BULLETIN

OF THE

MUSEUM OF COMPARATIVE ZOÖLOGY

AT

HARVARD COLLEGE, IN CAMBRIDGE.

VOL. I.

Nos. 1-13.

CAMBRIDGE, MASS., U. S. A.
1863-1869.

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KRAUS REPRINT CORPORATION
New York
1967

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Printed in U.S.A.

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BULLETIN

OF THE

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CAMBRIDGE, MASSACHUSETTS, U. S. A.

March 1, 1863.

In order to leave no doubt respecting the authority of the names adopted in our collections, as well as to explain various changes in the nomenclature of the specimens sent to other institutions by the Museum of Comparative Zoölogy, rendered necessary by the careful investigation to which they were submitted while arranging our own series, it is proposed from time to time to issue a Bulletin, calling attention to the evidence upon which the names adopted may rest. This will render the duplicates available for exchanges before a full account of the results thus reached can be published. Although the responsibility is left to those who may sign them, it is proper that I should add, that, in almost every instance, I have satisfied myself, by a direct revision, of the accuracy of the identifications.

Much important scientific work has been stored up with the specimens in the galleries of the Museum, during the past years, and left unpublished; but, in order to give proper credit to all those connected with our progress, it is recorded in this Bulletin with the date at which the investigation was made, though no claim of priority is thus intended. It is merely a matter of justice to those concerned in the arrangement of the collections.

L. AGASSIZ,

Director of the Museum.

No. 1. — *List of the Fishes sent by the Museum to different Institutions, in exchange for other Specimens, with Annotations. By* F. W. Putnam.

[Authentic labels accompany the specimens, having numbers on the left corresponding to those attached to the specimens. The figures on the right margin designate the number of specimens forwarded of each species.]

From the Fresh Waters of North America.

Lepidosteus osseus LaCépède, Hist. Nat. Poiss. V. p. 333. 1803.

Lepidosteus oxyurus Rafinesque, Ichth. Ohien. p. 73. 1820.

Cylindrosteus platostomus Rafinesque, Ichth. Ohien. p. 72. 1820.

The synonymy of the species of the genera *Lepidosteus* and *Cylindrosteus* is very complicated. The specimens included under the name of *Lepidosteus osseus* LaCépède are from South Carolina, the locality of Linnæus's *Esox osseus*, which LaCépède has confounded with the *Lepidosteus ferox* of authors, from the Mississippi River, under the name of *Lepidosteus spatula*.

Polyodon folium LaCépède, Hist. Nat. Poiss. I. p. 403. 1798.

Amia calva Linnæus, Syst. Nat. (12 ed.) I. p. 500. 1766.

Pimelodus atrarius DeKay, Fishes N. York. p. 185. 1842.

The specimens of *Pimelodus* forwarded are undoubtedly identical with the species described by DeKay under this name, but it remains to be proved that DeKay's species is not synonymous with some one of Rafinesque's.

Petromyzon americanus LeSueur, Trans. Am. Phil. Soc. (New Series,) I. p. 382. 1818.

Ichthyomyzon argenteus Girard, Pac. R. R. Surv. X. p. 381. 1859.

Syn. *Petromyzon argenteus* Kirtland, 1838.

Anguilla bostoniensis LeSueur, Jour. Philad. Acad. Nat. Sci. I. p. 82. 1817.

We question the validity of the several species of *Anguilla* that are described from our sea-coast and fresh waters.

Uranidea gracilis Putnam, MS. 1856.

Syn. *Cottus gracilis* Heckel, Ann. Wien. Mus. II. p. 148, 1837; *Uranidea quiescens* DeKay, 1842.

We do not see the necessity of the name *Acanthocottus*, proposed by Girard for the marine species of the old genus *Cottus*, when DeKay, many years before, by giving the name of *Uranidea* to one of our fresh-water species, recognized the two genera. It may be that DeKay did not have the *Cottus gobio* in view when he proposed the name of *Uranidea*, but his *U. quiescens* is the American representative of the *Cottus gobio* of Europe; and therefore, as he was the first to distinguish the two genera included under the name of *Cottus*, his name should be retained for the fluviatile species, and that of *Cottus* for the marine, called by Girard *Acanthocottus*. If the principle adopted by Girard were followed, it would involve the change of such a large number of generic names as to create the greatest confusion in nomenclature.

Catonotus lineolatus AGASSIZ, Am. Journ. Sci. Arts, (2ᵉ) XVII. p. 304. 1854.

Catonotus flabellatus PUTNAM, MS. 1860.

SYN. *Etheostoma flabellatum* RAFINESQUE, Ichth. Ohien. p. 36, 1820; *Etheostoma Linsleyi* H. R. STORER, 1851; *Oligocephalus humeralis* GIRARD, 1859; *Oligocephalus Linsleyi* GIRARD, 1859; *Catonotus fasciatus* GIRARD, 1859.

Catonotus Kennicotti PUTNAM, MS. 1860. (Nov. sp.)

We have dedicated this species to Mr. R. Kennicott, who has collected a number of fine specimens in "a rocky brook in Southern Illinois." It is closely allied to *C. lineolatus* AGASSIZ, but the scales are larger, and there are no distinct longitudinal stripes as in that species. The males have the scales of the upper portion of the tail spotted; the first dorsal fin is black, with a white base; the second dorsal, black, with spots of white upon the rays. Females, of a light brown color, with mottlings of a darker shade; no transverse bars, as in the females of the other species of the genus; with eggs in April and May.

Nothonotus AGASSIZ, MS. 1860. (Nov. gen.)

This genus differs from *Catonotus* by having the body more compressed, by the smaller and more numerous scales, and by the longer and higher first dorsal fin. *Nothonotus maculatus* AGASSIZ, MS. (*Etheostoma maculatum* KIRTLAND) and the following species are the only known representatives of the genus.

Nothonotus punctulatus AGASSIZ, MS. 1860.

SYN. *Pœcilichthys punctulatus* AGASSIZ, Am. Journ. Sci. Arts, (2ᵉ) XVII. p. 304, 1854; *Pœcilichthys mirabilis* GIRARD, MS. 1859; *Boleichthys Whipplei* GIRARD, 1859.

Pœcilichthys cœruleus AGASSIZ, MS. 1860.

SYN. *Etheostoma cæruleum* STORER, Proc. Bost. Soc. N. H. II. p. 47, 1845; *Pœcilosoma erythrogastrum* KIRTLAND, 1854; *Pœcilichthys erythrogaster* AGASSIZ, 1854; *Pœcilichthys versicolor* AGASSIZ, 1854; *Pileoma cymatogramma* ABBOTT, 1860.

Pœcilichthys spectabilis Agassiz, Am. Journ. Sci. Arts, (2e) XVII p. 304, 1854.

Microperca Putnam, MS. 1860. (Nov. gen.)

Body much compressed; tail long and broad; scales very large; no lateral line; first dorsal fin composed of six to seven rays; anal fin deep; pectorals and ventrals long; caudal slightly rounded.

Microperca punctulata Putnam, MS. 1860. (Nov. sp.)

This is the only known species of the genus, and is the smallest one in the family; the average length of the specimens being only an inch and a half. The color is buff, with dark brown zigzag markings. All the fins spotted, except the ventrals. Pectorals, and ventrals, reaching the commencement of second dorsal. We have received specimens from various points in Michigan, Wisconsin, Illinois, and Alabama.

Hololepis Agassiz, MS. 1860. (Nov. gen.)

Body much compressed; lateral line strongly arched over the pectorals; dorsal fins of nearly equal size; caudal fin slightly rounded; head covered with small scales. Only two species known.

Hololepis Barratti Agassiz, MS. 1860.

Syn. *Boleosoma tenue* Agassiz, 1850, without description; *Boleosoma Barratti* Holbrook, Journ. Philad. Acad. Nat. Sci. (New Series,) III. p. 56, 1855.

Hololepis fusiformis Putnam, MS. 1860.

Syn. *Boleosoma fusiforme* Girard, Proc. Bost. Soc. N. H. V. p. 41, 1854.

Boleichthys exilis Girard, Proc. Philad. Acad. Nat. Sci. XI. p. 103. 1859.

Boleichthys Warreni Girard, Proc. Philad. Acad. Nat. Sci. XI. p. 104 1859.

Etheostoma blennioides Rafinesque, Ichth. Ohien. p. 37. 1820.

Syn. *Diplesion blennioides* Girard, 1859.

Hadropterus nigrofasciatus Agassiz, Am. Journ. Sci. Arts, (2e) XVII. p. 303. 1854.

Hadropterus variatus Agassiz, MS. 1860.

Syn. *Etheostoma variatum* Kirtland, Zoöl. Ohio, pp. 168, 192, 1838; *Etheostoma notatum* Agassiz, 1850; *Pœcilosoma variatum* Agassiz, 1850; *Pœcilichthys variatus*, Agassiz, 1854.

Hadropterus maculatus Girard, Proc. Philad. Acad. Nat. Sci. XI. p. 100 1859.

Syn. *Alvordius maculatus* Girard, 1859.

Cottogaster Putnam, MS. 1860. (Nov. gen.)

General form of body, and position of mouth, as in *Boleosoma;* lateral line, straight; first dorsal fin with ten rays, lower than the second, which is of the same size and coterminal with the anal; caudal fin slightly forked.

Cottogaster tessellatus Putnam, MS. 1860.

Syn. *Boleosoma tessellatum* Thompson, App. Hist. Vt. p. 31, 1853. (Not of DeKay.)

Boleosoma Olmstedi Agassiz, Lake Sup. pp. 299, 304. 1850.

Syn. *Etheostoma Olmstedi* Storer, 1842; *Perca (Percina) minima* Haldeman, 1842; *Boleosoma tessellatum* DeKay, 1842; *Boleosoma tessellatum* Agassiz, 1850; *Boleosoma maculatum* Agassiz, 1850; *Boleosoma Olmstedi* Storer, 1853; *Arlina effulgens* Girard, 1859; *Estrella atromaculata* Girard, 1859.

Hyostoma transversum Putnam, MS. 1860.

Syn. *Pœcilosoma transversum* Abbott, Proc. Philad. Acad. Nat. Sci XII. p. 326. 1860.

Percina caprodes Girard, Proc. Philad. Acad. Nat. Sci. XI. p. 66. 1859.

Syn. *Sciæna caprodes* Rafinesque, 1818; *Etheostoma caprodes* Rafinesque, 1820; *Perca (Percina) nebulosa* Haldeman, 1842; *Pileoma semifasciatum* DeKay, 1842; *Percina bimaculata* Haldeman, 1843; *Etheostoma nebulosum* Storer, 1846; *Etheostoma semifasciatum* Storer, 1846; *Etheostoma bimaculatum* Storer, 1846; *Pileoma caprodes* Agassiz, 1850; *Pileoma Zebra* Agassiz, 1850; *Etheostoma Zebra* Agassiz, 1850; *Percina nebulosa* Girard, 1859; *Percina semifasciata* Girard, 1859; *Percina Zebra* Girard, 1859.

Pleurolepis Agassiz, MS. 1860. (Nov. gen.)

Body cylindrical, flattened above, and slightly tapering to the base of the caudal. Mouth terminal. Dorsal fins distinctly separated, of equal height, first longer than the second. Anal fin as large as the second dorsal, and placed opposite. Caudal slightly emarginate. Pectorals and ventrals long and pointed. Scales deeply imbedded and placed wide apart. The row containing the lateral line and the one each side of it are the most conspicuous. Cheeks and operculum covered with scales. Lateral line straight. The following is the only known species: —

Pleurolepis pellucidus Agassiz, MS. 1860. (Nov. sp.)

Syn. *Etheostoma pellucidum* Baird, MS. 1853.

From ten to fourteen small square olive blotches on the back and on each side, the rest of the body of a light cream-color; fins unicolored.

The last twenty species mentioned belong to the Etheostomata, a family of small fishes inhabiting the fresh waters of North America east of the Rocky Mountains, no species of which has thus far been discovered elsewhere. This family was first characterized by Professor Agassiz, in 1850, in "Lake Superior," p. 298.

Amblodon grunniens Rafinesque, Ichth. Ohien. p. 24. 1820.

Amblodon lineatus AGASSIZ, Am. Journ. Sci. Arts, (2^e) XVII. p. 307. 1854.

Perca flavescens CUV. & VAL. Hist. Nat. Poiss. (4° ed.) II. p. 33. 1828.

Merone americana GILL, Proc. Philad. Acad. Nat. Sci. XI. p. 115. 1860.

SYN. *Perca americana* GMELIN, 1788; *Merone rufa* MITCHILL, 1814; *Bodianus rufus* MITCHILL, 1814; *Labrax mucronatus* CUV. & VAL. 1828; *Labrax rufus* DEKAY, 1842; *Labrax americanus* HOLBROOK, 1855.

Grystes nobilis AGASSIZ, Am. Journ. Sci. Arts, (2^e) XVII. p. 298. 1854.

Pomoxis hexacanthus AGASSIZ, Am. Journ. Sci. Arts, (2^e) XVII. p. 299. 1854.

Centrarchus irideus CUV. & VAL. Hist. Nat. Poiss. III. (4° ed.) p. 66. 1829.

Calliurus gulosus AGASSIZ, Am. Journ. Sci. Arts, (2^e) XVII. p. 300. 1854.

Ichthelis incisor HOLBROOK, Ichth. S. Car. I. p. 12. 1860.

Ichthelis rubricauda HOLBROOK, Ichth. S. Car. I. p. 15. 1860.

Bryttus obesus GIRARD, Proc. Philad. Acad. Nat. Sci. XI. p. 64. 1859.

Pomotis auritus RAFINESQUE, Ichth. Ohien. p. 29. 1820.

SYN. *Perca fluviatilis gibbosa* CATESBY, II. Pl. 8, f. 3, 1742; *Labrus auritus* LINNÆUS, 1766; ? *Merone maculata* MITCHILL, 1814; *Ichthelis* (*Pomotis*) *aurita* RAFINESQUE, 1820; *Pomotis Catesbei* CUV. & VAL. 1831; *Pomotis vulgaris* of all authors except CUV. & VAL.

There seems to have been such a general misunderstanding in regard to this, our most common species of the genus, that a few words of explanation are necessary to show the reason for restoring the specific name of *auritus* to the species in question.

In the tenth edition of the "Systema Naturæ," Linnæus mentions a fish from Philadelphia under the name of *Labrus auritus*. This fish is undoubtedly a *Pomotis;* but from the short description given it would be impossible to refer the species with precision to any of the many that inhabit our fresh waters, were it not for the reference in the twelfth edition of the "Systema Naturæ" to the figure of Catesby, which unquestionably represents our common "Bream," or "Pond-fish," — thus settling the species which Linnæus had in mind, though we think he confounded with it some other species sent him by Dr. Garden from South Carolina, probably the *Ichthelis rubricauda* of Holbrook.

In 1820, Rafinesque described the species in question under the specific name given by Linnæus, referring it to his sub-genus *Pomotis*.

In the third volume of the "Histoire Naturelle des Poissons," the authors, overlooking the description by Rafinesque, describe and figure a species of the genus under the name of *Pomotis vulgaris*, referring the *Labrus auritus* of Linnæus to it. This species is very different from the one figured by Catesby, and is probably identical with the *Labrus appendix* of Mitchill (*Pomotis appendix* DEKAY), though in the second edition of the "Règne

Animal" Cuvier refers the figure of Catesby to it. In this mistake Cuvier and Valenciennes have been followed by all subsequent authors, who seem to have taken it for granted that the species bearing the name of *vulgaris* must be the common one, or, omitting to look up the authority of the specific name *auritus*, have considered that name as obsolete. In the seventh volume of the "Histoire Naturelle des Poissons," referring to the figure in Catesby, the authors have again described the *Labrus auritus* under the name of *Pomotis Catesbei*. In the illustrated edition of the "Règne Animal," the *Pomotis auritus* is very well figured under the name of *Pomotis vulgaris*.

Percopsis guttatus Agassiz, Lake Sup. p. 286. 1850.
Syn. *Salmoperca pellucida* Thompson, 1853.

Esox reticulatus LeSueur, Journ. Philad. Acad. Nat. Sci. I. p. 414. 1818.

Esox fasciatus DeKay, Fishes of N. York, p. 224. 1842.
Syn. *Esox ornatus* Girard, 1854.

Amblyopsis spelæus DeKay, Fishes of N. York, p. 187. 1842.
This is the well-known "Blind-fish" of the Mammoth Cave, Kentucky.

Fundulus multifasciatus Cuv. & Val. Hist. Nat. Poiss. (4° ed.) XVIII. p. 150. 1846.

Hydrargyra catenata Agassiz, Am. Journ. Sci. Arts, (2e) XVII. p. 353. 1854.

Plargyrus americanus Putnam, MS. 1861.
Syn. *Cyprinus americanus* Linnæus, 1766 (not of the 10th ed. Syst. Nat.); *Cyprinus americanus* LaCépède, 1803; *Cyprinus chrysoleucus* Mitchill, 1815; (*Rutilus*) *Plargyrus chrysoleucus* Rafinesque, 1820; (*Cyprinus*) *Leuciscus chrysoleucus* Richardson, 1837; *Leuciscus chrysoleucus* Storer, 1839; *Stilbe chrysoleucus* DeKay, 1842; *Abramis versicolor* DeKay, 1842; *Leuciscus Boscii* Cuv. & Val. 1844; *Leuciscus americanus* Storer, 1846; *Leucosomus americanus* Girard, 1853; *Luxilus americanus* Girard, 1856.

Hypsolepis cornutus Agassiz, Am. Journ. Sci. Arts, (2e) XVII. p. 359. 1854.
Syn. *Cyprinus cornutus* Mitchill, 1817; *Leuciscus cornutus* Storer, 1842; *Plargyrus cornutus* Girard, 1856.

Hypsolepis frontalis Agassiz, Am. Journ. Sci. Arts, (2e) XVII. p. 356. 1854.
Syn. *Leuciscus frontalis* Agassiz, (male,) 1850; *Leuciscus gracilis* Agassiz, (female,) 1850; *Plargyrus frontalis* Girard, 1856; *Plargyrus gracilis* Girard, 1856.

Hypsolepis diplemius Putnam, MS. 1861.
Syn. *Semotilus diplemius* Rafinesque, Ichth. Ohien. p. 50, 1820; *Leuciscus diplemius* Kirtland, 1845.

Semotilus argenteus PUTNAM, MS. 1861.

SYN. *Leuciscus argenteus* STORER, (young,) Rep. Fishes of Mass. p. 90, 1839; *Leuciscus pulchellus* STORER, (adult,) 1839; ? *Leucosomus argenteus* HECKEL, 1841; ? *Leucosomus chrysoleucus* HECKEL, 1841; ? *Leuciscus nitidus* DEKAY, 1842 (young?); *Leuciscus Storeri* CUV. & VAL. 1844; *Cheilomenus pulchellus* GIRARD (in STORER), 1855; *Leucosomus pulchellus* GIRARD, 1856; ? *Hybognathus nitidus* GIRARD, 1856 (young?).

Semotilus corporalis ABBOTT, Proc. Philad. Acad. Nat. Sci. XIII. p. 154. 1861.

SYN. *Cyprinus corporalis* MITCHILL, 1817; *Cyprinus atromaculatus* MITCHILL, 1817; *Semotilus dorsalis* RAFINESQUE, 1820; *Semotilus cephalus* RAFINESQUE, 1820; *Leuciscus atromaculatus* DEKAY, 1842; *Leuciscus iris* CUV. & VAL. 1844; *Semotilus atromaculatus* GIRARD, 1856; *Semotilus corporalis* PUTNAM, MS. 1861; *Semotilus corporalis* ABBOTT, 1861; *Semotilus atromaculatus* ABBOTT, 1861; *Leucosomus rhotheus* COPE, 1861; *Leucosomus atromaculatus* COPE, 1861.

