirty days we quarried the shale, slid it down the mountain side in blocks to a trail, and transported it to camp on pack horses, where, assisted by Mrs. Walcott, the shale was split, trimmed, and packed, and then taken down to the railway station at Field, 3000 feet below. Among the finds there were a number of specimens of a beautifully preserved *Merostome* which will be the subject of this paper, and the first species to be described in a preliminary manner from the new locality.

CAMBRIAN MEROSTOMATA

The only Merostomes heretofore known from Cambrian rocks are from the Upper Cambrian formations of America. The first discovered was described by James Hall in 1863¹ as *Aglaspis barrandi*. Subsequently R. P. Whitfield described a second species as *Aglaspis eatoni*.² This genus was subsequently referred to the sub-order Synziphosura of Packard.³

No Eurypterid remains were reported until in 1901 C. A. Beecher described *Strabops thacheri* from the Upper Cambrian Potosi limestone of Missouri.⁴

Both *Aglaspis* and *Strabops* indicated that at the close of Cambrian time the Merostomata had advanced a long way toward a full development of the sub-class and that a series of ancestral forms had preceded them. It has been my desire for many years to discover something of the older Merostome fauna in the Cambrian and thus, if possible, secure further connections between the pre-Cambrian Algonkian crustacean, *Beltina*,⁵ and the great Merostome fauna of the Silurian.

In this paper two genera, *Sidneyia* and *Amiella*, are described: the former, from very fine material, and the latter, from one broken and imperfect individual. Both genera appear to belong to a sub-order of the Eurypterida and it may be a distinct order.

When preparing this paper I received from H. Mansuy, Geologist of Indo-China, a series of photographs of Cambrian fossils from Yunnan, and among them one of a fragment of a Merostome showing six segments of the abdomen. From their form and surface markings the species appears to belong to the genus *Amiella* described in this paper. (See p. 28.)

Classification.—The two new genera, *Sidneyia* and *Amiella*, are placed in the new sub-order Limulava of the order Eurypterida, under the new family Sidneyidae. The relations of the order and sub-order are shown in the following tabular view.

¹ Sixteenth Ann. Rept. New York State Museum, 1863, pp. 181-182, pl. xi, figs. 7-16.

² Geol. Surv. Wisconsin, Vol. 4, 1882, p. 192, pl. 10, fig. 11.

³ Memoirs National Acad. Sci., Vol. 3, 1885, p. 151.

⁴ American Journ. Sci., Vol. 12, 1901, pp. 364-366, pl. 7.

⁵ Bull. Geol. Soc. America, Vol. 10, 1899, p. 238, pls. 25-27.

Sub-Class MEROSTOMATA

Order Euryptera

1. Cephalo-thorax long.
2. Cephalo-thorax with six (6) pairs of appendages; the anterior pair chelate antennae, and the posterior pair, long, strong swimming legs.
3. Epistoma present in *Pterygotus* where it is narrow. Metastoma large.
4. Six anterior abdominal segments bear leaf-like branchial appendages.
5. Surface of test with scale-like ornamentation.
6. Terminal segment a simple lanceolate or spatulate telson.

Sub-Order Limulava

1. Cephalo-thorax short.
2. Cephalo-thorax with five (5) pairs of appendages; the anterior simple antennae, the third pair multi-chelate, and the posterior pair short, the outer joint serving as a branchial organ.
3. Epistoma large. Metastoma unknown.
4. Nine anterior abdominal segments bear leaf-like branchial appendages.
5. Surface of test smooth or with imbricating lines, as in many of the Trilobita.
6. Terminal segment a caudal fin formed of a central expanded telson and one or more swimmerets on each side.

Differences other than those tabulated will probably be found when more of the detailed structure of the Limulava can be determined.

The sub-order Limulava, as represented by the genus *Sidneyia* with its four pairs of cephalo-thoracic appendages and simple antennae, approaches the Trilobita, which has a similar scheme of cephalic appendages. In both, the antennae are large and simple, jointed, sensory organs. The branchiae of *Sidneyia* also suggest the broad, thin joints of the exopodite of the trilobite's legs with their branchial fringes. For comparison, the branchial fringes of *Neolenus serratus*, a trilobite associated with *Sidneyia inexpectans*, are illustrated on pl. 6, figs. 1 and 2.

The branchial lamellae of *Pterygotus* also have branchial fringes as well as the leaf-like, oval lamellae, as illustrated by Henry Woodward.¹

The short cephalo-thorax of *Sidneyia* is found also in *Strabops thacheri* Beecher (p. 19) from the Upper Cambrian, a form that may have had but five pairs of movable, cephalo-thoracic appendages.

¹ Monogr. British Fossil Crustacea, Order Merostomata, 1866-1878, pl. 11, fig. 2b; pl. 12, figs. 1a, 1d.

Relations to pre-Cambrian Merostomes.—The fragmentary remains that were described under the name of *Beltina danai* were referred to the Merostomata,¹ and the genus was considered to be more or less closely related to *Eurypterus* and *Pterygotus*. All the original specimens are flattened in a calcareous shale and none of them show definite surface markings. In a collection made by Prof. Stuart Weller in the Altyn limestone in the valley of Swift Current Creek, Montana, the specimens are embedded in a very fine calcareo-arenaceous matrix, and many of them show the convexity, and some, the original surface markings. One of these (illustrated on pl. 7, fig. 4), an abdominal segment, shows the convexity and general form of the segment, and the surface is more or less roughened by what appear to be depressed tubercles.

Specimens collected from about the same horizon to the north in British Columbia, and embedded in a siliceous matrix, are more flattened than those from the Altyn limestone, but they show certain definite surface characters. Two of the specimens are illustrated on pl. 7. Fig. 2 is a portion of a cephalo-thorax, with irregular transverse ridges near the posterior margin and depressed tubercles over other portions of the surface. An abdominal segment (fig. 3) shows depressed tubercles not unlike those shown by the segment from the Altyn limestone illustrated by fig. 4.