Gobio plumbeus AGASSIZ, Lake Sup. p. 366. 1850.

SYN. *Leucosomus plumbeus* GIRARD, 1856.

As Professor Agassiz has stated in "Lake Superior," this species differs generically from the true genus *Gobio;* but as it has not yet been referred to its proper genus, we send it under the original name of the describer.

Ceratichthys biguttatus BAIRD; GIRARD, Proc. Philad. Acad. Nat. Sci. VII. p. 112. 1856.

SYN. *Semotilus biguttatus* KIRTLAND, 1840; *Leuciscus biguttatus* DEKAY, 1842.

Chrosomus erythrogaster RAFINESQUE, Ichth. Ohien. p. 47. 1820.

SYN. ? *Rutilus ruber* RAFINESQUE, 1820; *Luxilus erythrogaster* KIRTLAND, 1842; *Leuciscus erythrogaster* STORER, 1846.

Pimephales promelas RAFINESQUE, Ichth. Ohien. p. 53. 1820.

SYN. ? *Pimephales maculosus* GIRARD, 1856; *Pimephales fasciatus* GIRARD, 1856; *Plargyrus melanocephalus* ABBOTT, 1860.

Exoglossum maxillingua HALDEMAN, in RUPP., Hist. Lanc. Co. Pa. p. 474. 1844.

SYN. *Cyprinus maxillingua* LESUEUR, 1817; *Exoglossum LeSueurianum* RAFINESQUE, 1818; *Catostomus maxillingua* DEKAY, 1842.

Campostoma anomalum AGASSIZ, Am. Journ. Sci. Arts, (2e) XIX. p. 219. 1855.

SYN. *Rutilus anomalus* RAFINESQUE, 1820; *Exoglossum dubium* KIRTLAND, 1838; *Exoglossum spinicephalum* CUV. & VAL. 1844; *Leuciscus prolixus* STORER, 1845; *Chondrostoma prolixum* AGASSIZ, 1854; *Chondrostoma pullum* AGASSIZ, 1854.

Hybognathus nuchalis Agassiz, Am. Journ. Sci. Arts, (2e) XIX. p. 224 1855.

Clinostomus elongatus Girard, Proc. Philad. Acad. Nat. Sci. VII. p. 112. 1856.

Syn. *Luxilus elongatus* Kirtland, 1838 ; *Leuciscus elongatus* DeKay, 1842 ; ? *Leuciscus productus* Storer, 1846 ; *Alburnus pleuriticus* Agassiz, MS. 1854.

Hybopsis Storerianus Agassiz, Am. Journ. Sci. Arts, (2e) XVII. p. 358. 1854.

Syn. *Rutilus Storerianus* Kirtland, 1842 ; *Leuciscus Storerianus* Kirtland, 1845.

Hybopsis dorsalis Agassiz, Am. Journ. Sci. Arts, (2e) XVII. p. 358. 1854.

Hybopsis hudsonius Putnam, MS. 1861.

Syn. *Clupea hudsonia* Clinton, Ann. Lyc. Nat. Hist. N. Y. I. p. 49, 1824 ; *Leuciscus hudsonius* DeKay, 1842 ; *Hudsonius fluviatilis* Girard, 1856.

Alburnus rubellus Agassiz, Lake Sup. p. 364. 1850.

Alburnus lineolatus Agassiz, MS. 1854. (Nov. sp.)

Body light brown with a broad silvery band having dark points, extending from the head to the caudal fin. Average length, two and a half inches. From the Osage River. Collected by Mr. G. Stolley.

Alburnus zonatus Agassiz, MS. 1854. (Nov. sp.)

Brown upon the back ; a silvery band from the nose across the eye to the caudal fin, beneath this a slightly broader dark band, which extends from the snout to the tip of the central rays of the caudal fin ; silvery below the dark band. Head large and rounded. Average length of specimens, three inches. Osage River, Mr. Stolley.

Alburnus formosus Putnam, MS. 1861. (Nov. sp.)

Specimens of this species were collected near Mobile, Alabama, by Judge LeSene and Albert Stein, Esq. The body is more arched, the scales are larger, and the anal fin is longer and deeper, than in any other species of the genus with which we are acquainted. Color brown above, with a lighter shade bordering the broad chocolate band on the side ; light brown below. Average length, two inches.

Rhinichthys atronasus Agassiz, Lake Sup. p. 354. 1850.

Syn. *Cyprinus atronasus* Mitchill, 1815 ; *Argyreus atronasus* Heckel, 1841 ; ? *Argyreus rubripinnis* Heckel, 1841 ; *Leuciscus atronasus* Cuv. & Val. 1844.

Rhinichthys nasutus Agassiz, Lake Sup. p. 354. 1850.

Syn. *Leuciscus nasutus* Ayres, 1843 ; *Argyreus nasutus* Girard ; Storer, 1855.

Rhinichthys obtusus AGASSIZ, Am. Journ. Sci. Arts, (2e) XVII. p. 357. 1854.
SYN. *Argyreus obtusus* GIRARD, 1856.

Rhinichthys marmoratus AGASSIZ, Lake Sup. p. 354. 1850.
SYN. *Argyreus marmoratus* GIRARD, 1856.

Bubalichthys Urus AGASSIZ, Am. Journ. Sci. Arts, (2e) XIX. p. 194. 1855

Ichthyobus Rauchii AGASSIZ, Am. Journ. Sci. Arts, (2e) XIX. p. 197. 1855.

Ptychostomus aureolus AGASSIZ, Am. Journ. Sci. Arts, (2e) XIX. p. 205. 1855.

Hylomyzon nigricans AGASSIZ, Am. Journ. Sci. Arts, (2e) XIX. p. 207. 1855.

Moxostoma oblongum AGASSIZ, Am. Journ. Sci. Arts, (2e) XIX. p. 203. 1855.

Moxostoma tenue AGASSIZ, Am. Journ. Sci. Arts, (2e) XIX. p. 203. 1855.

Moxostoma Sucetta AGASSIZ, Am. Journ. Sci. Arts, (2e) XIX. p. 203. 1855.

Catostomus bostoniensis LESUEUR, Journ. Philad. Acad. Nat. Sci. I. p. 106 1817.

Catostomus Fosterianus AGASSIZ, Lake Sup. p. 358. 1850.

Catostomus aurora AGASSIZ, Lake Sup. p. 360. 1850.

From the Atlantic Coast of North America and the West Indies.

Myxine limosa GIRARD, Proc. Philad. Acad. Nat. Sci. X. p. 223. 1858.
This Myzont is very abundant, at certain seasons, on the coast of Grand Menan. It has never been compared, as far as we are aware, with *Myxine glutinosa* LINNÆUS, and as we are doubtful of its being distinct, specimens from the Old World, or at least the results of a comparison, would be very acceptable to the Museum.

Mustelus Canis DEKAY, Fishes of New York, p. 355. 1842.

Acanthias americanus STORER, Synop. Fishes N. A. p. 254. 1846.
This species is viviparous. We send young taken from the mother.

Raja lævis MITCHILL, Am. Month. Mag. II. p. 327. 1817.
The synonymy of the genus *Raja* is in such a confused state, that we are not certain about the identification of a single species found on our coast.

Cyclopterus lumpus LINNÆUS, Syst. Nat. (12 ed.) I. p. 414. 1766.
We have not been able to compare this with the species of the same name on the European coast, and therefore cannot answer for its identity. We should be happy to receive specimens from Europe.

Muraenoides mucronatus GILL, Proc. Philad. Acad. Nat. Sci. XIII. App. p. 45. 1861.
SYN. *Gunnellus mucronatus* CUV. & VAL. 1836.

Anarrhichas vomerinus Agassiz; Storer, Mem. Am. Acad. (2^{e}) V. p. 265. 1855.

Zoarces anguillaris Storer, Rep. Fishes of Mass. p. 66. 1839.

Gasterosteus biaculeatus Mitchill, Trans. Lit. Phil. Soc. N. Y. I. p. 430. 1815.

The specimens included under this name are undoubtedly representatives of Mitchill's *Gasterosteus biaculeatus*, but it remains to be proved that the *G. biaculeatus* of Shaw and Mitchill are identical. There are two, if not three species, of two-spined *Gasterostei* inhabiting the Atlantic coast of North America.

Pygosteus DeKayi Brevoort; Gill, Proc. Philad. Acad. Nat. Sci. XIII. App. p. 45. 1861.

Syn. *Gasterosteus occidentalis* DeKay, 1842 (not of Cuv. & Val.); *Gasterosteus DeKayi* Agassiz, 1850.

Cryptacanthodes maculatus Storer, Rep. Fishes of Mass. p. 28. 1839.

Cottus grœnlandicus Cuv. & Val. Hist. Nat. Poiss. (4° ed.) IV. p. 135. 1829.

Syn. *Acanthocottus grœnlandicus* Girard, 1850.

We doubt the distinction of *Cottus variabilis* Ayres.

Cottus octodecimspinosus Mitchill, Trans. Lit. Phil. Soc. N. Y. I. p. 380. 1815.

Syn. *Cottus virginianus* Storer, 1839; *Acanthocottus virginianus* Girard, 1850.

Hemitripterus acadianus Storer, Mem. Am. Acad. (2^{e}) V. p. 83. 1855.

Sebastes norvegicus Cuv. & Val. Hist. Nat. Poiss. (4° ed.) IV. p. 240. 1829.

Prionotus palmipes Storer, Mem. Am. Acad. (2^{e}) V. p. 66. 1855.

? *Trigla carolina* Linnæus.

Ephippus faber Cuvier, Règne An. II. p. 190. 1829.

Holacanthus ciliaris LaCépède, Hist. Nat. Poiss. IV. p. 367. 1802.

Chætodon striatus Linnæus, Syst. Nat. (10 ed.) I. p. 275. 1758.

Mesoprion chrysurus Cuv. & Val. Hist. Nat Poiss. (4° ed.) II. p. 347. 1828.

Mesoprion uninotatus Cuv. & Val. Hist. Nat. Poiss. (4° ed.) II. p. 339. 1828.

Diplectrum fasciculare Holbrook, Ichth. S. Car. I. p. 32. 1855.

Holocentrum longipinne Cuv. & Val. Hist. Nat. Poiss. (4° ed.) III. p. 138. 1829.

The *Holocentrus sogho* Bloch is a distinct species.

Centropristes nigricans Cuv. & Val. Hist. Nat. Poiss. (4° ed.) III. p. 28. 1829.

Centropristes atrarius Holbrook, Ichth. S. Car. I. p. 42. 1855.

Centropristes trifurcus Cuv. & Val. Hist. Nat. Poiss. (4° ed.) III. p. 32 1829.

Homoprion xanthurus Holbrook, Ichth. S. Car. I. p. 170. 1855.
? *Perca punctatus* Linnæus, 1766. (Sic!!)
Considerable confusion exists in regard to this species. We send it under the name given by Dr. Holbrook, though he may be wrong in considering it as identical with LaCépède's *Liostomus xanthurus*.

Liostomus obliquus DeKay, Fishes of N. Y. p. 69. 1842.

Johnius ocellatus Girard, Ichth. Mex. Bound. II. p. 14. 1859.
Syn. *Corvina ocellata* Cuv. & Val. 1830.

Otolithus carolinensis Cuv. & Val. Hist. Nat. Poiss. (4° ed.) IX. p. 351. 1833.

Otolithus regalis Cuv. & Val. Hist. Nat. Poiss. (4° ed.) V. p. 50. 1830.

Pogonias fasciatus LaCépède, Hist. Nat. Poiss. III. p. 138. 1802.

Umbrina alburnus Cuv. & Val. Hist. Nat. Poiss. (4° ed.) V. p. 133. 1830.

Umbrina littoralis Holbrook, Ichth. S. Car. I. p. 142. 1855.

Micropogon undulatus Cuv. & Val. Hist. Nat. Poiss. (4° ed.) V. p. 163. 1830.

Larimus fasciatus Holbrook, Ichth. S. Car. I. p. 153. 1855.

Orthopristis duplex Girard, Ichth. Mex. Bound. II. p. 15. 1859.

Orthopristis fulvomaculatus Gill, Proc. Philad. Acad. Nat. Sci. XIII. App. p. 32. 1861.

Hæmylum formosum Cuv. & Val. Hist. Nat. Poiss. (4° ed.) V. p. 174. 1830.
In accordance with its etymology, the name *Hæmulon* is changed to *Hæmylum*, as stated in the "Nomenclator Zoölogicus."

Hæmylum elegans Cuv. & Val. Hist. Nat. Poiss. (4° ed.) V. p. 169. 1830.

Hæmylum Arara Poey, Mém. de Cuba, II. p. 177. 1860.

Diabasis albus Scudder, MS. Apr. 1862.
Syn. *Hæmulon album* Cuv. & Val. Hist. Nat. Poiss. (4° ed.) V. p. 179, 1830.

Anarmostus flavolineatus Scudder, MS. Apr. 1862.
Syn. *Diabasis flavolineatus* Desmarest, Decade Ichth. p. 35, 1823; *Hæmulon heterodon* Cuv. & Val. 1829.

Anarmostus serratus Scudder, MS. Apr. 1862.
Syn. ? *Hæmulon serratus* Poey, Mém. de Cuba, II. p. 181, 1860.

Bathystoma melanurum Scudder, MS. Apr. 1862.
Syn. *Perca melanura* Linnæus, Syst. Nat. (10 ed.) I. p. 292, 1758

Bathystoma Jeniguarno Scudder, MS. Apr. 1862.
Syn. *Hæmulon Jeniguarno* Poey, Mém. de Cuba, II. p. 183, 1860.

Bathystoma chrysopterum SCUDDER, MS. Apr. 1862.
SYN. *Hæmulon chrysopteron* CUV. & VAL. Hist. Nat. Poiss. (4° ed.) V. p. 179, 1830.

Ctenolabrus Burgall CUV. & VAL. Hist. Nat. Poiss. (4° ed.) XIII. p. 172. 1839.
SYN. *Ctenolabrus cœruleus* DEKAY, 1842.

Pleuronectes maculatus MITCHILL, Rep. Fishes of N. Y. p. 9. 1814.

Platessa oblonga DEKAY, Fishes of N. York, p. 299. 1842.

Platessa plana STORER, Rep. Fishes of Mass. p. 140. 1839.

Achirus mollis CUVIER, Règne An. II. p. 343. 1829.

Scomber vernalis MITCHILL, Trans. Lit. Phil. Soc. N. Y. I. p. 423. 1815.

Peprilus triacanthus STORER, Rep. Fishes of Mass. p. 60. 1839.

Temnodon Saltator CUVIER, Règne An. II. p. 207. 1829.

Atherina notata MITCHILL, Trans. Lit. Phil. Soc. N. Y. I. p. 446. 1815.

Ammodytes americanus DEKAY, Fishes of N. York, p. 317. 1842.

Phycis americanus STORER, Rep. Fishes of Mass. p. 138. 1839.

Phycis filamentosus STORER, Mem. Am. Acad. VI. p. 367. 1859.

Merluccius albidus DEKAY, Fishes of N. York, p. 280. 1842.

Merlangus purpureus STORER, Rep. Fishes of Mass. p. 130. 1839.

Morrhua americana, STORER, Rep. Fishes of Mass. p. 120. 1839.

Gadus Æglefinus LINNÆUS, Syst. Nat. (10 ed.) I. p. 251. 1758.

Clupea elongata LESUEUR, Journ. Philad. Acad. Nat. Sci. I. p. 234. 1818.

Alausa Menhaden STORER, Rep. Fishes of Mass. p. 117. 1839.

Osmerus viridescens LESUEUR, Journ. Philad. Acad. Nat. Sci. I. p. 230. 1818.

Mallotus villosus CUVIER, Règne An. II. p. 306. 1829.

Fundulus pisculentus CUV. & VAL. Hist. Nat. Poiss. (4° ed.) XVIII. p. 143. 1846.

Fundulus heteroclitus CUVIER, Règne An. II. p. 280. 1829.
SYN. *Cobitis heteroclita* LINNÆUS, 1766; *Fundulus cœnicolus* CUV. & VAL. 1846.

Fundulus spilotus HOLBROOK, (MS.?) 1854.
SYN. *Fundulus guttatus* AGASSIZ, MS. 1854 (female).

Hydrargyra majalis CUV. & VAL. Hist. Nat. Poiss. (4° ed.) XVIII. p. 155, 1846.
SYN. *Hydrargyra flavula* STORER, 1839.

Hydrargyra similis BAIRD & GIRARD, Proc. Philad. Acad. Nat. Sci. VI. p. 389. 1853.

Zygonectes chrysotus AGASSIZ, MS. 1861.
SYN. *Fundulus chrysotus* AGASSIZ; HOLBROOK, 1853 (MS.?).

Cyprinodon variegatus LACÉPÈDE, Hist. Nat. Poiss. V. p. 487. 1803.

Pœcilia latipinna AGASSIZ, MS. 1858.
SYN. *Mollinesia latipinna* LESUEUR, (male); *Pœcilia multilineata* LESUEUR, (female,) Journ. Philad. Acad. Nat. Sci. II. pp. 3, 4, 1821.

Gambusia Holbrookii GIRARD, Proc. Philad. Acad. Nat. Sci. XI. p. 61. 1859.
SYN. *Heterandria Holbrookii* AGASSIZ, 1853.

Girardinus formosus GIRARD, Proc. Philad. Acad. Nat. Sci. XI. p. 62. 1859.
SYN. *Heterandria formosa* AGASSIZ, 1853.

These last three species are viviparous. *G. formosus* is the smallest known Vertebrate.

From the Pacific Coast of North America.

Triacis semifasciata GIRARD, Proc. Philad. Acad. Nat. Sci. VII. p. 196. 1854.
SYN. *Mustelus Felis* AYRES, 1854.

Triacis Henlei PUTNAM.
SYN. *Isoplagiodon* sp. GILL, 1862; *Rhinotriacis Henlei* GILL, Proc. Philad. Acad. Nat. Sci. XIV. p. 486, 1862.

The characters given by Mr. Gill to the genus *Rhinotriacis* are, in our estimation, only of specific value. Mr. Gill's specimen being immature probably accounts for the apparent difference between the teeth of this species and those of *T. semifasciata*, for in our numerous examinations we have found teeth on both jaws having two distinct notches on each side of the central point, although these five-lobed teeth are more numerous in the lower than in the upper jaw. *T. Henlei* differs principally from *T. semifasciata* in its longer, flattened, and pointed snout; in its scales not being so strongly tri-lobed, and in the color, which is of a uniform brownish gray above, becoming lighter below. In young individuals the color is redder above and white below. In all specimens the two dorsals and the caudal are tipped with black. *T. Henlei* is more slender than *T. semifasciata*, but attains about the same length.

Acanthias Suckleyi GIRARD, Proc. Philad. Acad. Nat. Sci. VII. p. 196. 1854.

Porichthys notatus GIRARD, Proc. Philad. Acad. Nat. Sci. VII. p. 141. 1854.

Leptocottus armatus GIRARD, Proc. Philad. Acad. Nat. Sci. VII. p. 131. 1854.

Scorpænichthys marmoratus GIRARD, Proc. Philad. Acad. Nat. Sci. VII. p. 131. 1854.

Ambloplites interruptus GIRARD, Proc. Philad. Acad. Nat. Sci. VII. p. 129. 1854.

Genyonemus lineatus GILL, Proc. Philad. Acad. Nat Sci. XIII. p. 87. 1861.
SYN. *Leiostomus lineatus* AYRES, 1855.

Embiotoca Jacksoni AGASSIZ, Am. Journ. Sci. Arts, (2^e) XVI. p. 387. 1853.
SYN. *Holconotus fuliginosus* GIBBONS, 1854; *Embiotoca Cassidyi* GIRARD, 1854; *Embiotoca Webbi* GIRARD, 1855.