The relations of this very ancient form to the Middle Cambrian Merostomes described in this paper are very uncertain owing to the fragmentary character of all the specimens of *Beltina* yet discovered. Most of these fragments are quite similar to fragments of *Sidneyia inexpectans* where the latter is broken up and flattened in the shale, but, as a whole, the form of all the parts of *Beltina* thus far recognized indicates a closer relationship to the Euryptera than to the Sidneyidae.

Class CRUSTACEA

Sub-Class MEROSTOMATA (Dana) Woodward

Order EURYPTERIDA

Sub-Order LIMULAVA, new sub-order

Body elongate, with a thin epidermal skeleton either smooth or ornamented by lines or ridges. Cephalo-thorax with lateral or marginal eyes, on the ventral side with five pairs of movable appendages; mouth posterior to a large epistoma.

¹ Bull. Geol. Soc. America, Vol. 10, 1899, p. 238.

Abdomen with twelve segments, the anterior nine of which have a pair of ventral appendages to which the branchiae are attached; the posterior segment has a central spatulate-shaped section that, combined with swimmerets, forms a strong caudal fin.

The description of the branchiae will be found under the description of *Sydneyia*, the typical genus of the Limulava.

Observations.—The sub-order Limulava differs from the Eurypterida, to which it is most nearly related, in having a large epistoma similar to that of the Trilobita; in not having a metastoma, chelate antennae, and swimming cephalic appendages; and in having a broad fan-shaped caudal fin, and branchial appendages more or less unlike the lamellar branchiae of the Eurypterida and Xiphosura.

Family SIDNEYIDAE, new family

Cephalo-thorax small, without lobes, eyes marginal; ventral side with large epistoma, five pairs of movable appendages, the gnathobases of the three posterior pairs forming organs of manducation. Abdomen twelve-jointed, the three posterior segments annular and narrow, the terminal one forming, with lateral swimmerets, a fan-like tail; nine anterior segments with a pair of ventral branchial appendages on each; the three posterior segments without ventral appendages. Surface smooth or ornamented by narrow, irregular, fine, imbricating ridges.

Genus SIDNEYIA, new genus

Body elongate, broadly oval in outline, attaining as now known a length of 17 cm., covered with a thin dorsal shield or crust, divided into a short cephalon, broad anterior abdomen, and narrow posterior abdominal portion. Cephalo-thorax transverse, short, depressed convex, as compressed in the shale, with broadly rounded frontal margin and antero-lateral angles; margins smooth. Eyes reniform and situated near the postero-lateral outer margin. Ventral side with five pairs of movable appendages. The anterior pair are large, long, simple, jointed antennae; second pair, slender and jointed; third pair with numerous spines on the front side of the joints and with variously developed chelate-like outer joints (see pl. 4); fourth pair, slender and jointed; fifth pair with a large basal joint, and an outer, broad joint or palp that is fringed with fine branchial setae or spines. A large epistoma is attached to the front margin and back of it the gnathobases of the appendages, the three¹ posterior pairs of which form the organs of manducation.

¹ See description of species, *S. inexpectans* (p. 25).

Abdomen with twelve segments, the anterior nine of which each carry a pair of branchia-bearing appendages. The next two posterior segments, tenth and eleventh, are simple, annular rings, the terminal segment or telson has a central spatulate section that, with its lateral swimmeret on each side, forms a broad caudal fin.

Surface of dorsal shield smooth.

Genotype.—*Sidneyia inexpectans*, new species.

Stratigraphic range.—The stratigraphic range is limited, so far as known, to a thickness of 130 feet in a dark siliceous shale forming a part of the Stephen formation and described as the Ogygopsis shale in 1908.¹

Geographic distribution.—On the slope of the ridge between Mount Wapta and Mount Field north of Burgess Pass, and about 3800 feet above Field on the line of the Canadian Pacific Railway, British Columbia, Canada.

Observations.—*Sidneyia* is a most interesting type and one that I should have expected to find in an Ordovician rather than in a Middle Cambrian formation. It is associated with a large fauna, part of which is enumerated in the list of thirty-two species listed under the description of the Ogygopsis shale referred to above. The stratigraphic horizon in the British Columbia Cambrian section is over 6300 feet below the summit of the Cambrian series.²

The short, broad, cephalo-thorax, the broad elliptical abdominal portion formed by the first nine segments, the elongate, narrow three posterior segments, the last taking the form of a broad caudal fin, all unite to give the type a scorpion-like appearance.

The genus differs from all the genera of the Eurypterida in the form of the cephalo-thorax, smooth surface, presence of a very large epistoma, non-chelate antennae, absence of a metastoma, and (with the exception in *Stylonurus*) absence of a broad posterior pair of swimming appendages; also in the arrangement of the branchiae upon the nine anterior abdominal segments and in the presence of the broad caudal fin formed of the spatulate terminal section and swimmerets of the twelfth segment.

In this preliminary study and description some detail is omitted, but this will be worked out and inserted in the final study of the genus.

The generic name *Sidneyia* is proposed in recognition of the discovery of the type specimens by my son, Sidney S. Walcott, in August, 1910.

¹ Smithsonian Miscellaneous Collections, Vol. 53, No. 5, p. 210.

² Idem, pp. 216, 217.

SIDNEYIA INEXPECTANS, new species

(Pl. 2, figs. 1-3; pl. 3, figs. 1-4; pl. 4, figs. 1-4; pl. 5, figs. 1-3; pl. 6, fig. 3;
pl. 7, fig. 1.)

Cephalo-thorax.—Body elongate, with a thin epidermal skeleton or crust. Cephalo-thorax small, short and broad; in an entire dorsal shield having a length of 123 mm., the cephalo-thorax has a length of 15 mm. and a width of 56 mm.; surface depressed convex, as flattened in the shale; outline broadly rounded and almost transverse across the front, rounding gently at the antero-lateral angles before arching backward to the eye lobe where it curves slightly inward. The eye forms a distinct lobe a little more than one-third the length of the cephalo-thorax; it is situated close to the postero-lateral angle and has a narrow rim caused by a slight intermarginal depression. The posterior margin is transverse and without any intermarginal furrow. No traces of ocelli have been observed.

A very large transverse epistoma is attached to the ventral edge of the cephalo-thorax; in one example (pl. 5, fig. 3) it is nearly as wide as the cephalo-thorax and apparently quite as long, if not longer; the surface is smooth except for a slight intermarginal furrow which is indicated at the sides and posterior margin; the posterior outline is nearly transverse in the central portions and broadly curved at the sides; a large specimen having a width at the third abdominal segment of 87 mm. and a length of 143 mm. exclusive of the cephalo-thorax, has an epistoma 27 mm. in length and over 55 mm. in width. The ventral appendages of the cephalo-thorax will be described under the sub-heading *Appendages*.

Abdomen.—The abdomen has twelve segments as shown by fig. 1, pl. 2 and fig. 2, pl. 5. The anterior nine segments form a broad ellipse, the anterior end of which is attached to and merges into the outline of the cephalo-thorax; the length of these segments is about one-eighth of their width; the first segment terminates in a point equally converging from the front and back margins; in the second segment the convergence and curvature is greatest toward the front side and back of this the curvature of the front margin increases until there is a slight backward arching of the posterior margin so as to form a sharp point with the downward arching front margin; posteriorly the tenth and eleventh segments are nearly as long as wide, much narrower than the first nine segments and more than twice as long as the anterior segments from which they extend backward; they appear to be simple, annular rings; the twelfth or terminal segment has a central body, broadly oval in outline, that

extends backward from two-thirds to four-fifths of the distance to the posterior margin; at about half its length a wing-like extension continues backward and slightly outward to a transverse margin; on each side of the terminal segment (pl. 3, figs. 2-4), and attached to its anterior side, there is a lateral swimmeret that on the inside overlaps more or less the central terminal section and on the outside margin expands so as to form, with the central terminal section, a broad caudal fin suggestive of that occurring in the Schizopoda and Decapoda; it may be that there are more than one of the lateral swimmerets on each side, but if so they are so pressed in together as not to be distinguished. The anterior margin of each segment extends under the segment in front of it from one-fifth to one-third its length at the center, the underlap gradually narrowing to where it passes from beneath the segment near its outer termination; the anterior segment passes beneath the cephalo-thorax in the same manner.

Ventral appendages: Cephalo-thorax.—Cephalo-thorax with five pairs of movable appendages. The first or antennal pair are rather stout at the base, tapering gradually until they become very slender (pl. 2, fig. 1); the joints vary in length, they are usually a little wider than long for the first half of the length of the appendage, gradually becoming proportionately longer toward the outer end. One appendage shows over thirty joints beyond the edge of the carapace, and another from its length must have many more; each joint has a short, fine spine or fringe of spines at the anterior margin of the joint. The inner point of attachment of the first joint has not been seen as it is covered by either the epistoma or cephalo-thorax in all specimens.

The second pair of appendages is formed of long, slender joints; so far as known they extend only a little distance beyond the margin of the cephalo-thorax and terminate in a joint that has two or three short spines projecting from the outer end of it.

The simple form of the third pair of appendages is shown by fig. 1, pl. 5. They have a relatively large basal joint, the anterior inner margin of which is provided with six or more sharp spines that appear to have been used in connection with the basal joints of the fourth and fifth pair of appendages as manducatory organs. This appendage has broad, strong joints in small specimens (pl. 5, fig. 1) and in large specimens it is developed into a peculiarly constructed and complex chelate terminal section; this is formed of twelve or more joints of a forward curving appendage to which

are attached on the anterior side long spines carrying numerous smaller spines on the margin opposed to the main body of the appendage (pl. 4, fig. 4). There is also in this specimen a broad appendage of three joints attached to the outer posterior end of the basal joint. The features described are partially illustrated on pl. 4, by figs. 1-4. Fig. 3 illustrates some of the long spines where they are sufficiently separated to show the shorter secondary spines. Another unusual variation is illustrated by fig. 1. In the small specimen illustrated by fig. 2, pl. 2, it looks as though there were two jointed branches extending outward with small spines on their anterior margins. A larger series of specimens will undoubtedly enable us to interpret these chelate appendages more accurately but with our present information it seems probable that in the complex form represented by fig. 1, pl. 4, provision was made for capturing the numerous small phyllopod crustaceans and numerous annelids with which the bottom and adjacent water were abundantly supplied. It may be that the chelate, complex appendages were also used in fighting and that there was a marked difference in those belonging to the male and female.

The fourth pair of appendages so far as known have a small basal joint or gnathobase which has on its inner margin two strong spines, the form and size as compared with the gnathobases on the third and fifth pair of appendages is illustrated by fig. 1, pl. 5. The joints beyond the gnathobase are elongate and form a slender appendage that extends out beyond the third and fifth appendages. The terminal joint has three small spines projecting from its outer end.

Each of the fifth pair of appendages has a large basal joint or gnathobase, the inner margin of which is provided with short, strong spines. As far as can be determined from the material available for study, there are three or four strong, broad joints beyond the gnathobase, the outer of which are provided with fine setae or branchial filaments. The gnathobase is well shown by fig. 1, pl. 5, and the filaments on the outer joints by figs. 2 and 3, pl. 2.

Ventral appendages: Abdominal.—A number of specimens show more or less of traces of abdominal appendages on the first nine segments of the abdomen. None of these indicates the presence of a jointed appendage in any way comparable with the appendages of the cephalo-thorax, or the abdominal appendages of the trilobite. The appendages appear to be formed of clusters of branchial fringes attached to short lobes that are round or oval in outline and affixed to the ventral surface on each side of the abdomen at the outer

edge of its inner third, or they may be of a lamellated structure as shown by fig. 1, pl. 3, fig. 1, pl. 2, fig. 3, pl. 6. What is now known of these branchial clusters recalls very strongly the lamellated branchial fringes occurring in the cephalic portion of the trilobite *Calymene scitaria*,¹ and in specimens of *Neolenus serratus* (see pl. 6, figs. 1 and 2) associated with *Sidneyia inexpectans*.

Observations.—In this preliminary notice of this remarkable crustacean I have not attempted to describe many minor features of the ventral appendages of the cephalo-thorax and abdomen. The combination of characters shown by the conformation of the dorsal shield and the grouping of the appendages indicates quite clearly a transition form between the Trilobita and Eurypterida. In view of larger collections being made available during the season of 1911 further description will be deferred.