Hypsurus Caryi A. AGASSIZ, Proc. Boston Soc. Nat. Hist. VIII. p. 133. 1861.
SYN. *Embiotoca Caryi* AGASSIZ, 1853; *Holconotus Gibbonsii* Cal. Acad. Nat. Sci. 1854.

Tæniotoca lateralis A. AGASSIZ, Proc. Boston Soc. Nat. Hist. VIII. p. 133. 1861.

SYN. *Embiotoca lateralis* AGASSIZ, 1854; *Holconotus Agassizi* GIBBONS, 1854; *Embiotoca lineata* GIRARD, 1854; *Embiotoca ornata* GIRARD, 1855; *Embiotoca perspicabilis* GIRARD, 1855; *Damalichthys lateralis* GILL, 1862.

This species is, without doubt, congeneric with DITREMA of the "Fauna Japonica."

Damalichthys Vacca GIRARD, Proc. Philad. Acad. Nat. Sci. VII. p. 321. 1855.

Cymatogaster aggregatus GIBBONS, Proc. Cal. Acad. Nat. Sci. May 18, 1854.

SYN. *Micrometrus aggregatus* GIBBONS, 1854; *Holconotus rhodoterus* GIRARD, 1854 (not of AGASSIZ); *Metrogaster lineolatus* AGASSIZ, MS.

Micrometrus minimus GIBBONS, Proc. Cal. Acad. Nat. Sci. May 30, 1854.
SYN. *Cymatogaster minimus* GIBBONS, 1854; *Holconotus Trowbridgii* GIRARD, 1854; *Abeona Trowbridgii* GIRARD, 1855; *Abeona minima* GILL, 1862.

Rhacochilus toxotes AGASSIZ, Am. Journ. Sci. Arts, (2^e) XVII. p. 367. 1854.
SYN. *Pachylabrus variegatus* GIBBONS, 1854.

Amphistichus argenteus AGASSIZ, Am. Journ. Sci. Arts, (2^e) XVII. p. 367. 1854.

SYN. *Mytilophagus fasciatus* GIBBONS, 1854; *Amphistichus similis* GIRARD, 1854.

Holconotus rhodoterus AGASSIZ, Am. Journ. Sci. Arts, (2^e) XVII. p. 368. 1854 (not of GIRARD).

SYN. *Cymatogaster Larkinsii* GIBBONS, 1854; ? *Cymatogaster ellipticus* GIBBONS, 1854; *Amphistichus Hermanni* GIRARD, 1854; *Ennichthys Hermanni* GIRARD, 1855.

Hyperprosopon argenteum Gibbons, Proc. Cal. Acad. Nat. Sci. May 18, 1854

Syn. *Holconotus megalops* Girard, 1854; *Ennichthys megalops* Girard, 1855; *Bramopsis Mento* Agassiz, MS.

Hyperprosopon arcuatum Gibbons, Proc. Cal. Acad. Nat. Sci. May 30, 1854.

Syn. *Hyperprosopon argenteum* var. *punctatum* Gibbons, 1854; *Hyperprosopon Agassizi* Gill, 1862.

For a full revision of the Synonymy of the Holconoti, see *Notes on the Described Species of Holconoti found on the Western Coast of North America*, by A. Agassiz, in the Proc. Boston Soc. Nat. Hist. Vol. VIII. p. 122. 1861.

Platichthys rugosus Girard, Proc. Philad. Acad. Nat. Sci. VII. p. 139. 1854.
We send both natural and reversed specimens of this species.

From the East Indies.

Pegasus natans Linnæus, Syst. Nat. (12 ed.) I. p. 418. 1766.

Scatophagus Argus Cuv. & Val. Hist. Nat. Poiss. VII. p. 103. 1831.

From Europe.

Trachinus Vipera Cuv. & Val. Hist. Nat. Poiss. (4° ed.) III. p. 189. 1829.

Agonus cataphractus Bloch, Syst. Ichth. ed. Schn. p. 104. 1801.

Tinca vulgaris Cuvier, Règne An. II. p. 193. 1817.

Gobio fluviatilis Agassiz, Mem. Soc. Neuch. I. p. 36. 1834.

Leuciscus rodens Agassiz, Mem. Soc. Neuch. I. p. 39. 1834.

Leuciscus prasinus Agassiz, Mem. Soc. Neuch. I. p. 46. 1834.

Published, April 28, 1863.

No. 2. — List of the Echinoderms sent to different Institutions in Exchange for other Specimens, with Annotations. By A. AGASSIZ.*

Phyllacanthus BR. Prod. (emend.). — *Leiocidaris* DESOR, Synop.

Phyllacanthus imperialis BR.

Under the name of *Cidaris imperialis* two very distinct species have been confounded, one of which (*Ph. fustigerus* A. AG.) is found in New Holland and the East India Islands, while the other species (*Ph. imperialis*), of which a good figure is given by Seba, is found at Zanzibar and Mozambique.

Cidaris KLEIN, Disp. Nat. Echin. (emend.).

This genus is here limited in such a way as to include only the following and allied species: —

Cidaris Thouarsii VAL. Ag. Cat. Rais. — Panama.

Cidaris tribuloides LAMK. An. s. Vert. — Red Sea.

Cidaris annulata GRAY. Proc. Zoöl. Soc. 1855. — Florida.

Cidaris baculosa LAMK. An. s. Vert. (non Mich.). — Red Sea.

A good figure of this species is given by Savigny, Descrip. Egypt. Zool., Pl. 7, fig. 1, which is very different from the figure given by Michelin, Mag. Zool., IV., Pl. 8. The last is a *Prionocidaris*, and probably the *C. pistillaris* LAMK.

Gymnocidaris A. AG.

Gymnocidaris metularia A. AG.

SYN. *Cidaris metularia* LAMK. An. s. Vert. — Zanzibar.

Gymnocidaris minor A. AG.

This species, which is found at the Sandwich and Kingsmills Islands, differs from the *G. metularia* in the proportions of the ovarian and ocular plates. The genital plates are much smaller than in the *C. metularia*, in which they cover nearly the whole of the abactinal system.

Orthocidaris AG.

Orthocidaris hystrix AG.

SYN. *Cidaris hystrix* LAMK. An. s. Vert. — Nice.

Orthocidaris affinis AG.

SYN. *Cidaris affinis* PHIL. Wieg. Archiv., 1845; *Cidaris Stokesi* AG. Cat. Rais. — Mediterranean.

To this genus belongs also *Cidaris papillata* FLEM.

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* Descriptions of the new genera based upon species already known may be found in the "Illustrated Catalogue of the Museum." — L. AGASSIZ.

Temnocidaris A. Ag.

Unlike the other genera allied to *Cidaris*, the abactinal system of this genus is deeply notched in the angles of the interambulacral plates.

Temnocidaris canaliculata A. Ag.

The spines of this species resemble those of *Orthocidaris hystrix;* they are very short, hardly equal in length to the diameter of the test. Coronal plates high, tubercles with a large scrobicular circle sunk below the level of the miliaries. — Caroline Islands.

Prionocidaris A. Ag.

Prionocidaris pistillaris A. Ag.

Syn. *Cidaris pistillaris* Lamk. An. s. Vert. — Zanzibar.

Stephanocidaris A. Ag.

Stephanocidaris tubaria A. Ag.

Syn. *Cidaris tubaria* Lamk. An. s. Vert. — New Holland.

Chondrocidaris A. Ag.

The whole test, with the exception of the scrobicular circle, covered with very small, closely-packed granules, supporting minute spines. Spines resembling those of the genus *Rhabdocidaris.* Median ambulacral area convex.

Chondrocidaris gigantea A. Ag.

The scrobicular circle is small, not occupying more than half the length of the plate. Plates of actinal system covered with long, narrow spines. Median ambulacral space containing eight rows of small tubercles, of uniform size. The primary spines are large, with a tendency of the angles of the grooves to run into thin, sharp lamellæ, and spread, fan-shaped, at the extremity. — Sandwich Islands.

Goniocidaris Ag. Cat. Rais.

Goniocidaris geranioides Ag. Cat. Rais. — Hobart Town.

Astropyga Gray, Ann. Phil. 1828.

Astropyga radiata Gray, Ann. Phil. 1828. — Zanzibar.

Syn. *Astropyga Mossambica* Pet. Seeig. v. Moss.

Garelia Gray, Proc. Zoöl. S. Lond. 1855. — *Savignya* Des. Syn.

Garelia subularis A. Ag.

Syn. *Astropyga subularis* Ag. Cat. Rais.; *Echinothrix subularis* Pet. Seeig. v. Mossambique; *Savignya subularis* Des. — Red Sea.

Garelia cincta A. Ag.

Interambulacral space with six vertical rows of large tubercles, four vertical rows of small tubercles in ambulacral space, which increases regularly in width towards the abactinal region, where it is slightly petaloid. Poriferous zone broad. Spines of interambulacra equalling in length two thirds of the diameter of the test; polar diameter depressed. This species may be the *Echinothrix turcarum* of Peters, which is undoubtedly a *Garelia*, and not an *Echinothrix*. — Kingsmills and Sandwich Islands.

Echinothrix PET. Seeig. v. Moss. (emend.). — *Savignya* DES. Syn.

This genus has been restricted in such a manner, that the species, such as *Diadema subulare* AG., *D. turcarum* RUMPH., placed by Peters in this genus, have been removed to the genus *Garelia* of Gray, containing species which can at once be distinguished from *Echinothrix* by their short and longitudinally striated spines, while the genus *Echinothrix*, as limited here, contains species having broad ambulacra, and spines resembling those of *Diadema*.

Echinothrix annellata PET. Seeig. v. Moss. — Zanzibar.

Echinothrix aperta A. AG.

Eight rows of large tubercles in interambulacral space; bare space of interambulacrum extending below the equatorial line of test. Anal membrane very large; genital and ocular plates small; anal plates very small, disconnected. The spines vary much in color; in some specimens they are yellowish, in others perfectly black, in others whitish mixed with black. — Society Islands.

Echinothrix scutata A. AG.

Ambulacra more pointed towards the abactinal region than in the preceding species. Spines shorter and more slender in proportion to the test. Can at once be distinguished by the large size of the genital and ocular plates, and the coating of prominent plates over the greater part of the anal membrane, which is quite small. One row of small tubercles extending along the poriferous zone in interambulacral space. — Sandwich Islands.

Diadema GRAY, Ann. Phil. 1828.

Diadema antillarum PHIL. Wieg. Archiv. 1845. — Florida.

SYN. *Cidaris diadema* LAMK. An. s. Vert. (non *Diadema turcarum* RUMPH.).

Diadema Savignyii MICH. Guér. Mag. Zool. 1845; AG. Cat. Rais. 1847. — Zanzibar.

Diadema paucispinum A. AG.

Outline, when seen from above, pentagonal; ambulacra very prominent, large openings for suckers, poriferous zone narrow near actinostome. Cuts of actinal system deep. Interambulacral tubercles arranged in six rows, four large and two small median rows; high coronal plates, which gives this species the appearance of being but sparingly covered with spines; spines stout, equalling in length diameter of test. — Sandwich Islands.

Diadema mexicanum A. Ag.

Abactinal system much smaller in proportion to actinal than in any other species of the genus. Spines exceedingly long, equalling in length twice the diameter of test, moderately stout. Outline of spherosome perfectly circular, regularly arched in profile. Cuts of actinal system slight. The large tubercles extend almost to abactinal system. — Acapulco.

Diadema globulosum A. Ag.

This is a small species, perfectly globular, with only four rows of large tubercles in interambulacrum; abactinal system depressed. Remarkable for the great length and extreme slenderness of the spines; they are at least three times the diameter of test; actinal portion of test very convex. — Kingsmills and Society Islands.

Echinocidaris Desml. Etud. Echin. (emend.). — *Agarites* Ag. Cat. Rais.

Echinocidaris punctulata Desml. Etud. Echin.

Syn. *Echinocidaris* (*Agarites*) *punctulata* Ag. Cat. Rais. — Charleston, South Carolina.

Echinocidaris Davisii Ag.

Differs from the South Carolina species in having a greater number of tubercles closely packed together. Spines quite short, granulation round the primary tubercles very prominent. Color of test and spines dark violet, almost black. Tubercles very crowded in ambulacral space. — Naushon, Massachusetts, south of Cape Cod.

Echinocidaris incisa A. Ag.

Abactinal system very prominent, sutures between the plates well marked; tubercles large, spines short, stout, color yellowish-brown. — Guayamas, Panama.

Arbacia Gray (non Ag.). — *Tetrapygus* Ag. Cat. Rais.

Arbacia nigra Gray.

Syn. *Echinocidaris* (*Tetrapygus*) *nigra* Ag. Cat. Rais. — Mejillones.

Arbacia æquituberculata Gray.

Syn. *Echinocidaris* (*Tetrapygus*) *æquituberculata* Ag. Cat. Rais. — Fayal.

Echinostrephus A. Ag.

Small sea-urchins with tubercles resembling those of *Holopneustes* in their arrangement, with narrow poriferous zones, pores arranged in arcs. Abactinal system raised above level of abactinal part of test. Large genital plates occupying nearly the whole of this system. Actinal system large, circular, no indentations. Spines long, slender, longitudinally striated. Test convex near actinal portion, flattened above, the greatest diameter being nearer the abactinal pole. Auricles of medium size, with a large opening and no connecting ridge. Teeth provided with transverse arc.

Echinostrephus aciculatus A. Ag.

Tubercles of ambulacral and interambulacral space of the same size. Spines long, equalling diameter of test. Anal system small, pores arranged in arcs of four pairs. — Kingsmills and Sandwich Islands.

Heterocentrotus Br. Prod. (emend.)

Heterocentrotus mammillatus Br. Prod.

Syn. *Heterocentrotus carinatus* Br. Prod.; *H. Postellsii* Br.; *Acrocladia mammillata* Ag. Cat. Rais.; *A. hastifera* Ag. Cat. Rais. — Sandwich Islands.

Acrocladia Ag. (emend.)

Acrocladia trigonaria Ag. Cat. Rais. — Kingsmills Islands.

Acrocladia cuspidata A. Ag.

Syn. *Acrocladia trigonaria* Mich. Faune de Maurice (non Ag.)

Circular outline of test, uniform size of tubercles, distinctness of ocular and genital plates, distinguish this species. Spines triangular, rather short, tapering rapidly. — Mauritius.

Podophora Ag. Cat. Rais. (emend.).

Podophora atrata Ag. Cat. Rais. — Mauritius.

Podophora Quoyi A. Ag.

Syn. *Echinometra Quoyi* Bl. non *P. Quoyi* Ag. — Sandwich Islands.

Colobocentrotus Leskei Br. belongs to a different genus. *Podophora* has, therefore, been retained for the preceding species, although Brandt included the *P. atrata* in his genus *Colobocentrotus*. (See Cat. Echin. N. P. Ex. Ex.)

Echinometra Breyn.

Echinometra Michelini Des., Ag. Cat. Rais. — Florida.

It is with some doubt that the common *Echinometra* of Florida is referred to this species.

Echinometra oblonga Bl. Dict. Sc. Nat. — Sandwich Islands.

Echinometra acufera Bl. Dict. Sc. Nat. — Zanzibar.

Echinometra lucunter Lamk.

Echinometra Mathæi Ag. Cat. Rais. p. p. (non Bl.) — Sandwich, Society, and Kingsmills Islands.

Echinometra VanBrunti A. Ag.

Remarkable for its flatness, the height of its tubercles, and the narrowness of the poriferous zone. Spines long and slender, of uniform size, color dark violet. — Acapulco.

Echinometra rupicola A. Ag.

Closely allied to *E. VanBrunti*; differs from it by the smaller number of tubercles, the great difference in size between the ambulacral and interambulacral tubercles, large ocular and genital plates, smaller spines, and broad poriferous zone. — Panama.

Echinometra microtuberculata A. Ag.

Can easily be distinguished from *E. lucunter*, to which it is closely allied, by the great height of the polar diameter, the large number and uniform size of the small tubercles, the arched test, and short, stout spines. Color light green. — Sandwich and Kingsmills Islands.

Echinometra viridis A. Ag.

The genital plates are greatly developed, smooth, occupying nearly the whole of the abactinal area. Tubercles very prominent. Spines short, stout. Color generally light green. — Florida.

Echinometra plana A. Ag.

Flat species with a circular outline; abactinal region less covered with spines than rest of test. Spines long, sharp, equalling in length the diameter of test. Tubercles distant, not numerous. — Hayti.

Parasalenia A. Ag.

Resembles *Salenia* in having the abactinal system raised. There are only four anal plates, as in *Echinocidaris*, otherwise resembles *Echinometra*. The genital and ocular plates are smooth. Pores in pairs, forming an irregular vertical line.

Parasalenia gratiosa A. Ag.

Outline elliptical. Tubercles arranged in two vertical rows in ambulacral and interambulacral spaces. Spines moderately long, tapering gradually. Tubercles of ambulacra closely crowded; miliaries small, not numerous. — Kingsmills and Society Islands.

Heliocidaris Desml. (emend.).

Heliocidaris variolaris Desml. Etud. Echin. — Zanzibar.

Toxocidaris A. Ag.

Toxocidaris Delalandi A. Ag.

Syn. *Heliocidaris Delalandi* Ag. Cat. Rais. — Port Jackson.

Toxocidaris mexicana A. Ag.

Syn. *Heliocidaris mexicana* Ag. Cat. Rais. — Acapulco.

Toxocidaris franciscana A. Ag.

This species grows to a very large size. High coronal plates, large openings for suckers. Pores arranged in arcs of nine pairs. Two very prominent rows of large tubercles in interambulacral space. The large tubercles of ambulacra of same size as secondary of interambulacra. Spines long, tapering gradually, equalling in length two thirds the diameter of test. — San Francisco.

Toxopneustes AG. Cat. Rais. (emend.).

Toxopneustes drobachiensis AG. Cat. Rais.

SYN. *E. drobachiensis* MÜLL. Zool. Dan.; *E. chlorocentrotus* BR. Prod.; *E. granularis* SAY, Journ. Phil. Ac. v. 182; *E. granulatus* GOULD, Invert. Mass.; *E. neglectus* LAMK. An. s. Vert. — Massachusetts Bay, Grand Menan, Puget Sound.

Toxopneustes lividus AG. Cat. Rais. — Fayal.

Loxechinus DES. Synops. Echin. Foss.

Loxechinus albus DES. Synops.

SYN. *E. albus* MOL.; AG. Cat. Rais. — Mejillones.

Loxechinus purpuratus A. AG.

SYN. *E. purpuratus* STIMPS. Crust. Echin. Pacif. Sh. N. A. — San Francisco.

Psammechinus AG. Cat. Rais. (emend.).

Psammechinus miliaris AG. Cat. Rais. — Norway.

Psammechinus microtuberculatus AG. Cat. Rais. — Mediterranean.

Psammechinus chloroticus A. AG.

SYN. *Heliocidaris chloroticus* AG. Cat. Rais.; *Psammechinus asteroides* GIR. Proc. Bost. Soc. — New Zealand.

Echinus L. (DES. emend.)

Echinus esculentus L.

SYN. *Echinus sphæra* Müll. Zool. Dan. — Norway.

Echinus melo LAMK. An. s. Vert. — Nice.

Echinus Flemingii BALL, Forb. Brit. Starfishes. — Great Britain.

Sphærechinus DES. Synops. Echin. Foss.

Sphærechinus brevispinosus DES. Synops.

SYN. *Echinus brevispinosus* RISSO, Hist. Nat. Eur. Mér. — Nice.

Sphærechinus granularis A. AG.

SYN. *Echinus granularis* LAMK. An. s. Vert. — Fayal.