Formation and locality.—Middle Cambrian: Stephen formation, Ogygopsis shale on west slope of ridge between Mount Field and Mount Wapta, about 3800 feet above Field on the line of the Canadian Pacific Railway, British Columbia, Canada.

Genus AMIELLA, new genus

What is known of this genus is contained in the description of the type species. It differs markedly in form and surface from *Sidneyia*. From *Pterygotus*, *Eurypterus*, and other genera of the Eurypterida it differs in the character of the surface, epistoma, and abdominal segments.

Genotype.—*Amiella ornata* Walcott, which is associated with *Sidneyia inexpectans* in British Columbia.

The generic name is given in honor of Dr. Henry M. Ami, of the Geological Survey of Canada.

AMIELLA ORNATA, new species

(Pl. 5, fig. 4.)

Of this species only one broken specimen of the dorsal shield is known. This shows that the body was elongate, narrow, and the abdomen formed of a number of large segments of which remains of seven are preserved; also a part of the cephalo-thorax.

Crust thin and compressed in the shale.

Cephalo-thorax.—The portion of the cephalo-thorax preserved (it may be only the epistoma) has been turned about, the dorsal shell of the cephalo-thorax having been loosened and displaced. If it is

¹ Bulletin Museum of Comparative Zoology, Vol. 8, 1881, pl. 3, figs. 1, 2.

the cephalo-thorax it has a nearly transverse posterior margin with slightly rounded lateral angles. The anterior outline is curved so as to give an inward slope to the sides and a rounded, slightly transverse section along the central portion. No traces of eyes. I am strongly inclined to the view that the part preserved is the large epistoma characteristic of the family Sidneyidae.

Abdomen.—There are traces of seven abdominal segments. In front of the epistoma? is the remnant of a segment which was largely broken away in exposing the epistoma?. The same is true of the anterior of the segments united in the abdomen; of this segment only a small fragment remains on the left side. The first fairly well preserved segment has a length of 13 mm. and a width of 30 mm. Before the anterior margin was removed it had a length of 16 mm. The next two segments are large and broad, and the last two narrow and long. All are more or less pushed one over the other so as to obscure their true proportions.

Surface.—The surface of all parts of the abdomen is ornamented by irregular, imbricating lines, roughly sub-parallel to the longitudinal axis of the abdomen, or else, toward the outer edges, sub-parallel to the gently curved outer margins of the segments. The epistoma? has much finer lines sub-parallel to its lateral margins.

Observations.—The outline of the body of this species suggests the form of *Pterygotus bilobus* Salter var. *inornatus* Woodward.¹ The surface markings are unlike those of *Pterogotus*, *Eurypterus*, and other genera of the Eurypterida, as are also the proportions of the abdominal segments.

Formation and locality.—Middle Cambrian: Stephen formation, Ogygopsis shale, west slope of ridge between Mount Field and Mount Wapta, about 3800 feet above Field on the line of the Canadian Pacific Railway, British Columbia, Canada.

A second species of this genus or a closely allied form occurs in the *Redlichia chinensis* zone of Indo-China. (See p. 19.) It is the oldest Merostome now known as it comes from the horizon of the Man-t'ò shale formation of the upper Lower Cambrian terrane.²

¹ Monogr. British Fossil Crustacea, Order Merostomata; 1866-1878, pl. 10.

² See Willis and Blackwelder, Research in China, 1907, Vol. 1, Pt. 1, p. 26.

DESCRIPTION OF PLATE 2

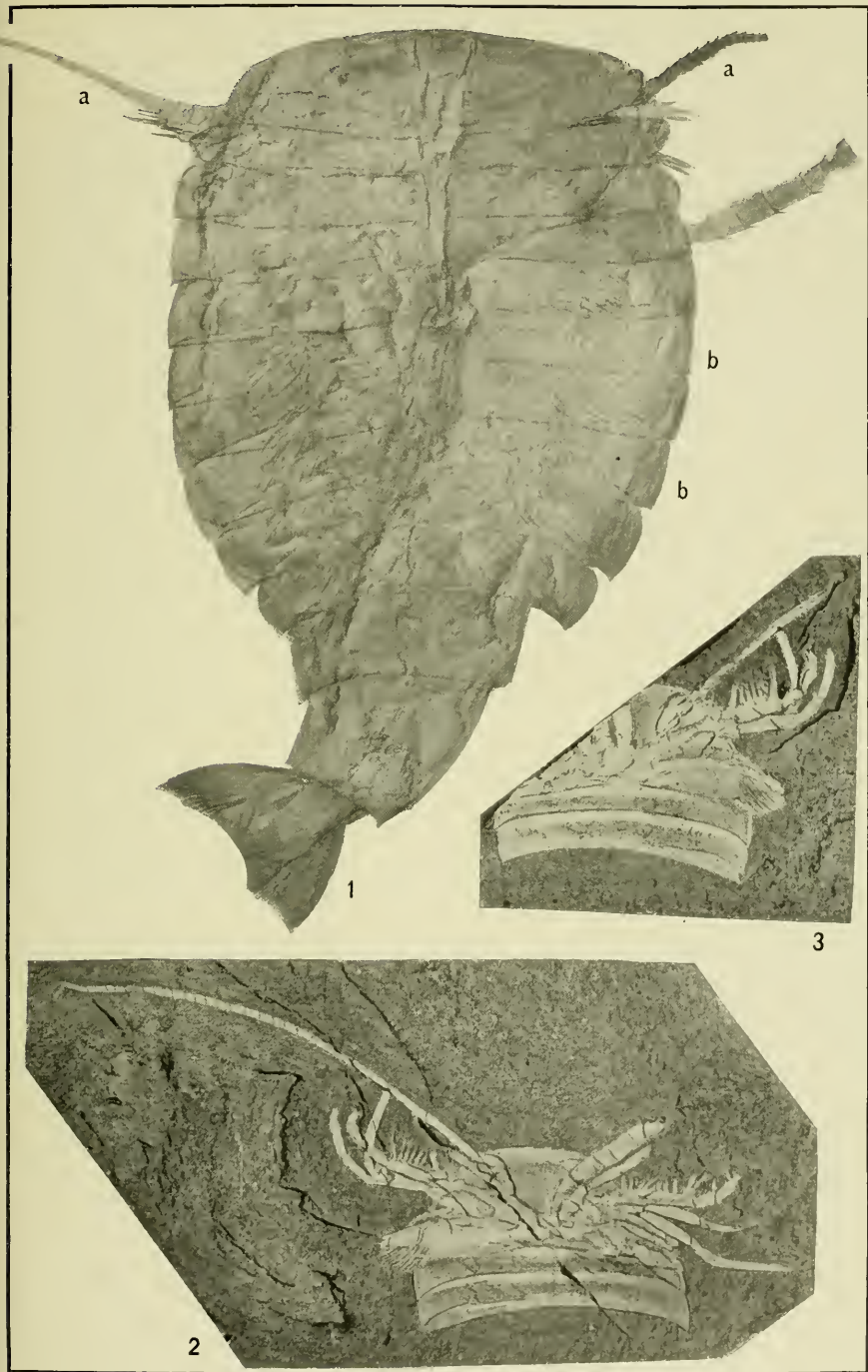
	PAGE
<i>Sidneyia inexpectans</i> Walcott.....	24