Temnopleurus AG. Cat. Rais.

Temnopleurus toreumaticus AG. Cat. Rais. — East India.

Temnopleurus Reevesii A. AG.

SYN. *Toreumatica Reevesii* GRAY, Proc. Zoöl. Soc. 1855. — Hong-Kong.

Toreumatica GRAY.

Toreumatica concava GRAY, Proc. Zoöl. Soc. 1855. — Hong-Kong.

Salmacis AG. Cat. Rais.

Salmacis bicolor AG. Cat. Rais. — Zanzibar.

Melobosis Gir. Proc. Bost. Soc. Nat. Hist. 1850.

Melobosis rarispinus A. Ag.

Syn. *Salmacis rarispinus* Ag. Cat. Rais. — East India.

Lytechinus Ag. — *Psammechinus* Ag. p. p.

Lytechinus carolinus Ag.

Syn. *Echinus variegatus* Rav. (non Lamk.), Cat. Echin. So. Car. — South Carolina, Georgia, and Florida.

Lytechinus variegatus A. Ag.

Syn. *Echinus variegatus* Lamk. (non Rav.) ; *Psammechinus variegatus* Ag. Cat. Rais. — Cienfuegos, Hayti.

Lytechinus atlanticus A. Ag.

Readily distinguished from the South Carolina species by the large number of tubercles in each vertical row, and from the *L. variegatus* by the smaller size of its spines. — Bermudas.

Boletia Ag. Cat. Rais. — *Hemiechinus* Gir. Proc. Bost. Soc. N. H. 1850.

Boletia granulata A. Ag.

Remarkable for its comparatively long spines. Tubercles uniform in size, very closely crowded together. — Sandwich Islands.

Boletia rosea A. Ag.

Spines exceedingly short and stout; the exterior row of tubercles in ambulacral and interambulacral space of greater size. — Acapulco.

Tripneustes Ag. Cat. Rais. (emend.)

Tripneustes ventricosus Ag. Cat. Rais. — Florida.

Syn. *Heliechinus Gouldii* Gir. Proc. Bost. Soc. Nat. Hist. 1850.

The genus is here limited to species in which the median ambulacral and interambulacral space is covered with tubercles. There is in the collection of the Smithsonian a species from Guayamas, *T. depressus* A. Ag., closely allied to *T. ventricosus*, which differs from it in the flatness of the test, the large and uniform size of the tubercles, and the stoutness of its spines.

Hipponoë Gray, 1841 ; Proc. Zoöl. Soc. 1855.

Hipponoë sardica Gray, Proc. Zoöl. Soc. 1855.

Syn. *Tripneustes sardicus* Ag. Cat. Rais. — Zanzibar.

Hipponoë violacea A. Ag.

Tubercles small, numerous, of uniform size; abactinal portion of test regularly arched. Spines short, slender; color of test dark violet. — Sandwich and Kingsmills Islands.

Hipponoë nigricans A. Ag.

Row of large tubercles in interambulacral space near the oral area other tubercles small. Ambulacral zone broad near abactinal region, with double concave outline near the middle of test. Color of test black; spines of same color mixed with spines of straw-color. — Society Islands.

Echinoneus Van Phel.

Echinoneus elegans Des. Monog. des Galérites. — Hayti.

Echinocyamus Van Phel.

Echinocyamus angulosus Leske, Addiment. ad Klein. Ech. — Norway.

Fibularia Lamk.

Fibularia volva Ag. Cat. Rais. — Red Sea.

Clypeaster Lamk. (emend.). — *Echinanthus* Gray (non Des.).

Clypeaster rosaceus Lamk. An. s. Vert. — Florida.

Stolonoclypus Ag.

Stolonoclypus placunarius Ag.

Syn. *Clypeaster placunarius* Lamk. An. s. Vert. — Red Sea.

Stolonoclypus prostratus Ag.

Syn. *Clypeaster prostratus* Rav. Cat. Echin. So. Car. — Florida.

Stolonoclypus rotundus A. Ag.

Closely allied to *S. prostratus*, from which it differs by its almost circular outline, its thin edge, the great size of the ambulacral rosette, and width of the ambulacral system. — Acapulco.

Rhaphidoclypus A. Ag.

Rhaphidoclypus scutiformis A. Ag.

Syn. *Clypeaster scutiformis* Lamk. An. s. Vert. — Red Sea.

Rhaphidoclypus microtuberculatus A. Ag.

Differs from *R. scutiformis* by its elongated ambulacral rosette, and the great number and small size of the closely crowded tubercles. — Kingsmills Islands.

Rumphia Des. Synop. Echin. Foss. — *Polyaster* Mich. Guér. Rev. de Zool. 1859. — *Michelinia* Duj. et Hupé, Echin.

Rumphia Lesueuri A. Ag.

Syn. *Laganum Lesueuri* Ag. Cat. Rais.; *Polyaster elegans* Mich. Guér. Rev. de Zool.; *Michelinia elegans* Duj. et Hupé.

This species is mentioned by Professor Agassiz as coming from Guadeloupe; this is probably a mistake. There are no specimens of his *L. Lesueuri* in the Museum, and the present species is identified with the figures in his Monog. des Scutelles. It is undoubtedly the *Polyaster elegans* of Michelin. — Hong-Kong.

Laganum Kl. Nat. Disp. Echin.

Laganum depressum Less., Ag. Cat. Rais.

Syn. *Laganum attenuatum* Ag.; *Laganum pentagonum* Ag. MS. — Kingsmills Islands.

Echinarachnius Van Phels.

Echinarachnius parma Gray, An. Phil. 1825.

Syn. *Echinarachnius atlanticus* Gray; Ag. Cat. Rais. — New England, Grand Menan.

Dendraster Ag. Cat. Rais.

Dendraster excentricus Ag. Cat. Rais. — San Francisco.

Echinodiscus Breyn. (Gray, non Desor), Brit. Mus. Cat. (emend.).*

Echinodiscus biforus Gray, Cat. Brit. Mus.

Syn. *Lobophora bifora* Ag. Cat. Rais. — Madagascar.

Lobophora Ag. Cat. Rais. (emend.).

Lobophora bifissa Ag. Cat. Rais. — Zanzibar.

Echinoglycus Van Phels. (Gray), Brit. Mus. Cat. (emend.).

Echinoglycus Stokesi Gray, Cat. Brit. Mus.

Syn. *Lobophora Stokesi* Ag. — Panama.

Encope Ag. Cat. Rais. — *Echinoglycus* Gr. p. p.

Encope Valenciennesii Ag. Cat. Rais. — Cumana.

Encope grandis Ag. Cat. Rais. — Gulf of California.

Encope Michelini Ag. Cat. Rais. — Tampa Bay, Florida.

Rotula Kl. Nat. Disp. Echin.

Rotula Rumphii Kl. Nat. Disp. Echin. — Cape Palmas.

Rotula Augustii Kl. Nat. Disp. Echin. — Cape Palmas.

Mellita Kl.

Mellita testudinata Kl. Nat. Disp. Echin. — South Carolina, Florida, Texas.

Mellita quinquefora Ag. Cat. Rais. — Cumana.

Mellita hexapora Ag. Cat. Rais. — West Indies, Florida.

Mellita longifissa Mich. Rev. Mag. Zool. 1858. — Panama.

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* In order not to introduce additional names, the old genera *Echinodiscus* and *Echinoglycus*, as adopted by Gray, have been circumscribed so as to include the species which are here separated from *Lobophora* and *Encope* of Agassiz, as representatives of new genera.

Pygorhynchus Ag.

Pygorhynchus pacificus Ag.

This species is a living representative of the genus *Pygorhynchus*, thus far only known as fossil. It resembles in outline *Echinolampas*. The vent is transverse, supra-marginal. The lower side is almost flat, the edges of the test being slightly raised. The very broad, smooth band, shaped like a dagger, extending entirely round the mouth and reaching the anterior and posterior edge of the test, and the rosette of large pores round the mouth, are characters of the genus which are not easily seen in fossil specimens. As specific, whole upper surface covered with short silk-like spines. Tubercles of lower side large, sunken, increasing in size as they approach the smooth band. Spines long, sharp, very slightly arched, comparatively much stouter than on upper part of test. — Acapulco.

Spatangus Kl.

Spatangus purpureus Müll. Zool. Dan. — North Europe.

Spatangus meridionalis Risso, Hist. Nat. Eur. Mérid. — Mediterranean.

Maretia Gray, Cat. Brit. Mus.

Maretia planulata Gray, Cat. Brit. Mus.

Syn. *Spatangus planulatus* Lamk. An. s. Vert.; *Trichoproctus tenuis* Ag. MS. — Kingsmills Islands.

Lovenia Ag. Cat. Rais.

Lovenia hystrix Ag. Cat. Rais. — Zanzibar.

Echinocardium Gray, Cat. Brit. Mus. (emend.). — *Amphidetus* Ag. Cat. Rais. p. p.

Echinocardium cordatum Gray, Cat. Brit. Mus.

Syn. *Amphidetus cordatus* Ag. Cat. Rais. — North Europe.

Amphidetus Ag. (emend.)

Amphidetus ovatus Ag. Cat. Rais. — North Europe.

Brissus Klein (Ag. Cat. Rais.).

Brissus carinatus Lamk. (non Ag.), An. s. Vert. — Sandwich Islands.

Brissus columbaris Ag. Cat. Rais. — Florida.

Kleinia Gray, Ann. & Mag. 1851.

Kleinia nigra A. Ag.

Test rather depressed, ambulacral rosette narrow, long; peripetalous fasciole extending almost to the circumference; spines rather short, sharp, stout, black. — Acapulco.

It is with some doubt that this species is referred to the genus *Kleinia*; should it prove a different genus, I would suggest the name *Rhyssobrissus* for it.

Xanthobrissus A. Ag.

This genus is closely allied to *Meoma* of Gray; differs from it by the position of the vertex, which is near the anterior extremity. Lateral ambulacra of equal size, anterior ambulacrum in a deep groove. Subanal fasciole heart-shaped, with lateral branches extending to the side of the anal system.

Xanthobrissus Garretti A. Ag.

Syn. *Brissopsis Garretti* Ag. MS.

Anal system large, pointed at both extremities. Posterior ambulacra arched exteriorly; few large tubercles near the apex of rosette on both sides of anterior ambulacra. Tubercles numerous, small. Spines very slender, quite long. — Kingsmills Islands.

Brissopsis Ag. Cat. Rais.

Brissopsis lyrifera Ag. Cat. Rais. — North Europe.

Agassizia Val., Ag. Cat. Rais.

Agassizia scrobiculata Val., Ag. Cat. Rais. — Panama.

Mœra Mich. Rev. et Mag. de Zool. 1855. — *Schizaster* Ag. p. p.

Mœra atropos Mich. Rev. et Mag. de Zool.

Syn. *Schizaster atropos* Ag. Cat. Rais.; *Schizaster lachesis* Gir. Proc. Bost. Soc. Nat. Hist. 1850. — Charleston, S. C., and Texas.

Published August 15, 1863.

No. 3. — List of the Polyps and Corals sent by the Museum of Comparative Zoölogy to other Institutions in Exchange, with Annotations. By A. E. VERRILL.

ALCYONARIA.

Renilla reniformis CUVIER, Règne An. 2d ed. III. p. 319, 1830 (non HERKLOTZ).

SYN. *Pennatula reniformis* PALLAS, Elench. Zooph. 1766; *Renilla americana* LAMARCK, 1816; *Renilla reniformis* AGASSIZ, Proc. Amer. Assoc. 1850. — Charleston, South Carolina; L. Agassiz.

Renilla Danæ VERRILL, MS. 1861.

SYN. *Renilla americana* (*pars*) DANA, Zoöph. Pl. 57, f. 1; *Renilla reniformis* HERKLOTZ.

This differs widely from *R. reniformis* in its broad, rounded form, it being wider than long, while the preceding is longer than broad; in its much deeper sinus and overlapping posterior lobes; in its costate and granulous under surface, which in the other is nearly smooth with lighter radiating lines; in its more crowded and smaller polyps; and in having much more prominent spicula on the upper surface around the cells. Its color, also, is darker purple. — Rio Janeiro; J. D. Dana, U. S. Expl. Exp.

Renilla peltata VERRILL.

This is a very large species, readily distinguished by its very broad, thick frond, nearly straight on the outer margin, shallow sinus, and central position of the peduncle. The cells are larger than in any other known species, and armed with five prominent spicula. Color of alcoholic specimens, light purple. — Breton Island, near the mouth of the Mississippi River; C. T. Pierce.

Renilla patula VERRILL.

Very large and thin, with a broadly reniform frond, regularly rounded at the outer margin; sinus very deep, dividing the frond beyond the middle, with the posterior lobes considerably overlapping. Cells rather small, with five slightly prominent lobes. Polyps very long when expanded. Lower surface slightly scabrous, marked with scarcely raised radiating lines. Peduncle attached close to the margin of the sinus. — Cumana, Ven., South America; J. P. Couthouy.

Renilla amethystina VERRILL.

Broad reniform, wider than long; sinus narrow; peduncle inserted near its edge. Under surface rough, with numerous large spicula. Cells small and crowded. Color deep purple; spicula amethystine. — Panama; T. Rowell.

Stylatula Verrill.

Elongated, slender, nearly cylindrical; near the base naked, bulbous at the end. Pinnæ short, supported by numerous strong radiating spines, the polyps clustered on their upper surface. Axis sub-cylindrical, extending through nearly the whole length.

Stylatula gracilis Verrill.

Very slender, nearly cylindrical above; base swollen. Pinnæ at first very narrow, leaving a linear naked space between the two rows on both sides; higher up they overlap and are much crowded, thirty-two in an inch. Length, a foot or more; diameter, .12 inch. Cape St. Lucas, California; J. Xantus.

Stylatula elongata Verrill.

Syn. *Virgularia elongata* W. M. Gabb, Proc. California Acad. Nat. Sci. II. 167, 1863.

Larger and stouter than the preceding. Pinnæ broader and more overlapping, leaving a naked space between the rows for only a short distance; in the middle, twenty occupy an inch. The spines are also larger and fewer. — San Francisco, California; A. Agassiz.

Funiculina Forbesii Verrill.

Syn. *Pavonaria quadrangularis* (*pars*) Johnson.

A careful examination of several perfect specimens of this species, collected on the coast of Scotland by Mr. Stimpson, proves it to be distinct from that of the Mediterranean, first figured and described by Bohadsch, and afterwards named *Pennatula quadrangularis* by Pallas.

It is much more slender than the latter, with far less numerous and crowded polyps; these are arranged in oblique series of two or three, instead of five; the outer ones are the largest, those occupying the central region being rudimentary and papilliform, but all are disproportionately smaller than those of *F. quadrangularis*. — Near Oban, Scotland; Wm. Stimpson.

Pteroides Putnami Verrill.

Small and delicate; the pinnate portion broad oval in outline. Peduncle a little more than half the whole length, smooth, slender-pointed. Pinnæ rather broad, with a wide base, supported by five or six clusters of strong spines, radiating from the base, eight or ten spines in each group. These give a strongly-lobed appearance to the edges of the pinnæ. — Hong Kong, China; Capt. W. H. A. Putnam.

Pterogorgia setosa Ehrenberg, Corall. roth. Meer. 1834.

Syn. *Gorgonia setosa* (*pars*) Linn. *Pterogorgia setosa* Dana, Zoöph.

This species and the following have been more or less confounded by nearly all authors, but when large series are examined they appear quite distinct. — Florida and West Indies; L. Agassiz.

Pterogorgia acerosa EHR. 1834.

SYN. *Gorgonia acerosa* (*pars*) PALLAS, Elench. Zooph. p. 172, 1766; *Gorgonia setosa* ESPER, Gorg. Tab. 17, fig. 1–3; *Pterogorgia acerosa* DANA, Zoöph. p. 649; *Pterogorgia pinnata* M. EDW. Corall. I. p. 168.

The *Gorgonia pinnata* of Linnæus seems to apply more particularly to a European species, entirely distinct from this. — Florida, West Indies, and Bermuda; L. Agassiz, D. F. Weinland.

Pterogorgia americana EHR. 1834.

SYN. *Gorgonia americana* GMELIN; *Pterogorgia turgida* (?) EHR. Corall. roth. Meer. p. 116, 1834; *Pterogorgia pinnata* DANA, Zoöph.; *Pterogorgia Ellisiana* M. EDW. Corall. p. 169.

The *Gorgonia americana* of Gmelin was based upon the figure of Ellis and Solander (Pl. 14, fig. 3), which is a good representation of the species when preserved in alcohol with the polyps expanded. The polyps are much larger than in the two preceding species, and are arranged somewhat irregularly, in two or three rows on each side of the large and nearly cylindrical branchlets — Florida; L. Agassiz.

Pterogorgia bipinnata VERRILL.

Coral broad, flabelliform, branching in a plane. The primary branches arising nearly opposite on the sides of the principal stalk, and about one fourth of an inch apart, spread at a large angle; the principal ones are again pinnate, with their branchlets similarly arranged, and about one and a half inches long. Branchlets slender, strongly compressed, a few of them sometimes coalescing, forming rectangular openings. Cells very small, in two alternating series on the edges of the branches. Color violet or bright yellow. — Cumana, Ven., South America; J. P. Couthouy.

Leptogorgia virgulata M. EDW. Coralliaires. 1857.

SYN. *Gorgonia virgulata* LAMK. 1816; *Gorgonia Olivierii* LAMX. Polyp. Flex. 1817; *Plexaura virgulata* VAL.; *Plexaura viminea* VAL. 1855. — Charleston, South Carolina; L. Agassiz. — Beaufort, North Carolina; A. S. Bickmore.

Leptogorgia purpurea M. EDW. 1857.

SYN. *Gorgonia purpurea* PAL., 1766; *Leptogorgia purpurea* M. EDW., Corall. p. 164; *Leptogorgia purpuracea* M. EDW. l. c. p. 164.

This species is very distinct from the preceding in its longer, slender, rounded branches, arising in a fasciculate manner, nearly in a plane. Color purple, red, or orange. — Florida; G. Wurdemann.

Leptogorgia sanguinolenta VERRILL.

SYN. *Gorgonia sanguinolenta* PAL., Elench. Zooph. 1766.

Low, densely branching, somewhat in a plane. Several principal branches, arising near the base, give off from each side in a pinnate manner, numerous, crowded, obtuse branchlets, many of which again divide in a similar way, and even their subdivisions are sometimes pinnate. Color variable, often yellow or whitish with purple cells; axis yellowish, subtransparent, compressed. — Hayti, W. I.; D. F. Weinland.

Leptogorgia rigida Verrill.

Arborescent, rather tall, branching numerously and irregularly, somewhat in a plane. Principal branches long, irregular, often crooked, subpinnate, giving off lateral branches at irregular intervals of similar character. Very variable in form and color; often deep bluish purple, less frequently orange, ferruginous, or white; axis black, amber colored near the ends. — Acapulco, Mexico; A. Agassiz, D. B. Vanbrunt. — Cape St. Lucas, California; J. Xantus. — Panama; J. H. Sternberg.

Leptogorgia ampla Verrill.

Very large flabelliform. Several large, nearly equal branches, springing close to the base, curve outward at first and then ascend nearly parallel, giving off, usually at intervals of two or three inches, long and rather thick branches and branchlets of nearly uniform size, which at first spread nearly at right angles and then rise abruptly, parallel to the main branches. The largest specimen is 20 inches high; 16 broad. Color bright lemon-yellow. — Margarita Bay, Lower California (?); A. Garret. Possibly from the Bonin Islands.

Rhipidogorgia flabellum Valenciennes, Comptes-rendus, XLI. p. 13. 1855.

Syn. *Gorgonia flabellum* Linn. — Florida, West Indies, and Bermuda; L. Agassiz, A. S. Bickmore.