FIG. 1. A large dorsal shield (natural size) flattened and somewhat broken by compression in the shale; an antenna projects out from each side in front of the eye, and, on the right-hand side, probably the fourth appendage of the cephalo-thorax which has been pushed back under the second segment of the abdomen. U. S. National Museum, Catalogue No. 57487.

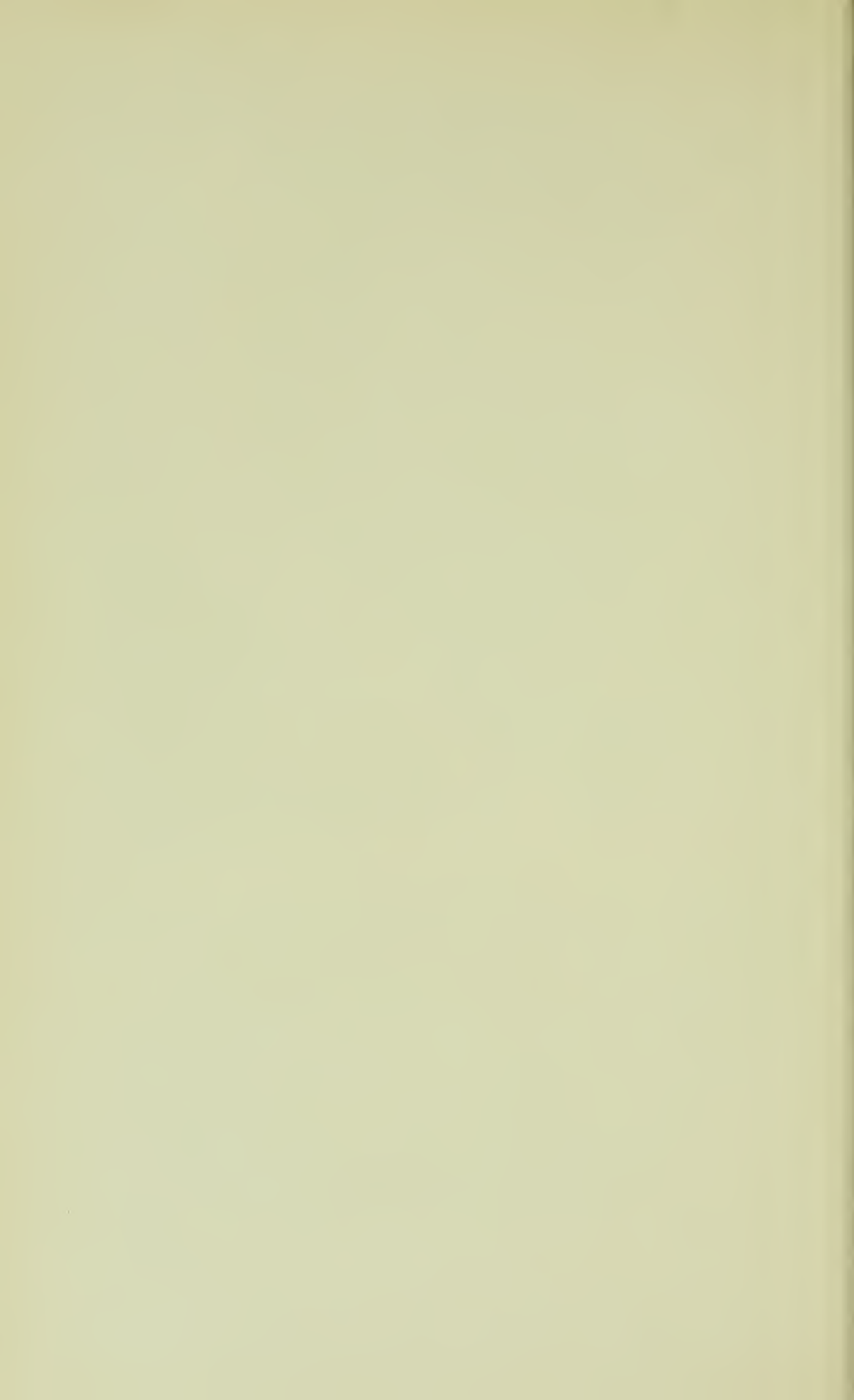
2. Enlargement of the under side of a small cephalo-thorax to which are attached the antennae and four pairs of appendages. Only a portion of the epistoma is preserved. This is the only specimen in the collection preserving the appendages of the cephalo-thorax in their approximately normal position. $\times 3$. U. S. National Museum, Catalogue No. 57488.

3. A portion of the matrix of the specimen represented by fig. 1. $\times 3$.

The illustration on pls. 2-7 are from photographs taken by Mr. J. M. Jessup and slightly retouched by pencil.