Rhipidogorgia stenobrachis Val. 1855.

Syn. *Gorgonia stenobrachis* Val. Voyage de la Vénus, Pl. 12, fig. 1; *Rhipidogorgia Engelmanni* Horn, Proc. Phil. Acad. Nat. Sci. 1860, p. 233.

I have satisfied myself, by an examination of the original specimen of Horn, that the species last quoted was founded on a small and bad specimen of *R. stenobrachis*. In the Museum there are large numbers of specimens, both dry and in alcohol, from different localities on the Pacific coast showing a complete series between the extreme forms, which, indeed, seem to depend more on age than any other cause. — Acapulco, Mexico; D. B. Vanbrunt, A. Agassiz. — Panama; A. Agassiz, J. H. Sternberg.

Rhipidogorgia Agassizii Verrill.

Fronds broader than high, very finely and evenly reticulated, the openings nearly square or pentagonal, about .12 of an inch in diameter. The very short thick base divides at once into numerous small and nearly equal branches, which subdivide so evenly and rapidly that the principal branches cannot usually be traced more than half across the frond. Terminal branchlets free for about one fourth of an inch. Cells small, crowded, a little raised. Color purple, light red, or yellowish. — Acapulco; A. Agassiz, D. B. Vanbrunt. — Panama; J. H. Sternberg.

I have named this fine species in honor of its discoverer, Mr. A. Agassiz, who has greatly contributed to our knowledge of the Marine Faunæ of the Pacific coast of North America.

Rhipidogorgia media VERRILL.

Fronds low, broader than high, intermediate between the two preceding species in the size of its reticulations; these are usually square or pentagonal, quite irregular, generally about one quarter of an inch wide and nearly the same in height. Several large branches usually radiate from the base across the frond. Cells numerous on the sides, a little prominent. Color red with yellow cells, or uniform red or purple. — Acapulco, Mexico; A. Agassiz, D. B. Vanbrunt.

Xiphigorgia anceps M. EDW. Coralliaires. 1857.

SYN. *Gorgonia anceps* PAL. *Pterogorgia anceps* EHR., 1834; *Pterogorgia Guadalupensis* DUCH. et MICH., 1850. — Florida and West Indies; L. Agassiz, G. Wurdemann.

Xiphigorgia citrina VERRILL.

SYN. ? *Gorgonia citrina* ESP. 1790; *Gorgonia anceps* (*pars*) ESP. Planz. t. II. p. 38, tab. VII. 1788; *Gorgonia* (*Pterogorgia*) *citrina* DANA, Zoöph. 1846; *Pterogorgia fasciolaris* EHR., Corall. roth. Meer. p. 145, 1834; ? *Pterogorgia Sancti-Thomæ* EHR. l. c. p. 145.

This species is unquestionably *P. citrina* Dana, but if, as is possible, the *Gorgonia citrina* of Esper should prove to be a distinct species, the name *X. fasciolaris* (EHR.) will be next in order.

It is a smaller and more branching species than *X. anceps*, forming low, broad corals, branching somewhat in a plane, with much compressed slender branchlets, three or four inches long; these are rarely triangular, — a form very frequent in *X. anceps*. Color violet, or bright yellow with purple cells. — Florida; L. Agassiz. — St. Thomas; Dr. Otis.

Gorgonia verrucosa PALLAS. — Nice; J. Burkhardt.

Gorgonia ramulus VAL. — Panama; A. Agassiz, J. H. Sternberg. — Acapulco; D. B. Vanbrunt.

Gorgonia aurantiaca VERRILL.

SYN. *Lophogorgia aurantiaca* HORN, Proc. Phil. Acad. Nat. Sci. 1860, p. 233.

This is a very branching species, with short irregular branchlets, verruciform, bilobed cells, and a distinct median groove. Color brick-red, or yellowish. Axis somewhat compressed. — Acapulco, Mexico; A. Agassiz.

Lophogorgia palma M. EDW.

SYN. *Gorgonia palma* PAL. 1766; *Gorgonia flammea* ELLIS and SOL. 1786. — Cape of Good Hope.

Plexaura homomalla LAMOUROUX, Polyp. Flex. 1816.

SYN. *Gorgonia homomalla* ESPER. — Florida; L. Agassiz. — Bermuda; A. S. Bickmore.

The cells of this species sometimes have the borders prominent.

Plexaura flexuosa LAMX. Polyp. Flex. 1816.

SYN. *Eunicea furcata* EHR. 1834; *Gorgonia anguiculus* DANA, 1846; ? *Plexaura rhipidalis* VAL. 1855; *Plexaura salicornoides* M. EDW. 1857.

This species varies greatly in form and color, as well as in the degree of prominence of the cells, which depends upon the state of contraction of the polyps when dried. The color is most commonly either dull wine-red, or grayish yellow. — Florida and West Indies; L. Agassiz.

Plexaura crassa LAMX. Polyp. Flex. 1816.

SYN. *Gorgonia crassa* ELLIS and SOL. p. 91, pl. 18, fig. 3, 1786 (non *Eunicea crassa* M. EDW., nec *Gorgonia crassa* DANA); *Gorgonia porosa* ESP. Planz. tab. X. (form with large cells); *Gorgonia antipathes* (*pars*) ESP. tab. XXIII. (1789); *Gorgonia vermiculata* LAMK. 1816; *Plexaura macrocythara* LAMX., l. c. p. 429, 1816; *Plexaura friabilis* (*pars*) LAMX., l. c. p. 430; do. Exp. Methodique, p. 35, pl. 18, fig. 3, 1821; *Plexaura antipathes* EHR., 1834 (non *Gorgonia antipathes* LINN.); *Gorgonia vermiculata* DANA, 1846; *Plexaura arbusculum* DUCH., An. rad. des Antilles (1850).

There is no American species known to us, except the present, to which the description of Ellis can apply, while it agrees perfectly with this. The character of having a very black axis, very small at the extremities, is especially characteristic, and, also, of having "long fleshy branches that bend a little out and then grow upright," and, in addition, the "violet flesh," and "scattered arrangement of the cells" can leave no question of its identity. The figure quoted above, of which Ellis gave no explanation, agrees perfectly with his description and with alcoholic specimens in the Museum. — Florida; L. Agassiz. — Bermuda; A. S. Bickmore.

Plexaura dichotoma DANA, Zoöph. 1846.

SYN. *Gorgonia dichotoma* ESP., Planz. Gorg. tab. XIV. (1788); *Gorgonia multicauda* (*pars*) LAMK. Hist. An. s. Vert. 1816; *Gorgonia heteropora* LAMK., l. c. 1816; *Plexaura heteropora* LAMX. Polyp. Flex. (1816); *Gorgonia* (*Plexaura*) *dichotoma* (*pars*) DANA, Zoöph. 1846; *Gorgonia crassa* DANA, Zoöph. 1846; *Gorgonia brevis* (young) DUCHASSAING, An. rad. des Ant. p. 20 (1850); *Eunicea multicauda* M. EDW. Corall. 1857; ? *Plexaura friabilis* M. EDW. l. c. I. p. 156, 1857. — Florida; L. Agassiz. — St. Thomas; Dr. Otis.

This species varies greatly in appearance according to the mode of preservation and the state of contraction of the cells, and for this reason much confusion has arisen in regard to its synonymy. In the Museum there is a specimen labelled *Gorgonia dichotoma* by Dana, with the exterior in great part removed, which is almost a fac-simile of the specimen figured by Esper. Other specimens agree with the descriptions by Lamarck and Milne Edwards. The axis in the present species is always gray or fuscous, looking more like wood than horn, differing greatly, in this respect and several others, from *G. crassa* Ellis.

The character of having cells flat or slightly prominent is entirely insufficient to separate *Plexaura* and *Eunicea*, since all the species of *Plexaura* have, in certain states of preservation, cells with raised borders, and there are often to be seen on the same specimen flat cells and others which are quite prominent. For this reason the genera *Rhinogorgia* and *Gonidora*, proposed by Gray, are not admissible (Ann. and Mag. 1859, p. 442).

Plexaura turgida Verrill.

Syn. *Eunicea turgida* Ehr. 1834; ? *Eunicea crassa* M. Edw. Coralliaires I. p. 148, 1857 (non *Gorgonia crassa* Ellis and Sol.).

This is one of the largest known species, growing to the height of two or three feet, with the branches one half an inch or more in diameter.

In the structure of the polyps I have been unable to detect any difference between this species and *P. dichotoma*, the type of *Plexaura* Lamx., or *P. homomalla* and *P. flexuosa*, uniformly referred to this genus by authors. — Florida Reefs; L. Agassiz.

Plexaura flavida Val. 1855.

Syn. *Gorgonia flavida* Lamk. 1816.

The color of this species is often dark violet, with the surface merely tinged with yellow. — Hayti; D. F. Weinland.

Plexaura fucosa Val. 1855.

Syn. *Gorgonia fucosa* Val. Voyage de la Vénus. — San Francisco, California; T. G. Cary.

Plexaura suffruticosa M. Edw. 1857.

Syn. *Gorgonia suffruticosa* Dana, Zoöph. 1846. — Feejee Islands; J. D. Dana, U. S. Expl. Exp.

Eunicea limiformis Lamx. Polyp. Flex. 1816.

Syn. *Eunicea quincuncialis* Ehr. 1834; *Gorgonia quincuncialis* Dana, 1846. — Florida and West Indies; L. Agassiz.

Eunicea calyculata Lamx. 1816.

Syn. *Gorgonia caliculata* Ellis and Sol., p. 95, pl. 18, fig. 2, 1786; *Eunicea clavaria* Lamx. 1821. — Florida; L. Agassiz.

Eunicea laxispica M. Edw. 1857.

Syn. *Gorgonia laxispica* Lamk.; *Eunicea mammosa* Lamx.; *Gorgonia papillosa* Dana. — Florida; L. Agassiz.

Eunicea plantaginea Val. 1855.

Syn. *Gorgonia plantaginea* Lamk. — Florida; L. Agassiz.

Eunicea ramulosa EHR. 1834.

SYN. *Gorgonia spicifera* DANA, 1846. — Florida; L. Agassiz.

Eunicea Tourneforti M. EDW. 1857. — Florida and West Indies; G. Wurdemann.

Eunicea Rousseaui M. EDW. 1857. — Turk's Island, W. I.; J. E. Webber.

Muricea spicifera LAMX. 1821.

SYN. *Gorgonia muricata* (*pars*) PALLAS. — Florida and West Indies; L. Agassiz.

Muricea lima M. EDW. 1857.

SYN. *Gorgonia lima* LAMK. — Florida; L. Agassiz.

Muricea elongata LAMX. 1821. — Florida and West Indies; L. Agassiz.

Muricea laxa VERRILL.

Very slender, with long flexuous branches. . This is closely allied to *M elongata*, but has longer and very acute verrucæ, which are much more loosely arranged and armed with very long, sharp spicula. Axis nearly terete, somewhat compressed at the axils. Color light yellow. — Florida; L. Agassiz.

Muricea elegans AG. MS.

A large erect species, irregularly pinnate and bipinnate, branching nearly in a plane. Trunk stout and nearly erect, transversely compressed; branches very numerous, curved, often pendulous. Verrucæ broad, conical, spreading, armed with large spicula. Color orange. — Off Charleston, South Carolina; L. Agassiz.

Muricea echinata VAL. Comptes-rendus. 1855. (No description.)

SYN. *Muricea echinata* M. EDW. Coralliaires, 1857. — Panama; C. F. Davis, J. H. Sternberg.

Muricea robusta VERRILL.

This is a low, stout species, branching very irregularly in a subdichotomous manner, with thick, clavate, crooked branches. Cells crowded, large, open, little prominent, especially towards the base, where they open outward. Spicula numerous, short and thick. Color brownish yellow or purple. — Acapulco, Mexico; A. Agassiz.

Muricea hebes VERRILL.

The specimens of this species, which are probably young, have erect, simple, or sparingly dichotomous stalks, three or four inches high, slender at the base, but thick and clavate above. The verrucæ are crowded, broad, and prominent, armed with numerous rather sharp spicula. Color deep reddish purple, or dark brown. It resembles *Gonigoria clavata* GRAY, which should be referred to the genus *Muricea*, but the latter is stouter, with shorter and more crowded cells. The axis is also described as black, while in the present species it is fuscous. — Acapulco, Mexico; A. Agassiz.

Muricea appressa Verrill.

Corallum broad, flabelliform, very branching, even to the base. The trunk divides at about half an inch from the base into two, three, or more principal branches, which rapidly diverge and subdivide in an irregularly dichotomous or subpinnate manner. Branchlets slender, cylindrical or slightly clavate, with obtuse tips, one or two inches long and one eighth of an inch in diameter. Cells small, thickly crowded on all sides of the branches, rounded, closely appressed, the summits curved inward; exterior densely covered by small oblong spicula. Color, in alcohol, dark umber-brown. — Panama; J. H. Sternberg.

Primnoa reseda Verrill.

Syn. *Gorgonia reseda* Pallas, Elench. Zooph. 1766: *Gorgonia lepadifera* Linn. Syst. Nat. ed. XII. 1767; Ellis and Sol. 1786; *Primnoa lepadifera* Lamx. Polyp. Flex. 1816. — St. George's Bank; C. H. Fifield.

Callogorgia verticillaris Gray.

Syn. *Primnoa verticillaris* Ehr. 1834. — Fayal, Azores; Chas. Dabney.

Gorgonella umbraculum Verrill, MS. 1862.

Syn. *Gorgonia umbraculum* Ellis and Sol. 1786; *Rhipidogorgia umbraculum* Val. 1855; *Umbracella umbraculum* Gray. — East Indies.

Gorgonella stricta Verrill, MS. 1862.

Syn. ? *Gorgonia stricta* Lamk. 1816; ? *Rhipidogorgia stricta* M. Edw. 1857.

This species agrees in all its external characters with the species quoted, but has a calcareous axis. — Cape of Good Hope.

Juncella juncea Val. 1855.

Syn. *Ellisella juncea* Gray. — Indian Ocean.

Juncella extans Verrill.

Tall and simple, with the very prominent verrucæ curved inward and arranged crowdedly in a band on each side of the axis, leaving a wide naked space on each side. Color white. Axis grayish white, stony and rigid. — Fayal, Azores; C. Dabney.

Isis hippuris Linn. — East Indies.

Parisis Verrill.

Corallum irregularly branching, nearly in a plane. The axis consists alternately of calcareous and suberous segments, of uniform thickness, traversed by numerous narrow sulcations. The branches originate from the calcareous segments. Cœnenchyma persistent, rather thin, somewhat membranous, with a rough surface. Cells prominent, arranged irregularly on all sides of the branchlets, but often absent on the median surfaces of the larger branches.

Parisis fruticosa Verrill.

Large, flabelliform; the principal branches arising irregularly along the sides of the trunk, divide and subdivide rapidly into other smaller branches and branchlets, producing a densely ramulous frond. The branches ascend and diverge usually at an angle of about 50°; the branchlets often spread at right angles, and do not coalesce. Papillæ numerous, crowded on the branchlets, elongated, conical. Color grayish yellow; axis white; internodes yellowish brown. — Sooloo Sea; J. D. Dana, U. S. Expl. Exp.

Melitodes ochracea VERRILL.

SYN. *Isis ochracea* LINN.; *Melitæa ochracea* LAMX. 1812. — Singapore, Capt. W. H. A. Putnam.

The name *Melitæa* having been used for a genus of Insects by Fabricius in 1808, four years before it was employed by Lamouroux, we have adopted *Melitodes* for this genus, as restricted by Gray. (See Proc. Zoöl. Soc. Lond. 1859, p. 485.)

Melitodes virgata VERRILL.

SYN. *Melitæa ochracea* (*pars*) DANA (from Feejee Islands).

A comparison of the specimens collected by the U. S. Exploring Expedition at the Feejee Islands with several hundred specimens of all forms and sizes from Singapore, in the collection of the Museum, proves that they are unquestionably distinct, though closely resembling one another in general appearance.

The principal branches in *M. virgata* rise nearly parallel, and are much more elongated, tapering and subdividing far less rapidly than in *M. ochracea*. The calcareous segments are also longer, and the general appearance of the coral is more open. — Feejee Islands; J. D. Dana, U. S. Expl. Exp.

Mopsella elongata VERRILL.

SYN. *Melitella elongata* GRAY. Proc. Zoöl. Soc. Lond. 1859, p. 485. — Singapore; Capt. W. H. A. Putnam.

Mopsella dichotoma GRAY, Proc. Zoöl. Soc. Lond. 1857, p. 284.

SYN. *Isis dichotoma* LINN.; *Mopsea dichotoma* LAMX. 1816. — Cape Town; J. D. Dana, U. S. Expl. Exp.

I am unable to find any generic differences between this species, which is the type of *Mopsella* GRAY, and those subsequently referred by him to *Melitella*, and have, therefore, united the two genera.

Mopsella aurantia VERRILL.

SYN. *Isis aurantia* ESPER, 1797; *Melitæa retifera* LAMK. 1816; M. EDWARDS, 1857; *Melitella retifera* GRAY, Proc. Zoöl. Soc. Lond. 1859, p. 486. — Australia; A. Garret.

Mopsella textiformis VERRILL.

SYN. *Melitæa textiformis* LAMK.; *Melitella retifera* (*pars*) GRAY, l. c. 1859. — Australia; A. Garret.

Mopsella tenella Verrill.

Syn. *Melitæa tenella* Dana; *Melitella? tenella* Gray. — Sandwich Islands; J. D. Dana, U. S. Expl. Exp.

Briareum asbestinum Agassiz, MS.

Syn. *Alcyonium asbestinum* Pallas, 1766; *Gorgonia briareus* Ellis and Sol. 1786; *Briareum gorgonideum* Blainville, 1830; *Lobularia asbestina* Ehr. 1834; *Lobularia capitata* Duchassaing, 1850. — Florida; L. Agassiz. — Hayti; D. F. Weinland.

Briareum plexaureum Blainv. 1830.

Syn. *Alcyonium plexaureum* Lamx. Expos. Meth. p. 68, pl. 76, figs. 2, 3, 4, 1821. — Florida; L. Agassiz.

Titanideum Agassiz, MS.

This genus is closely allied to *Briareum*, but has a more distinct axis, which is spongy and very spiculose, but firm and less porous than that of the latter. The cells are scattered on all sides, and not prominent.

Titanideum suberosum Agassiz, MS.

Syn. *Gorgonia suberosa* Ellis and Sol. p. 93, 1786; Ellis, Corallines, Tab. 26, figs. P, Q, R; *Briareum suberosum* Dana, Zoöph. p. 463, 1846. — Charleston, South Carolina; L. Agassiz. — Beaufort, North Carolina; Wm. Stimpson. — Stono Inlet; Dr. J. W. Page, U. S. A.

Alcyonium digitatum Linn.

Coast of England; Free Public Museum of Liverpool.

Alcyonium carneum Agassiz, Proc. Amer. Assoc. 1850.

Coast of New England; L. Agassiz.

Sarcophytum glaucum Verrill.

Syn. *Alcyonium glaucum* Quoy et Gaimard; Dana, Zoöph. p. 623, pl. 58, figs. 4 and 5. — Feejee Islands; J. D. Dana, U. S. Expl. Exp.

Sarcophytum latum Verrill.

Syn. *Alcyonium latum* Dana. Zoöph. p. 623, pl. 58, figs. 6 and 7. — Tonga-Tabu; J. D. Dana, U. S. Expl. Exp.

Ammothea nitida Verrill.

This species grows in groups consisting of several smooth, subcylindrical stalks connected together at the base, undivided for about three inches, when they suddenly divide and subdivide into a cluster of numerous slender branchlets. Cells small, prominent, rather loosely scattered along the branchlets. — Zanzibar; C. Cooke.

Spongodes arborescens Dana.

Syn. *Spoggodia celosia, var. arborescens* Dana, Zoöph. p. 626, pl. 59, fig. 4 (non *S. celosia* Lesson). — Feejee Islands; J. D. Dana, U. S. Expl. Exp.

Spongodes capitata Verrill.

Large and very ramulous; the thick naked trunk subdividing in a dichotomous manner from near the base into short, capitate, terminal branches, having a dense cluster of very short branchlets at the ends on which the cells are closely crowded. Spicula white, not very conspicuous, the large ones not very numerous. Color in alcohol yellowish gray. — Hong Kong, China; Capt. W. H. A. Putnam.

Spongodes gigantea Verrill.

Grows in a manner similar to the preceding, but stouter and more arborescent, with larger and less crowded polyps and very large, conspicuous, white spicula. Color in alcohol dark brownish red. — Hong Kong, China; Wm. Stimpson, N. Pacif. Expl. Exp.

Telesto fruticulosa Dana.

Charleston, South Carolina; L. Agassiz. — Stono Inlet; Dr. J. W. Page.

Cœlogorgia palmosa M. Edw. 1857.

Syn. *Lobularia palmosa* Val. MS. — Zanzibar; C. Cooke.

Tubipora purpurea Pallas. — Singapore; Capt. W. H. A. Putnam.

Tubipora musica Linn. — East Indies; Capt. W. H. A. Putnam.

ZOANTHARIA.

Madrepora cervicornis Lamarck. — Florida and West Indies; L. Agassiz.

Madrepora robusta Dana. — Feejee Islands; J. D. Dana.

Madrepora gravida Dana. — Singapore; Capt. W. H. A. Putnam.

Madrepora nobilis Dana.

Syn. *Madrepora secunda* Dana. — Singapore; Capt. W. H. A. Putnam.

A careful comparison of the types of Dana with the extensive series of specimens in the Museum shows conclusively that *Madrepora nobilis* and *M. secunda* are but variable forms of one species.

Madrepora arbuscula Dana. — Singapore; Capt. W. H. A. Putnam.

Madrepora prolifera Lamarck. — Florida and West Indies; L. Agassiz.

Madrepora acuminata Verrill.

A large species allied to *M. nobilis*, but having much longer, regularly tapering, often curved branches, which are an inch in diameter, evenly rounded and thickly covered by spreading, nearly uniform, cylindrical, dimidiate corallites.* Surface of corallum between the cells and exterior of the corallites covered with minute spines, the latter subcostate. Septa

* We use the word *corallite* as the English equivalent of *polypiérite* employed by Milne-Edwards, as his *polypier* corresponds to *corallum* of Dana.

rudimentary, only the two largest usually distinct. A few rudimentary corallites, often opening downward, are scattered among the others. — Kingsmills Islands; A. Garret.

Madrepora diffusa Verrill.

Corallum low arborescent, much branched; branchlets widely spreading or divaricate, curved, gradually tapering to the acute extremities, about a third of an inch in diameter, and two or three long. Corallites broad tubo-nariform, short, scarcely compressed, widely open, the exterior closely striate, the costæ consisting of numerous, distinct points; intercellular tissue firm, reticulated, the surface spinose. Septa narrow, the six primary ones distinct, the inner one broadest. Terminal corallite exsert, scarcely larger than the lateral. This species resembles *M. arbuscula* and *M. formosa* in its mode of branching, but the cells are entirely different. — Kingsmills Islands; A. Garret.

Madrepora parvistella Verrill.

Arborescent, numerously branched; branchlets spreading, curved, neatly rounded and tapering, about half an inch in diameter and three or four long. Corallites evenly crowded, very small, short, tubular, opening obliquely upward; exterior costate, scabrous; cells small, broad oval, stellate; twelve septa distinct, the two largest nearly meeting in the centre. — Singapore; Capt. W. H. A. Putnam.

Madrepora horrida Dana. — Feejee Islands; J. D. Dana.

Madrepora abrotanoides Lamarck. — Feejee Islands; J. D. Dana.

Madrepora virgata Dana. — Feejee Islands; J. D. Dana.

Madrepora hebes Dana. — Feejee Islands; J. D. Dana.

Madrepora austera Dana. — Singapore; Capt. W. H. A. Putnam.

Madrepora implicata Dana. — Feejee Islands; J. D. Dana.

Madrepora tortuosa Dana. — Feejee Islands; J. D. Dana.

Madrepora formosa Dana. — Feejee Islands; J. D. Dana.

Madrepora brachiata Dana. — Sooloo Sea; J. D. Dana.

Madrepora echinata Dana. — Feejee Islands; J. D. Dana.

Madrepora longicyathus M. Edw. — Singapore; Capt. W. H. A. Putnam.

Madrepora tubigera Horn, Proc. Phil. Acad. Nat. Sci. 1860, p. 435.

Syn. ? *Madrepora corymbosa* Lamk. — Singapore; Capt. W. H. A. Putnam.

Madrepora Danæ Verrill.

Syn. *Madrepora deformis* Dana (non Michelin). — Tahiti; J. D. Dana, A. Garret.

Madrepora cuspidata Dana. — Tahiti; A. Garret.

Madrepora plantaginea LAMARCK (non DANA).

SYN. *M. acervata* DANA. — Singapore; Capt. W. H. A. Putnam.

Madrepora cerealis DANA. — Singapore; Capt. W. H. A. Putnam.

Madrepora nasuta DANA. — Tahiti; J. D. Dana, A. Garret.

Madrepora globiceps DANA. — Tahiti; J. D. Dana, A. Garret.

Madrepora millepora DANA. — Singapore; Capt. W. H. A. Putnam.

Madrepora convexa DANA.

SYN. *Madrepora corymbosa* DANA (non LAMK.), the young. — Singapore; Capt. W. H. A. Putnam.

Madrepora surculosa DANA. — Singapore; Capt. W. H. A. Putnam.

Madrepora turbinata DANA.

SYN. *Madrepora surculosa, var. turbinata* DANA.

This species is perfectly distinct from *M. surculosa*. Unbleached specimens are delicate rose-colored. — Tahiti; J. D. Dana, A. Garret.

Madrepora appressa DANA.

SYN. *Heteropora appressa* EHR. 1834; *? H. imbricata* EHR.; *Madrepora plantaginea* DANA (non LAMARCK); *? M. echidnæa* DANA. — Singapore; Capt. W. H. A. Putnam.

Madrepora paxilligera DANA. — Tahiti; A. Garret.

Madrepora cytherea DANA. — Tahiti; J. D. Dana, A. Garret.

Madrepora spicifera DANA. — Singapore; Capt. W. H. A. Putnam.

Madrepora palmata LAMARCK.

SYN. *Madrepora prolifera* HORN, Proc. Phil. Acad. Nat. Sci. 1860, p. 435. — Florida and West Indies; L. Agassiz, D. P. Woodbury.

Porites furcata LAMARCK. — Florida and West Indies; L. Agassiz.

Porites clavaria LAMARCK. — Florida and West Indies; L. Agassiz.

Porites compressa DANA. — Sandwich Islands; A. Garret.

Porites mordax DANA. — Sandwich Islands; A. Garret.

Porites lobata DANA. — Sandwich Islands; A. Garret.

Porites astræoides LAMARCK. — Florida and West Indies; L. Agassiz.

Synaræa VERRILL.

Corallum irregularly branched or glomerate. Cells without distinct walls, the septa rudimentary; six prominent paliform lobes surround the central cavity, which has a rudimentary or very small, tubercular columella; outside of the pali are other similar points, or granulations, scattered between the cells, which are not distinctly circumscribed, but often separated for some distance by a porous cœnenchyma.

This genus includes *Porites erosa*, *P. informis*, and *P. monticulosa* of

Dana, together with the following. The existence of generic characters distinct from *Porites* in these species was suggested by Milne-Edwards, although he had not been able to examine specimens of them.

Synaræa Danæ VERRILL.

SYN. *Porites contigua* DANA; *Porites Danæ* M. EDW. and HAIME. Feejee Islands; J. D. Dana.

Synaræa irregularis VERRILL.

This species forms large irregular masses, consisting of numerous angular, clavate, uneven and crowded branches, often nodose at the ends, and much coalesced, giving a rough, eroded appearance to the mass. Cells larger than in the following species; pali prominent, slender; columella rudimentary, often wanting. Surface covered with slender, prominent, often toothed granulations, which are rather loosely arranged. Color, deep umber brown. — Sandwich Islands; A. Garret.

Synaræa convexa VERRILL.

Corallum forming rounded hemispherical clumps, composed of numerous closely crowded, slender branches, very much divided, angular, and often flabelliform at the summits, much coalesced near the ends, leaving the tips free for about one third of an inch. Cells closely arranged even on the sides of the branches, small and shallow; pali short, thick, obtuse, surrounded by short, obtuse granulations, which are crowded over the whole surface between the cells. Color, dark ash. — Society Islands; A. Garret.

Synaræa solida VERRILL.

Corallum convex and glomerate, arising from a narrow base, formed by numerous very irregular stout branches, coalesced nearly throughout into a solid mass, leaving only the ends free for about half an inch; these are often one half an inch thick, angular and proliferous. Cells rather open and distinct, numerous; pali distinct, not very prominent; septa apparent, but imperfect; columella generally wanting; granulations of the surface rough, irregular, not crowded. Color, grayish brown. — Society Islands; A. Garret.

Alveopora excelsa VERRILL.

Coral incrusting at base, massive, gibbous, rising into long subcylindrical lobes, rounded at the summits. Cells deep, neatly polygonal, nearly uniform in size, averaging about .08 of an inch in diameter, with, occasionally, much larger ones intermingled; septa in two cycles, represented by twelve vertical series of slender spines, uniting at the middle into a loose rudimentary columella; walls thin, pierced by numerous rounded pores. — Singapore; Capt. W. H. A. Putnam.

Alveopora retusa VERRILL.

Corallum irregularly lobed or gibbous; the lobes thick, clavate, often compressed or subfurcate at the ends. Cells deep, unequal in size, the largest about one tenth of an inch in diameter, with others not half as large intermingled; septa represented in the large cells by three cycles of spines, uniting into an imperfect columella; walls rather stout, with large oval pores in vertical series. — Singapore; Capt. W. H. A. Putnam.

Montipora capitata M. Edw. and Haime.

Syn. *Manopora capitata* Dana. — Sandwich Islands; A. Garret.

Montipora effusa M. Edw. and Haime.

Syn. *Manopora effusa* Dana. — Society Islands; A. Garret.

Montipora nodosa M. Edw. and Haime.

Syn. *Manopora nodosa* Dana. — Feejee Islands; J. D. Dana.

Montipora erosa M. Edw. and Haime.

Syn. *Manopora erosa* Dana. — Feejee Islands; J. D. Dana.

Montipora hispida M. Edw. and Haime.

Syn. *Manopora hispida* and *M. spumosa* Dana (non Lamk.). — Singapore; Capt. W. H. A. Putnam.

Endopachys Maclurii M. Edw. and Haime. 1848.

Syn. *Turbinolia Maclurii* Lea. 1833. — Tertiary, Alabama.

Balanophyllia elegans Verrill, Report on the Polyps of the Northwest Boundary Survey, 1861 (not yet published).

Corallum attached by a broad base, low, subturbinate. Calyx broad, oval, deep. Epitheca well developed, covering more than half the height of the wall, which is thin and very porous. Septa thin, forming five complete cycles, the principal ones a little exsert, strongly toothed at the summit, finely dentate below; those of the last order unite together near the columella, and are joined near their middle by those of the preceding order; columella porous, little developed. Height .4 of an inch; greatest diameter of the calyx .48, shortest .4. Color of the living polyp, bright orange. — Crescent City and Mendocino, California; A. Agassiz.

Balanophyllia scabrosa Verrill.

Syn. *Dendrophyllia scabrosa* Dana, 1846; *Balanophyllia Cumingii* M. Edw. and Haime, 1848; *Dendrophyllia? scabrosa* M. Edw. Coralliares. — Singapore; J. D. Dana.

Cœnopsammia equiserialis M. Edw. Coralliaires. 1857.

Singapore; Capt. W. H. A. Putnam.

Cœnopsammia tenuilamellosa M. Edw. and Haime.

Monographie des Eupsammides, 1848. — Panama and Acapulco; A. Agassiz.

Cœnopsammia radiata Verrill.

Similar to the preceding species, but having a much smaller, spongy columella, more conical and less open cells, and the six primary septa much broader and thicker than the others, with rounded nearly entire edges. — Society Islands; A. Garret.

Stylophora digitata M. Edw. and Haime. 1850.

Syn. *Madrepora digitata* Pallas, Elench. Zooph. p. 326, 1766; *Porites scabra* and *elongata* Lamk. 1816; *Sideropora digitata* and *elongata* Blainville, 1830; Dana. 1846; *Porites digitata* Ehr. 1834. — Singapore; Capt. W. H. A. Putman.

Stylophora Danæ M. Edw. and Haime. 1850.

Syn. *Sideropora palmata* Dana, 1846 (non Lamk.). — Singapore; Capt. W. H. A. Putnam.

This approaches the preceding very closely in some of its forms, and may not be distinct.

Stylophora stellata Verrill.

Corallum forming even rounded clumps, a foot or more in diameter, consisting of numerous, evenly crowded branches, which are rounded, about one half an inch in diameter, furcate, often flattened at the ends. Cells evenly crowded over the surface, arranged somewhat in spiral lines, the upper edges prominent, rather stout. Septa forming three cycles, the last two often rudimentary or wanting; primary septa a little exsert, rather narrow, the inner edges vertical, scarcely traceable to the columella, which is small, papilliform. This species resembles *S. digitata* in form, but the cells are entirely different. — Kingsmills Islands; A. Garret.

Madracis decactis Verrill.

Syn. *Astrea decactis* Lyman, Proc. Bost. Soc. Nat. Hist. VI. p. 260, 1857. — Florida; L. Agassiz.

Stylaster roseus Gray, Zoöl. Misc. 1836.

Syn. *Madrepora rosea* Pallas, 1766; *Oculina rosea* Lamk. 1816; *Allopora rosea* Dana, 1846; *Stylaster roseus* Agassiz, Florida Reefs, with fig. (unpublished). — Florida; L. Agassiz.

Stylaster elegans Verrill.

Corallum flabelliform, the principal branches large, compressed, rapidly dividing into smaller branches and branchlets, the ultimate divisions very slender and delicate, rarely coalescent. Cells very small, a little prominent, mostly arranged on the edges of the branchlets, but a few are scattered over the sides; septa narrow, about sixteen distinct; columella minute, styliform. Color, bright rose, lighter on the large branches. — Ebon Island; A. Garret.

Stylaster tenuis Verrill.

Corallum similar to the preceding in its mode of branching, but the branches are not compressed. Cells one third larger, about .02 of an inch in diameter, arranged in simple longitudinal series on the edges of the branchlets, deep at the centre, with a minute slender columella, which is often wanting; septa twelve or fourteen, a little exsert, about one third as broad as the cells. Color, light red, with small irregular spots of white; sides of the branchlets thickly covered with small verrucæ. — Upolu, Navigator Islands; J. D. Hague.

Distichopora nitida VERRILL.

Corallum flabelliform, branching dichotomously in a plane. Branches round or flattened transversely; the branchlets obtuse, often compressed at the tips; surface very minutely granular, appearing almost smooth, with scattered patches of rounded verrucæ, having rudimentary septa and pits surrounding them, and therefore probably corresponding to the enlarged columellæ of cells without solid walls. Three rows of minute pits are arranged closely in regular series along the edges of the branches; those of the central, larger row are circular and often have a slender columella in the centre. The lateral ones are much smaller, and generally irregular in form; a transverse section shows that the central pits correspond to the central open space in the cells of *Stylaster*, while the lateral ones are interseptal chambers, the greater part of which have been obliterated by the thickening of the septa; in some of the cells, twelve septa may be traced. Color bright red, with the tips of the branches yellowish white; other specimens are light orange. — Ebon Island; A. Garret.

Distichopora coccinea GRAY. 1860. — Australia?; A. Garret.

Errina aspera GRAY, Trans. Zoöl. Soc. 1835.

SYN. *Millepora aspera*, LINN. Ed. XII. 1767. — Fayal; Chas. Dabney.

An examination of the structure of this coral has convinced me that it is closely allied to *Distichopora*, and consequently to *Stylaster*, the process of filling up the cells being here carried to the last degree.

Oculina varicosa LESUEUR. 1817. — St. Thomas, W. I.; Dr. G. H. Otis.

This species is unquestionably distinct from the next, with which it has been united by Milne-Edwards and Haime. It resembles more *O. Petiveri* M. EDW. and H.

Oculina diffusa LAMARCK. — Florida; L. Agassiz, G. Wurdemann.

Oculina arbuscula AGASSIZ, MS., Rep. on the Florida Reefs, with fig. (unpublished).

Corallum arborescent; the trunk, arising from a flat, incrusting base, divides rapidly into spreading, round, tapering branches and branchlets. Corallites prominent, arranged somewhat in spiral lines; cells large (.06 inch), open, deep; septa in three cycles well developed, the principal ones exsert, rounded at the summits, vertical within; columella little developed.

Costæ scarcely apparent between the cells. — Off Charleston, South Carolina; L. Agassiz.

Oculina implicata Agassiz, MS., l. c., fig. (unpublished).

Corallum forming dense clumps of irregular, crowded, much coalesced branches. Corallites irregularly arranged, numerous, very slightly prominent, with nearly level interstices, marked by the scarcely prominent radiating costæ. Cells smaller than in the two preceding species and less open; columella rudimentary; septa very little exsert. — Off Cape Hatteras, North Carolina; L. Agassiz. — Beaufort, North Carolina; A. S. Bickmore.

Astrangia Danæ Agassiz, Smith. Contr., with 6 plates (unpublished); Proc. Amer. Assoc. Vol. II. p. 68. 1849 (non M. Edw. and Haime, 1850).

Syn. *Astrangia astreiformis* Leidy (non M. Edw. and Haime). — Long Island Sound; L. Agassiz.

Astrangia astreiformis M. Edw. and Haime. 1850.

Charleston, South Carolina; L. Agassiz.

Astrangia solitaria Verrill.

Syn. *Caryophyllia solitaria* LeSueur, Journal Phil. Acad. Nat. Sci. I. p. 180, pl. VIII. fig. 11, 1817. — Hayti; D. F. Weinland. — St. Thomas; Dr. G. H. Otis.

The corallites in this species are distantly scattered, but connected by a thin basal expansion; septa crowded, strongly denticulate.

Syndepas Gouldii Lyman, Proc. Bost. Soc. Nat. Hist. VI. p. 274. 1857. — Cumana, Venezuela, South America; J. P. Couthouy.

Phyllangia dispersa Verrill.

Corallites connected by a basal expansion, which is generally thin, but sometimes thickened, irregularly scattered, often one half an inch distant, about one fourth of an inch in diameter, and somewhat less in height. Primary and secondary septa much exsert, with narrow, subentire summits. Columella well developed, trabicular, and rudely papillose. — Panama; A. Agassiz.

Cladocora arbuscula M. Edw. and Haime. 1849.

Syn. *Caryophyllia arbuscula* LeSueur, 1820; Dana, 1846. *Cladocora arbuscula* Agassiz, Florida Reefs, with fig. (unpublished). — Florida; L. Agassiz, G. Wurdemann.

Orbicella cavernosa Agassiz, MS. l. c., fig. (unpublished).

Syn. *Madrepora cavernosa* Esp. 1797; *Favia cavernosa* Oken, 1815; *Astrea argus* Lamarck, 1816; *Orbicella argus* Dana, 1846; *Heliastrea cavernosa* M. Edw. 1857. — Florida; L. Agassiz. — Hayti; D. F. Weinland.