SIDNEYIA INEXPECTANS



DESCRIPTION OF PLATE 3

	PAGE
<i>Sidneyia inexpectans</i> Walcott.....	24
FIG. 1. A portion of a branchial leaf or lamella showing something of the structure. $\times 3$. U. S. National Museum, Catalogue No. 57486.	
2. Enlargement ($\times 2$) of the posterior segments of a specimen showing what appears to have been the contents of the alimentary canal. U. S. National Museum, Catalogue No. 57489.	
3. Enlargement ($\times 2$) of the caudal fin of the specimen represented by fig. 2, pl. 5.	
4. Enlargement ($\times 2$) of the caudal fin of the specimen represented by fig. 1, pl. 2.	



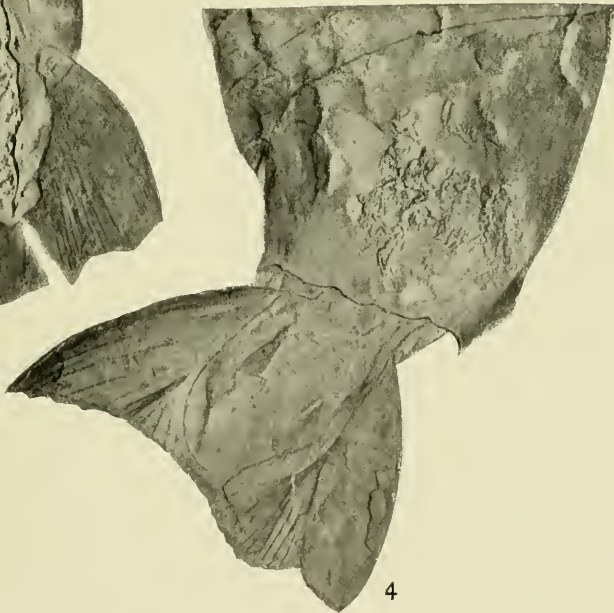
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3



2

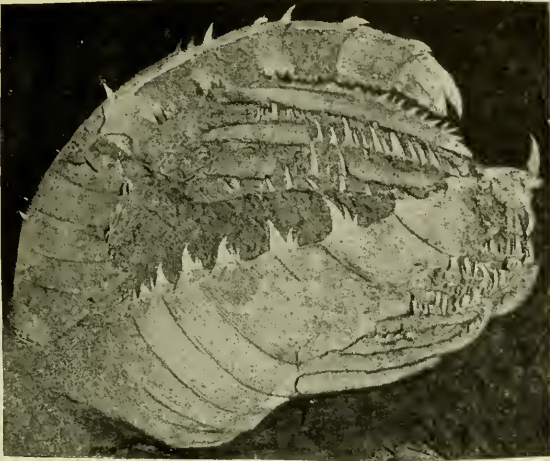


4

SIDNEYIA INEXPECTANS

DESCRIPTION OF PLATE 4

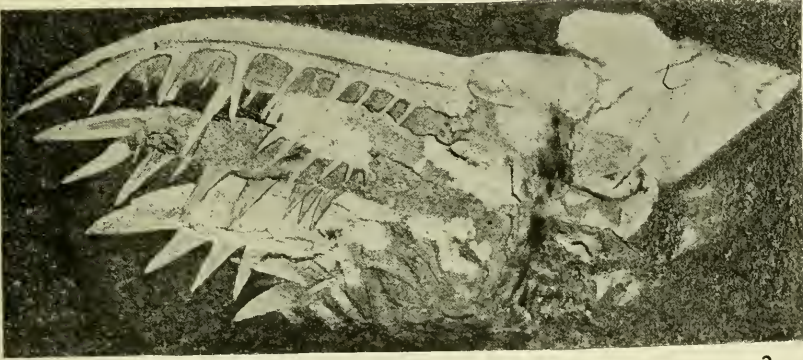
	PAGE
<i>Sidneyia inexpectans</i> Walcott.....	24
FIG. 1. Outer portion of the third pair of appendages of the cephalo-thorax ($\times 2$). In this there appears to have been a somewhat different development of parts as compared with those seen in figs. 3 and 4. U. S. National Museum, Catalogue No. 57490.	
2. Another form of the outward extension of one of the third pair of appendages of the cephalo-thorax ($\times 2$). This type reaches a very large size; one has a length of 65 mm. U. S. National Museum, Catalogue No. 57491.	
3. Outer extension of a part of one of the outer portions of the compound chelate termination of a third appendage ($\times 2$). The anterior arm, as shown in figs. 1 and 4, is broken away. U. S. National Museum, Catalogue No. 57492.	
4. Outer portion of one of the third pair of appendages of the cephalo-thorax, showing on the jointed primary appendage large, elongated spines with spinose fringes and a short, jointed appendage attached to the posterior outer side of the gnathobase. $\times 2$. U. S. National Museum, Catalogue No. 57493.	