The subgenus *Orbicella* of Dana is almost identical with *Heliastrea* of

Milne-Edwards, the first three species, at least, belonging to the latter genus; therefore there appears to be no sufficient reason for changing the earlier name.

Orbicella annularis Dana. 1846.

Syn. *Madrepora annularis* Ellis and Sol. 1786; *Astrea annularis* Lamarck; *Heliastrea annularis* M. Edw.; *Orbicella annularis* Agassiz, l. c., with fig. (unpublished). — Florida; L. Agassiz. — Hayti; D. F. Weinland.

Goniastrea varia Verrill.

Syn. *Astrea varia* Dana; *Prionastrea ? varia* M. Edw. and Haime. — St. Thomas; Dr. G. H. Otis.

Favia ananas Oken, Lehrb. der Nat. I. p. 67. 1815.

Syn. *Madrepora ananas* (*pars*) Linn. Ed. X. 1758; Pallas, Elench. Zooph. 1766; *Astrea ananas* Lamarck, 1816; *Parastrea ananas* M. Edw. and Haime, 1850; *Favia ananas* M. Edw. Coralliaires, 1857. — Florida; L. Agassiz, D. P. Woodbury.

Cœloria dædalea M. Edw. and Haime. 1851.

Syn. *Madrepora dædalea* Ellis and Sol. 1786; *Mæandrina dædâlea* Lamarck, 1816; Dana, 1846; *Astroria dædalea* M. Edw. and Haime, 1849. — Singapore; P. Ellis.

Hydnophora exesa M. Edw. and Haime. 1849.

Syn. *Madrepora exesa* Pallas, 1766 (young); *Hydnophora Pallasii* and *H. Demidoffi* Fischer, 1810; *Monticularia meandrina*. *M. folium*, and *? M. polygonata* Lamarck, 1816; *Hydnophora Demidoffi* and *? H. polygonata* M. Edw. and Haime, 1849. — Singapore; Capt. W. H. A. Putnam.

The extensive series of specimens in the Museum shows that the synonymes quoted refer to the various stages of growth of one species, as suggested by Milne-Edwards.

Diploria cerebriformis M. Edw. and Haime. 1849.

Syn. *Mæandrina cerebriformis* Lamarck. — Florida; L. Agassiz. — Bermuda; H. Hammond.

Manicina areolata (*pars*) Ehr. 1834.

Syn. *Madrepora areolata* Linn. Ed. X. 1758; *Mæandrina areolata* Lamarck; *? Manicina meandrites*, *M. hispida*, *M. prærupta*, and *M. manica* Ehr. 1834; *M. dilatata* Dana, 1846; *Manicina areolata* Agassiz, l. c., with fig. (unpublished). — Florida; L. Agassiz, G. Wurdemann. — St. Thomas; Dr. G. H. Otis.

Trachyphyllia amarantum M. Edw. and Haime. 1849.

Syn. *Manicina amarantum* Dana, 1846. — Singapore; Capt. W. H. A. Putnam.

Mæandrina clivosa Verrill.

Syn. *Madrepora clivosa* Ellis and Sol. p. 163, 1786; *Madrepora* *filograna* ESP. Tab. XXII. 1789 (non *Mæandrina filograna* LAMARCK); *Mæandrina mammosa* DANA; ? *M. interrupta* DANA; ? *Mæandrina grandilobata* M. EDW. and HAIME. — Florida; L. Agassiz, D. P. Woodbury. — Hayti; D. F. Weinland.

Mæandrina strigosa DANA. 1846.
SYN. *Cœloria strigosa* M. EDW. Coralliaires. — Florida; L. Agassiz.

Mæandrina labyrinthiformis DANA. 1846.
SYN. *Madrepora labyrinthiformis* LINN. Ed. X. 1758; *Madrepora labyrinthica* ELLIS and SOL. 1786, pl. 46, figs. 3 and 4 (non *Mæandrina labyrinthica* LAMARCK, EHR., nec *Cœloria labyrinthiformis* M. EDW. and HAIME); *Mæandrina labyrinthica* DANA; *Mæandrina sinuosissima* M. EDW. and HAIME. — Florida; L. Agassiz. — St. Thomas; Dr. G. H. Otis.

Mæandrina sinuosa LESUEUR, Mém. du Mus. VI. p. 278, pl. 15, figs. 4–7, 1820 (non *Madrepora sinuosa* ELLIS and SOLANDER, nec *Mæandrina sinuosa* QUOY and GAIM.).
SYN. *Madrepora labyrinthiformis* (*pars*) LINN. Ed. X.; *Mæandrina labyrinthica* (*pars*) LAMARCK; LAMOUROUX; *Mæandrina crassa* (?) M. EDW. and HAIME. — Florida; L. Agassiz, G. Wurdemann.

Colpophyllia gyrosa M. EDW. and HAIME. 1849.
SYN. *Madrepora gyrosa* ELLIS and SOL. 1786; *Mæandrina gyrosa* LAMARCK; *Mussa gyrosa* DANA; *Colpophyllia gyrosa*, AGASSIZ, l. c., with fig. (unpublished). — Florida; L. Agassiz.

Tridacophyllia lactuca BLAINVILLE. 1830.
SYN. *Madrepora lactuca* PALLAS, 1766; *Pavonia lactuca* LAMARCK, 1816. — Singapore; Capt. W. H. A. Putnam.

Tridacophyllia Manicina DANA. 1846.
SYN. *Madrepora lactuca* ELLIS and SOL. pl. 44 (non PALLAS). — Singapore; Capt. W. H. A. Putnam.

Caulastrea furcata DANA. — Feejee Islands; J. D. Dana.

Symphyllia radians M. EDW. and HAIME. 1849.
SYN. *Mussa crispa* DANA (non LAMARCK). — Singapore; Capt. W. H. A. Putnam.

Mussa tenuidentata M. EDW. and HAIME. 1849.
SYN. *Mussa sinuosa* DANA. — Singapore; Capt. W. H. A. Putnam.

Mussa cytherea DANA. — Society Islands; A. Garret.

Mussa regalis DANA, Zoöphytes. 1846.
SYN. ? *Symphyllia Valenciennesi* M. EDW. and HAIME, 1849. — Singapore; Capt. W. H. A. Putnam.

Isophyllia dipsacea AGASSIZ, MS.
SYN. *Mussa dipsacea* DANA; *Symphyllia ? dipsacea* M. EDW. and

HAIME; ? *Symphyllia guadulpensis* M. EDW. and HAIME, 1849. — Florida Reefs; L. Agassiz. — Bermuda; Frederic Rees. M. D.

Isophyllia sinuosa VERRILL.

SYN. *Madrepora sinuosa* ELLIS and SOL. 1786.

This species forms spreading rounded masses, often six inches in diameter and about two thick. Walls echino-costate exteriorly. The rather shallow, open cells are generally confluent in series of from two to five, but often simple. Septa very numerous, the edges divided into long, slender, subequal teeth. Columella well developed, papillose. It differs from the preceding in its broader growth, more numerous and thinner septa, much more shallow and narrow cells, which are about .7 of an inch, instead of an inch or more, in diameter. The ridges are narrow and sinuous, often with a groove at the top. — St. Thomas, West Indies; Dr. G. H. Otis.

Isophyllia rigida VERRILL.

SYN. *Astrea rigida* DANA, Zoöph. 1846. — Florida; L. Agassiz. — Bermuda; T. C. Hill.

Euphyllia fimbriata M. EDW. Coralliaires. 1857.

SYN. *Euphyllia mæandrina* DANA, Zoöph. 1846. — Singapore; Capt. W. H. A. Putnam.

Galaxea fascicularis OKEN. 1815.

SYN. *Madrepora fascicularis* LINN. Ed. X. 1758; *Anthophyllum fascicularis* DANA, 1846; *Galaxea fascicularis* M. EDW. and HAIME, 1851. — Singapore; Capt. W. H. A. Putnam.

Galaxea cæspitosa VERRILL.

SYN. *Madrepora cæspitosa* ESPER. 1789; *Anthophyllum cæspitosum* DANA, 1846; *Galaxea Ellisii* M. EDW. and HAIME, 1851. — Singapore; Capt. W. H. A. Putnam, J. D. Dana.

Fungia patella M. EDW. and HAIME. 1851.

SYN. *Madrepora patella* ELLIS and SOL. 1786; *Fungia agariciformis* and *patellaris* LAMARCK, 1801; *Fungia agariciformis* DANA. — Singapore; Capt. W. H. A. Putnam.

Fungia repanda DANA. 1846. — Singapore; Capt. W. H. A. Putnam.

Fungia dentata DANA. 1846. — Singapore; Capt. W. H. A. Putnam.

Fungia Danæ M. EDW. and HAIME. 1851.

SYN. *Fungia echinata* DANA, Zoöph. (non PALLAS nec ESPER.). — Singapore; Capt. W. H. A. Putnam.

Fungia confertifolia DANA. 1846 — Feejee Islands; J. D. Dana.

Fungia concinna VERRILL.

Corallum strongly convex, with a deep, narrow central fosse. Septa very unequal, the principal ones nearly evenly exsert, broad, rather thick, the edges evenly dentate, with large, regular, acute teeth; latest ones narrow and thin, deep between the larger, the edges scarcely divided. Lower surface crowdedly costate, the costæ unequal, covered with obtuse papilliform spines. This species is allied to *F. repanda*, but is very distinct in the character of the septa. — Zanzibar; C. Cooke, E. D. Ropes.

Fungia serrulata VERRILL.

Corallum somewhat convex in the centre; fosse very narrow. Principal septa subequal, much narrower than in the preceding, the edges irregularly dentate, with small, very acute, unequal teeth; latest septa thin, much more narrow, the edges finely and regularly denticulate. Lower surface with the principal costæ about .5 of an inch distant, and many other finer ones between; all of them covered with prominent, obtuse, papilliform spines. — Kingsmills Islands; A. Garret.

Fungia Haimei VERRILL.

SYN. *Fungia discus* M. EDW. and HAIME, 1851 (non DANA).

This species differs from *F. discus* DANA, of which the original specimen is before me, in having stronger and nearly equal costæ, furnished with numerous sharp, curved spines, instead of scattered, irregular, obtuse ones, nearly obsolete on the central portion, and in having more equally developed septa, which are more finely and regularly serrated with small, acute, angular teeth. — Zanzibar; C. Cooke.

Fungia valida VERRILL.

Nearly circular, elevated at the centre. Septa very unequal, the principal ones very broad and thick, the last narrow and thin, all except those of the latest cycle strongly serrate with very large, broad, acute teeth. Costæ very unequal, the principal ones thick and prominent, with numerous strong, acute, often curved spines; between these are from three to five, scarcely distinct, except near the edge, and not spinose. Columella fine spongy. — Zanzibar; C. Cooke.

Ctenactis AGASSIZ, MS. 1860. — Type, *Fungia echinata* PALLAS.

This genus includes besides *Fungia Ehrenbergii* LEUCKART, and *F. crassa* DANA, the following: —

Ctenactis gigantea AGASSIZ, MS.

SYN. *Fungia gigantea* (*var.*) DANA, Zoöphytes, p. 303, pl. 19, fig. 12. — Feejee Islands; J. D. Dana.

Ctenactis echinata AGASSIZ, MS. 1860.

SYN. *Fungia echinata* PALLAS, 1766; *Fungia pectinata* EHR.; DANA; *Fungia Ehrenbergii* (*pars*) DANA; *Fungia echinata* M. EDW. and HAIME. — Singapore; Capt. W. H. A. Putnam.

Lobactis AGASSIZ, MS. 1860. — Type, *Fungia dentigera* LEUCKART.

Lobactis Danæ AGASSIZ, MS. 1860.

SYN. *Fungia dentigera* DANA, Zoöphytes, p. 301, pl. 18, fig. 4, 1846 (non Leuckart). — Sandwich Islands; A. Garret.

Lobactis conferta AGASSIZ, MS.

Oblong oval, thick, massive, with even, closely crowded, rather thick, flexuous septa, evenly and finely serrate, with very small, acute, angular teeth, their sides strongly granulated. Tentacular lobes, much thickened, strongly exsert, angular, subacute. Lower surface thickly covered with rounded, slightly prominent papillæ. Length of a large specimen, 6.5 inches; breadth, 4; central fosse, 2.5 long. — Kingsmills Islands; A. Garret.

Pleuractis AGASSIZ, MS. 1860. — Type, *Fungia scutaria* LAMARCK.

Pleuractis scutaria AGASSIZ, MS. 1860.

SYN. *Fungia scutaria* LAMARCK, 1801; DANA; M. EDW. and HAIME. — Singapore; Capt. W. H. A. Putnam.

Herpetolitha Limax ESCHSCHOLTZ. 1825.

SYN. *Madrepora Limax* ESPER; *Fungia limacina* LAMARCK, 1816; *Haliglossa limacina* EHR., 1834; *Herpetolithus limacinus* DANA, 1846. — Singapore; Capt. W. H. A. Putnam.

Herpetolitha ampla AGASSIZ, MS.

A large, spreading species, broad oblong in form, obtusely rounded at the ends; rather thin, about one inch in the middle, half as much near the edges. Septa thin, rounded, exsert, the median ones about an inch in length, the lateral half an inch; the edges evenly serrate with fine, acute, angular teeth. Lower surface crowdedly echinate, with short, conical, acute spines. A specimen 13 inches in length is 6 broad. — Zanzibar; C. Cooke.

Podabacia crustacea M. EDW. and HAIME. 1851.

SYN. *Madrepora crustacea* PALLAS, Elench. Zooph., p. 291, 1766; *Pavonia explanulata* DANA; *Podabacia cyathoides* M. EDW. and HAIME, 1850. — Singapore; J. M. Barnard.

Cryptabacia talpina M. EDW. and HAIME. 1851.

SYN. *Fungia talpina* LAMARCK, 1801; *Polyphyllia talpa* BLAINVILLE; DANA. — Singapore; Capt. W. H. A. Putnam.

Halomitra clypeus VERRILL.

SYN. *Halomitra pileus* (*pars*) DANA, Zoöphytes, p. 311, pl. 21, f. 2, 2 *a*, 1846 (non *Madrepora pileus* LINN. Ed. X., *Fungia pileus* LAMARCK, 1801, nec *Halomitra pileus* M. EDW. and HAIME). — Feejee Islands; J. D. Dana.

This is a very thick, massive species, quite distinct from that described by Milne-Edwards and Haime, which appears to be the true *Madrepora pileus* LINN.

Halomitra tiara Agassiz, MS.

Corallum solid, very convex above, much thinner than the preceding, about half an inch thick. Septo-costal plates thin, short, strongly incise-dentate, the teeth elongated, acute, granulated. Cells very distinct, irregularly scattered, but less remote than in the preceding, owing to the much shorter plates, which are .3 of an inch long near the centre, and about .6 near the margin. Lower surface very concave, with the costæ distinct to the centre, close, slightly thickened, covered with nearly equal, sharp, conical spines. — Kingsmills Islands ; A. Garret.

Zoopilus echinatus Dana, Zoöphytes, p. 319, pl. 21, fig. 6. 1846.

Feejee Islands ; J. D. Dana.

This genus is perfectly well founded, being closely allied to *Lithactinia* ; not, as Milne-Edwards has supposed, a *Fungia*.

Trachypora Verrill.

Corallum explanate, thin ; below echinate and coarsely costate ; above with scattered polyp centres destitute of walls, with one or two cycles of septa, radiating at the centres, but becoming subparallel between them, as in *Halomitra*, strongly dentate or lacerately lobed, the strongest lobes surrounding the polyp centres ; columella loose, trabicular.

This genus is in several respects intermediate between *Halomitra* and *Echinopora ;* in its mode of growth it resembles the latter, but not in its cells. It appears to include, besides the following, *Echinopora aspera* Dana (*Madrepora aspera* Ellis and Sol.).

Trachypora lacera Verrill.

Broadly explanate and gibbous, thin, with many irregular openings near the margin. Below coarsely and irregularly ribbed or costate, the principal costæ very thick, prominent, strongly echinate, the spines irregular, lacerately lobed, smaller intermediate costæ scarcely spinose. Upper surface covered by rather loose, very unequal septo-costal plates, which are deeply and irregularly divided into strong lacerate spines ; the plates are nearly parallel, except close to the polyp centres, where they bend abruptly and unite with the columella. The spines around the centres are large and stout, often broad at the ends ; centres irregularly scattered, from half an inch to an inch distant. — Singapore ; J. M. Barnard.

Phyllastrea tubifex Dana. 1846.

Syn. *Mycedium tubifex* M. Edw. and Haime, 1851. — Feejee Islands ; J. D. Dana.

This genus is quite distinct from *Mycedium* in its coarse, spinose septa, and strong costæ beneath.

Phyllastrea explanata Agassiz. MS.

Differs from the preceding in its broadly explanate, thin, semicircular or subturbinate fronds, smooth below, with distant, strong costæ, and many smaller intermediate ones. The cells are smaller, less remote, with much thickened, lacerately toothed septa, which become very thin between the cells. Columella rudimentary. — Tahiti; A. Garret.

Echinopora flexuosa Verrill.

Corallum forming broad, thin, foliaceous, flexuous, and contorted plates, often growing upright, covered on both surfaces with circular, slightly prominent corallites about .12 of an inch in diameter, separated ordinarily about a quarter of an inch. Between the cells the septo-costal striæ are numerous, thin, divided into slender, sharp spines. There are two complete cycles of septa, with rudiments of a third; those of the first cycle are thickened exteriorly and divided into prominent teeth, which are themselves lacerate. Columella loose, trabicular, little developed. — Singapore; Capt. W. H. A. Putnam.

Echinopora reflexa Dana.

This differs from *E. rosularia* Lamk. in having *three* complete cycles of septa. — Feejee Islands; J. D. Dana.

Acanthopora Verrill. —Type, *Echinopora horrida* Dana.

Corallum ramose, solid, the cells being filled below as in *Oculina*. Costæ between the cells represented by series of spines. It differs also from *Echinopora* in its polyps.

Acanthopora horrida Verrill.

Syn. *Echinopora horrida* Dana, Zoöphytes, p. 282, pl. 17, f. 4, 4 a, 4 b, 4 c, 1846. — Feejee Islands; J. D. Dana.

Pavonia formosa Dana. — Tahiti; A. Garret.

The genus *Pavonia* was first established by Lamarck in 1801, in Système des Animaux sans Vertèbres, p. 372; therefore this name must be retained, instead of *Lophoseris* proposed by Milne-Edwards and Haime, since it was not employed among insects until 1816.

Pavonia prætorta Dana. — Tahiti; A. Garret.

Pavonia frondifera Lamarck.

Syn. *Pavonia frondifera (pars)* Dana; *Lophoseris frondifera* M. Edw. and Haime. — Singapore; Capt. W. H. A. Putnam.

This species is, possibly, *Madrepora ficoides* Ellis and Solander.

Pavonia loculata Dana.

Syn. *Pavonia crassa var. loculata* Dana; *Lophoseris? crassa (pars)* M. Edw. and Haime. — Singapore; Capt. W. H. A. Putnam.

This is, perhaps, *Madrepora accrosa* Ellis and Solander.

Pavonia venusta Dana.

Syn. *Lophoseris? venusta* M. Edw. and Haime. — Singapore; Capt. W. H. A. Putnam.

Pavonia Danæ Verrill.

Syn. *Pavonia boletiformis* Dana (non Lamk.); *Lophoseris Danai* M. Edw. and Haime. — Sooloo Sea; J. D. Dana.

Pavonia varians Verrill.