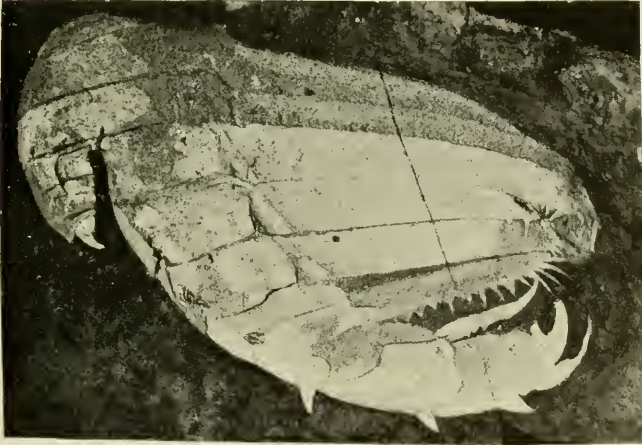
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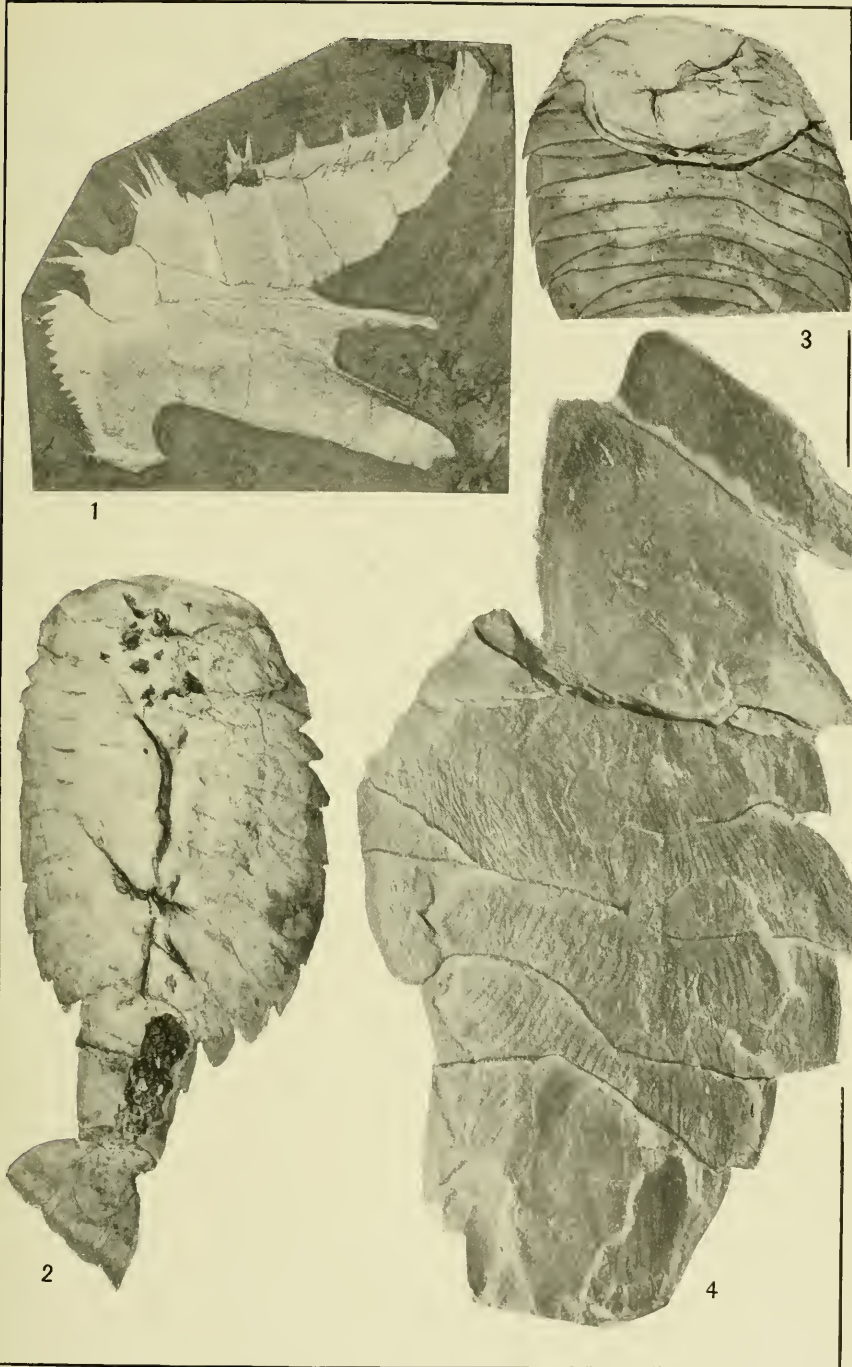


4

SIDNEYIA INEXPECTANS

DESCRIPTION OF PLATE 5

	PAGE
<i>Sidneyia inexpectans</i> Walcott.....	24
FIG. 1. The third, fourth, and fifth appendages of the cephalo-thorax, showing the gnathobases and something of the proportions of the appendages. $\times 3$. U. S. National Museum, Catalogue No. 57494.	
2. A small, nearly entire dorsal shield flattened and broken by compression in the shale. The position of the visceral cavity beneath the abdomen is faintly indicated through the thin test. Natural size. U. S. National Museum, Catalogue No. 57495.	
3. A large epistoma attached to the frontal rim of the cephalo-thorax and crowded back over the two anterior segments of the abdomen. Natural size. U. S. National Museum, Catalogue No. 57496.	
<i>Amiella ornata</i> Walcott.....	27
FIG. 4. Portion of a broken dorsal shield, showing parts of several abdominal segments which have been pushed one over the other. $\times 2$. U. S. National Museum, Catalogue No. 57499.	



SIDNEYIA INEXPECTANS AND AMIELLA ORNATA

DESCRIPTION OF PLATE 6

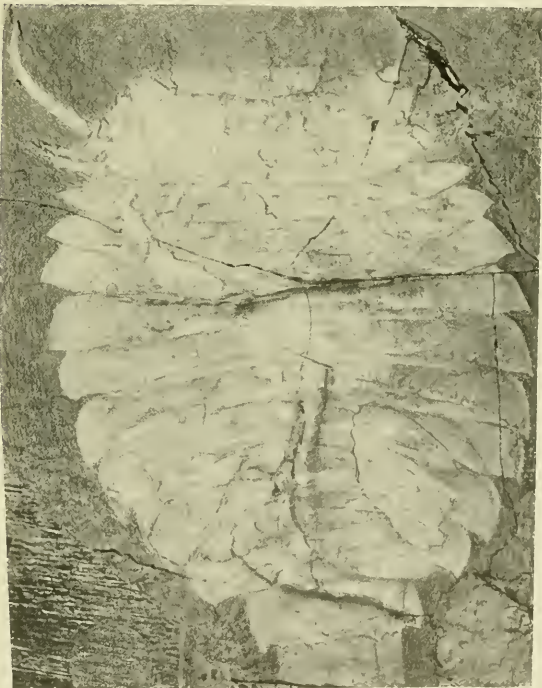
	PAGE
<i>Neolenus serratus</i> (Rominger).....	27
<p>FIG. 1. Branchial fringes on the exopodites of the left side of the interior of a compressed dorsal test. $\times 1.5$. Other specimens show the endopodites as slender, jointed legs. The specimen photographed was associated with <i>Sidneyia inexpectans</i>. U. S. National Museum, Catalogue No. 57500.</p> <p>2. A cephalic endopodite with lamellated branchial fringe. $\times 3$. This occurs on the opposite side of the specimen represented in part by fig. 1.</p>	
<i>Sidneyia inexpectans</i> Walcott.....	24
<p>FIG. 3. Photograph by reflected light of a broken specimen of the dorsal shield through which may be seen traces of the branchial lamellae and fringes and some of the appendages of the cephalo-thorax. Natural size. U. S. National Museum, Catalogue No. 57497.</p>	



1



2

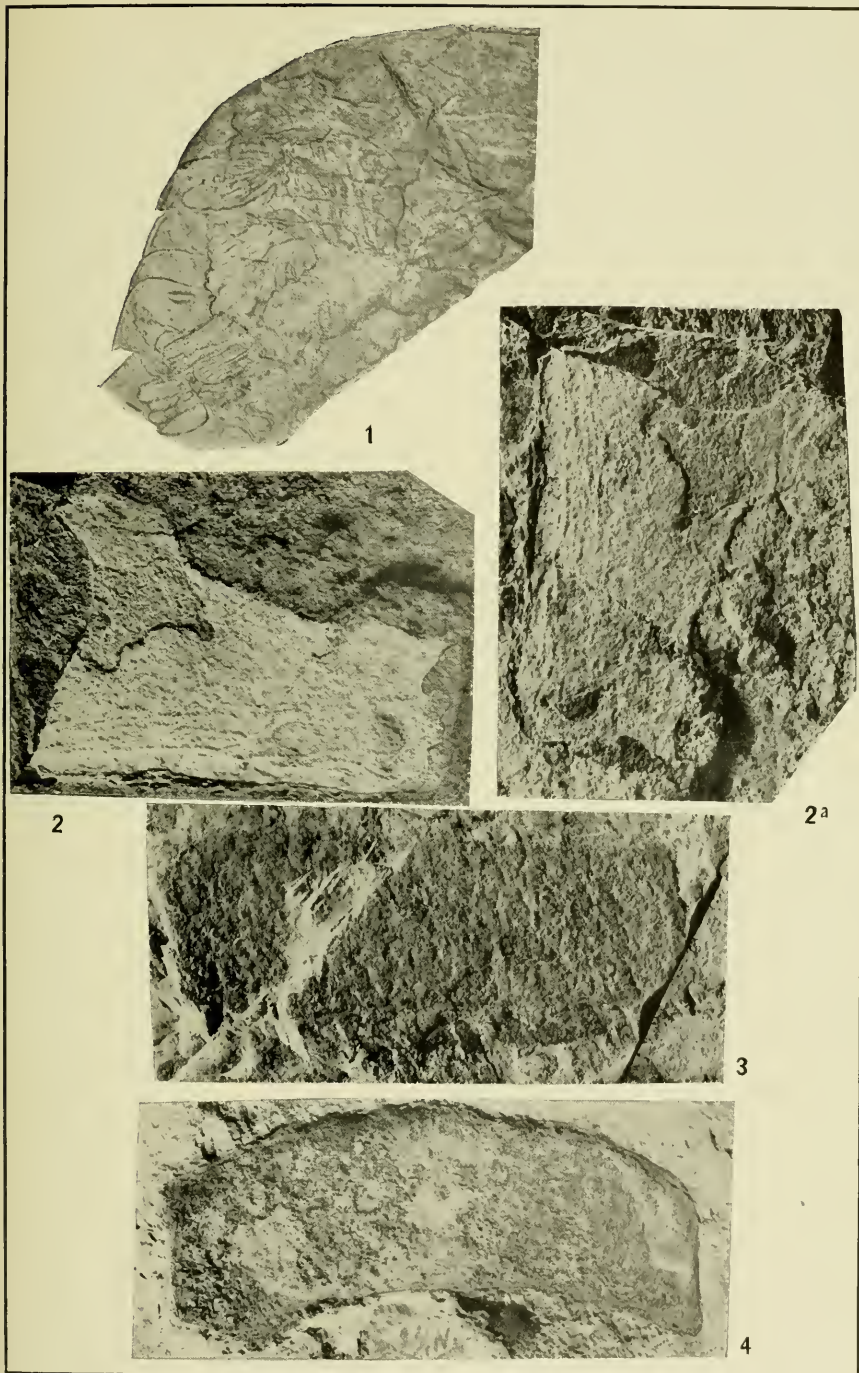


3

NEOLENUS SERRATUS AND SIDNEYIA INEXPECTANS

DESCRIPTION OF PLATE 7

- | | PAGE |
|--|------|
| <i>Sidneyia inexpectans</i> Walcott..... | 24 |
| <p>FIG. 1. Fragment of the ventral side of a small dorsal shield. $\times 2$.
 This shows the position of the leaf-like branchiae and branchial fringes. U. S. National Museum, Catalogue No. 57498.</p> | |
| <i>Beltina danaï</i> Walcott..... | 21 |
| <p>FIG. 2. Fragment of the cephalo-thorax, showing the posterior margin, a low, broad furrow, and in advance of that, irregular, transverse ridges and scattered tubercles. Natural size. U. S. National Museum, Catalogue No. 57501.</p> | |
| <p>2a. An untouched photograph of the specimen represented by fig. 2.</p> | |
| <p>3. An abdominal segment compressed in the siliceous shale that preserves more or less of the tuberculated surface. Natural size. U. S. National Museum, Catalogue No. 57502.</p> <p style="padding-left: 2em;">The specimens represented by figs. 2 and 3 are from locality (14z) Algonkian: near the head of Johnson Creek on the Continental Divide west of Pincher Post Office, Alberta, Canada.</p> | |
| <p>4. A large abdominal segment preserving a portion of the original convexity and tuberculated surface. Natural size. U. S. National Museum, Catalogue No. 57503.</p> <p style="padding-left: 2em;">The specimen represented by fig. 4 is from locality (14y) Algonkian: Altyn limestone; southeastern base of Appekuny mountain, opposite the mouth of Canyon Creek, in Swift Current Creek valley, at second gap from eastern end of mountain, near Altyn, Montana.</p> | |



SIDNEYIA INEXPECTANS AND BELTINA DANAI