Corallum incrusting, varying in form according to the object upon which it grows, at times glomerate, massive, and gibbous, with short angular or convoluted crests rising from the surface. These sometimes become more elevated, with an acute edge, or, by incrusting the tubes of Serpulæ, rise into irregular ramose forms. Septa from twelve to sixteen, the primary ones thickened, strongly granulated. Cells rather small, open; columella small, papilliform, often wanting. — Sandwich Islands; A. Garret.

Leptoseris papyracea Verrill.

Syn. *Pavonia papyracea* Dana. — Sooloo Sea; J. D. Dana.

Mycedium fragile Dana; Agassiz MS., Florida Reefs, fig. — Florida; L. Agassiz.

Agaricia agaricites M. Edw. and Haime. 1851.

Syn. *Madrepora agaricites* Pallas, 1766; *Pavonia agaricites* Lamk.; *Agaricia* (*Mycedia*) *agaricites* Dana. — Florida; L. Agassiz. — Hayti; D. F. Weinland.

Agaricia purpurea LeSueur. — Hayti; D. F. Weinland.

Siderastrea radians Agassiz, MS. l. c., fig. (unpublished).

Syn. *Madrepora radians* Pallas, 1766; *Madrepora galaxea* Ellis and Sol. 1786; *Astrea galaxea* Lamk. 1801; *Siderastrea galaxea* Bainv. 1830; M. Edw. and H. 1850; *Siderina galaxea* Dana, 1846; *Astrea radians* M. Edw. 1857. — Florida; L. Agassiz. — Hayti; D. F. Weinland.

Professor Agassiz ascertained by an examination of the living polyps of this species, in 1850, that it is a *Fungian* closely allied to *Pavonia*, with which it also agrees in the structure of the coral; the name *Astrea*, therefore, cannot with propriety be retained for the genus, although it was one of the species originally included in that genus by Lamarck.

Siderastrea siderea Blainville. 1830.

Syn. *Madrepora siderea* Ellis and Sol. 1786; *Astrea siderea* Lamk. 1816; *Pavonia siderea* Dana, 1846. — Florida; L. Agassiz. — Hayti; D. F. Weinland.

Siderastrea clavus Verrill.

Syn. *Pavonia clavus* Dana, 1846; *Lophoseris ? clavus* M. Edw. — Feejee Islands; J. D. Dana.

Pachyseris fluctuosa Verrill.

Corallum forming large explanate plates, which are rather thin, somewhat semicircular in outline, attached by the central part of the lower edge. The upper surface concave, sometimes undulate near the margin; lower surface strongly striated, the costæ close and thickened, somewhat granulated. The transverse ridges of the upper surface are regular and often extend across the whole breadth of the surface, occasionally interrupted, mostly undulated or flexuous, about as high as broad. Centres of the polyp cells very minute, but distinct, not radiated; septo-costal striæ close and even; bent in a zigzag manner on the ridges. Breadth of a large specimen, 28 inches; height, 15; average thickness, .25; width of the valleys, .20. — Kingsmills Islands; A. Garret.

Merulina ampliata Ehrenberg. 1834.

Syn. *Madrepora ampliata* Ellis and Sol. 1786; *Agaricia ampliata* Lamk. 1801; *Merulina speciosa* Horn (non Dana) is the mature form with rising branches, Proc. Phil. Acad. Nat. Sci. 1860, p. 435. — Singapore; Capt. W. H. A. Putnam.

Merulina regalis Dana. 1846. — Feejee Islands; J. D. Dana.

Merulina speciosa Dana. 1846. — Feejee Islands; J. D. Dana.

Clavarina Verrill.

Corallum compact, branching. Cells imperfectly circumscribed, but not confounded in series. Septa and walls thickened, the former lacerate-toothed, with paliform teeth at the bases. Columella rudimentary.

Clavarina scabricula Verrill.

Syn. *Merulina scabricula* Dana, Zoöphytes, p. 275, pl. 16, f. 2, 2 a, 2 b, 1846. — Feejee Islands; J. D. Dana.

Zoanthus sociatus Lamarck. 1801.

Syn. *Actinia sociata* Ellis, Phil. Trans. 1767; Ellis and Sol. 1786; *Zoantha sociata* Lamk. Syst. An. sans Vert. 1801; *Zoantha Ellisii* Lamk. Hist. An. sans Vert. 1816; *Zoanthus sociatus* Ehr. 1834. — Florida; L. Agassiz.

Cerianthus americanus Agassiz. MS.

Body very long, often two feet when expanded, and upwards of an inch in diameter, tapering gradually to the base. Outer tentacles very numerous, one hundred and twenty or more, slender, about 1.5 inches long, very flexible; inner ones close to the mouth, about .75 of an inch long, often twisted together spirally. Color of column dark cinnamon brown, with darker lines of the same; marginal tentacles cinnamon color, lighter at the base; inner ones darker, marked with longitudinal white lines; outer portion of the disk yellow, with dark spots at the base of the tentacles. — Charleston, South Carolina, buried in mud; L. Agassiz.

The descriptions of the colors of this and other species of *Actinidæ* have been taken from a series of drawings which Professor Agassiz caused to be made from living specimens, in 1852.

Halcampa albida AGASSIZ, MS.

SYN. *Corynactis albida* AGASSIZ, Proc. Bost. Soc. Nat. Hist. VII. p. 24, 1859.

Column, in full expansion, long and slender, but very changeable in form; upper half covered with prominent suckers, arranged rather closely in longitudinal rows. Tentacles twenty, slender, with a rounded knob at the end. Length in expansion, about 3 inches; thickness, .4. Color light brownish yellow; tentacles lighter, with the ends dark brown. — Nantucket, Massachusetts, buried in sand; B. T. Morrison.

Dysactis pallida VERRILL.

SYN. *Actinia pallida* AGASSIZ, MS. 1849; ? *Anthea flavidula* McCRADY, Proc. Elliott Soc. of Charleston, S. C., I. p. 280 (without description).

Column short, subcylindrical, expanding above the middle to the margin of the broad disk, but varying somewhat in form according to the state of contraction. Inner tentacles an inch or more long, slender, those near the margin short, conical, with some of intermediate length between. Column sometimes 1.25 inches high; disk .75 broad. Color light yellowish brown; longest tentacles lighter, spotted with white. — Charleston, South Carolina; L. Agassiz.

Bunodes cavernata VERRILL.

SYN. *Actinia cavernata* BOSC, Hist. nat. des Vers, 1802 (the young). — Charleston, South Carolina; L. Agassiz.

Rhodactinia Davisii AGASSIZ, Comptes-Rendus, XXV. p. 677, 1847; Revue zoologique Soc. Cuv. p. 394. 1847.

SYN. *Actinia obtruncata* STIMPSON, Marine Invertebrata of Grand Menan, p. 7, 1853 (littoral variety). — Massachusetts Bay; L. Agassiz. — Eastport, Maine; A. E. Verrill.

The genus *Rhodactinia*, established by Professor Agassiz in 1847, is perfectly equivalent to *Tealia* recently proposed by Gosse, the type of the former, *R. Davisii*, being the American representative of *R. crassicornis* of Europe, to which it is very closely allied.

Aulactinia AGASSIZ, MS.

Column elongated, upper portion capable of involution. Walls with prominent verrucæ in longitudinal rows on the upper portion; the marginal ones larger, trilobed, the lobes again subdivided on the lower side. Tentacles short, subequal.

Aulactinia capitata AG., MS. 1849.

Column much elongated; basal disk somewhat expanded. Suckers extending down about an inch from the summit, becoming obsolete below. Marginal tubercles well developed, lower surface lobed and papillose. Tentacles numerous, short, and thick. Color of the column greenish or purplish brown, with lighter lines; tentacles light yellowish green, with a dark longitudinal line on the inside, interrupted by white spots. — Charleston, South Carolina, buried in sand to the tentacles; L. Agassiz.

Metridium marginatum M. Edwards, Coralliaires. 1857.

Syn. *Actinia marginata* LeSueur, Journal Phil. Acad. Nat. Sci. I. p. 172, 1817; *Actinia dianthus* Dawson, Canadian Nat. and Geologist, Vol. III. p. 412, figs. 1 and 2, 1858. — Massachusetts Bay; L. Agassiz. — Bay of Fundy; A. E. Verrill.

This is the American representative of *M. dianthus* of Europe, which it closely resembles in colors and form. Living specimens of the two species, compared side by side in the Museum, however, have shown constant differences in the arrangement of the tentacles. The specimens of *M. dianthus* were forwarded from the Free Public Museum of Liverpool, through Capt. J. Anderson.

Cereus sol Agassiz, MS.

Syn. *Actinia sol* Agassiz, MS. 1849.

Very contractile and variable in form; when fully expanded usually elongated, narrowest in the middle, expanding both above and below. Tentacles very numerous, often four or five hundred, those of the primary cycles about half an inch long, seattered, placed about midway between the mouth and the margin of the disk, the outer ones becoming very crowded and small. Actinostome with seven folds on each side. Walls for a short distance below the tentacles covered with small suckers and pierced with loopholes. Column with about eight broad stripes of cinnamon brown, alternating with narrower gray ones, the whole surface irregularly spotted with dark brown, darkest near the tentacles; mouth bright yellow, surrounded by a ring of deep crimson or purple; outside of this the disk is greenish blue, with darker radiating lines; inner tentacles with a white longitudinal line on each side and darker brown spots on the inside and at the base; others nearer the margin are tipped with red, then farther outward they become orange-yellow with red tips, while the outermost ones are nearly white. — Charleston, South Carolina, on shells inhabited by hermit crabs; L. Agassiz.

This species is closely allied to *C. Bellis* of Europe, the type of the genus *Cereus* of Oken; therefore I have restricted that name to this section of the genus *Sagartia* of Gosse.

Edwardsia sipunculoides Stimpson, MS.

Syn. *Actinia sipunculoides* Stimpson, Marine Inv. of G. Menan, p. 7, pl. 1, f. 2, 1853. — Eastport, Me.; A. E. Verrill.

HYDROIDEA.

Tabulata.

Millepora alcicornis Linn. Ed. X. 1758; Agassiz, Florida Reefs, fig. (unpublished).

Florida; L. Agassiz, D. P. Woodbury. — Hayti; D. F. Weinland.

M. moniliformis Dana is a form of this species.

Millepora pumila Dana, Zoöph. 1846. — Porto Cabello, South America; Coll. Harvard University.

Millepora intricata M. Edwards. 1857. — Manilla; J. Russell.

Millepora insignis Verrill.

Corallum forming large, meandering plates, giving off smaller plates at right angles to their surface; the edges are thick, obtuse, often lobed, and sometimes divided into short, irregular branches, obtuse at the ends; surface irregular, covered with small verrucæ. Cells large for the genus, the principal ones situated at the summit of slight prominences, surrounded by a circle of about six small ones. — Kingsmills Islands; A. Garret.

Heliopora cœrulea Blainville. 1830.

Syn. *Millepora cærulea* Pallas, 1766; *Madrepora cærulea* Esper; *Pocillopora cærulea* Lamarck, 1816. — Singapore; Capt. W. H. A. Putnam.

Heliopora compressa Verrill.

Corallum forming a thick, massive or incrusting base, from which it rises into broad winding plates, thin at their edges, which give off from their sides smaller plates and compressed, lobe-like branches. Cells somewhat larger than in the preceding species and more distant; the minute secondary cells are also less numerous and smaller. Surface of the cœnenchyma covered with crowded papillæ, terminating in two or three points. — Kingsmills Islands; A. Garret.

Pocillopora cæspitosa Dana. — Sandwich Islands; A. Garret.

Pocillopora ligulata Dana. — Sandwich Islands; A. Garret.

Pocillopora nobilis Verrill.

Syn. *Pocillopora verrucosa* Dana, Zoöphytes, p. 529, pl. 50, fig. 3 (non Lamarck). — Sandwich Islands; A. Garret.

Pocillopora Danæ Verrill.

Syn. *Pocillopora favosa* Dana, l. c., pl. 50, fig. 1 (non Ehr.). — Feejee Islands; J. D. Dana.

Pocillopora squarrosa Dana. 1847. — Feejee Islands; J. D. Dana.

Pocillopora acuta Lamk. 1816. — Feejee Islands; J. D. Dana.

Pocillopora suffruticosa Verrill.

This species forms neat, densely-branched, rounded clumps, often eight inches in diameter, resembling those of *P. bulbosa*, with small, irregular, and very proliferous branches. The surface is more strongly echinate than that of the latter, with much deeper and less open cells. — Tahiti; A. Garret.

Pocillopora ramiculosa Verrill.

Branches very slender and elongated, much divided, forming rounded clumps less dense than the preceding, or *P. cæspitosa*, to which it is allied. Branchlets very small, often .1 of an inch in diameter, subacute, not crowded. Cells small and deep, nearly circular. Surface evenly and crowdedly echinulate. This species resembles *P. acuta* in its mode of branching, but is more slender and has much smaller cells than either that species or *P. cæspitosa*. — Kingsmills Islands; A. Garret.

Pocillopora stellata Verrill.

Corallum forming close clumps of long, moderately thick, subparallel branches, which are covered with rising, elongated, subacute, rather distant verrucæ: surface crowdedly echinulate. Cells distant, small, and deep with twelve prominent radiating plates, which give them a stellate appearance. This species resembles *P. damicornis* somewhat in the size of its branches and mode of growth, but is entirely distinct in the structure and small size of the cells. — Zanzibar; C. Cooke, Capt. Ashby.

Pocillopora damicornis Lamk. 1816.

Syn. *Madrepora damicornis* Esper. — Singapore; Capt. W. H. A. Putnam.

Pocillopora bulbosa Ehr. 1834. — Singapore; Capt. W. H. A. Putnam.

Pocillopora capitata Verrill.

The corallum consists of a cluster of large irregular branches, often an inch or more in diameter, covered with elongated, squarrose, subacute verrucæ, .3 of an inch long and .1 in diameter, about .2 of an inch distant. Branchlets spreading, often rounded and clavate at the end, where the verrucæ become obsolete; surface echinulate, the grains unequally scattered, most prominent immediately around the edges of the cells, which are small, circular, and very deep. This species, although very variable in the form and size of the branches, is very distinct from all the other species known, in the character of the surface and cells. — Acapulco, Mexico; A. Agassiz.

Published January, 1864.

No. 4. — *List of the Brachiopoda from the Island of Anticosti, sent by the Museum of Comparative Zoölogy to different Institutions in Exchange for other Specimens, with Annotations. By* N. S. SHALER.

Lingula BRUGIÈRE.

Lingula elegantula SHALER.

Shell large, oblong, transverse diameter a little over one half the distance from beak to border; margin opposite the beak evenly rounded; sides straight for over two thirds the height of shell, suddenly converging to the beaks; apical angle, 110°; cardinal edges straight; diameter at right angles to valves one fifth the height. Valves moderately, nearly equally, convex. Homologue of toothed valve most convex, depressed near the border; surface with fine concentric lines of growth accumulated in low plications on the sides, no radial striæ. The surface of all the specimens is of a beautiful iridescent blue color, apparently the original hue of the shell.

Height, 1.7 inches; width, 1 inch. — Upper twenty feet of Junction Cliff, west end of Anticosti.

Lingula Forbesi BILLINGS. New species of Lower-Silurian Fossils; Geol. Sur. Canada. June, 1862. — West end of Anticosti.

Strophomena (RAFINESQUE) BLAINVILLE.

Strophomena semiovalis SHALER.

Shell semi-oval, transverse diameter from one fifth to one seventh greater than from the beak to the border; hinge-line straight, slightly alate; sides slightly converging until a little below the middle, thence rapidly converging, sometimes slightly produced opposite the hinge-line. Socket-valve flat or slightly concave, over the surface of the visceral disk, which occupies from one half to two thirds the distance from beak to border, then rather sharply deflected; depth of valve equal to one third the length from beak to border. Surface covered with close-set, irregular radial striæ of several sizes, in irregular alternation, crossed by very fine concentric lines. Near the hinge-line are several irregular undulations, which do not extend to the middle of the visceral disk. Area of socket-valve narrow, almost linear, interrupted by a small cardinal process. Area of toothed valve rather broad, half a line wide in specimens measuring one inch from beak to border. Fissure narrow, with a V-shaped deltidium. — Ellis Bay, Anticosti. Division D, Canada Geological Survey.

Strophomena reticulata Shaler.

Sub-triangular, one third wider than high, greatest width at hinge-line. Toothed valve very convex, ventricose, flattened towards the extremities of the hinge-line, slightly alate, most convex point a little more than half the distance from beak to border, depth equal to one third the length of hinge-line, nearly evenly rounded from beak to border, beak minute, projecting a little beyond the hinge-ledge. area one and a half lines wide in a specimen twenty lines broad, fissure broad, without deltidium. Area of socket-valve about one fourth that of toothed valve; surface deflected to correspond with opposite valve. Surface covered with very numerous, minute, close-set radial striæ, crossed by numerous concentric undulations, which near the umbo are small and even; away from that point they are irregular and larger. — Ellis Bay, Anticosti. Division D, Canada Geological Survey.

Strophomena arcuata Shaler.

Shell obscurely trigonal; distance from beak to border two fifths less than length of hinge-line; greatest width at hinge-line; toothed valve slightly convex, or nearly flat near the beak, suddenly evenly deflected at two thirds the distance from the beak to border; surface covered with rather fine, irregular, radial striæ, branching several times from beak to border, five to seven in the space of one line on the border.

This species is a member of the same group with *Strophomena euglypha* of the Wenlock Lime. — Ellis Bay, Anticosti. Division D, Canada Geological Survey.

Strophomena anticostiensis Shaler.

Syn. *Strophomena alternata* Billings.

Outline rather variable, usually evenly semi-oval; length of hinge-line usually a little greater than from beak to border; sides nearly straight for half the distance from the beak to border; rest of border gradually curved. Toothed valve slightly evenly convex; hinge-line narrow; teeth very slight. Socket-valve flat or nearly so; hinge-line narrow; cardinal process very slight; sockets bordered on the inside by a pointed tooth-like ridge. Muscular impressions at all ages indistinct and scarcely impressed. Surface covered with fine punctate markings. Surface of shell with fine striæ of two or three sizes, alternately disposed.

Very closely related to *S. alternata* Con., from which it differs in being far more regular; by the presence of ridges below the sockets; in wanting the tendency to a sudden deflection, and interior thickening of the borders of the valves. — Heath Point, Anticosti.

Strophomena alterniradiata SHALER.

Shell semi-oval; width at hinge-line about three eighths greater than from beak to border. Toothed valve distinctly convex near the umbo; remainder of valve flattened or slightly concave. Socket-valve slightly concave just below the umbo, slightly convex over the remainder of the surface. Surface of both valves with distinct rounded radii, one half of which originate at the beak, the others coming in by implantation at the border of the umbonal third of the valves; intervals very wide. Hinge area of toothed valve wide, — one line in specimens ten lines broad; that of socket-valve narrow, nearly linear. Fissure wider than high; teeth small and pointed. Brachial supports oblique, meeting at an angle of 90°. Cardinal process very small, slightly projecting. — Southwest Point, Anticosti.

Brachyprion SHALER.

Dental plates transversely much elongated; scarcely distinct from the remainder of the hinge-line; vertically serrated.

Type. — *Strophomena leda* BILLINGS.

Brachyprion leda SHALER.

SYN. *Strophomena leda* BILLINGS. — Near Beescie River Bay.

Brachyprion ventricosum SHALER.

SYN. *Strophomena Philomela* BILLINGS?

Sub-trigonal margin opposite the hinge-line rounded, strongly alate, one side being unusually more prolonged than the other; hinge-line two fifths longer than distance from beak to border; width on hinge-line, 2.30 inches; at one third the distance from beak to border, 1.33 inches; convexity of toothed valve equal to one third the distance from beak to border. Toothed valve strongly evenly convex, much compressed near the alations; highest point two thirds the distance from beak to border; hinge area narrow; fissure very small, triangular, not extending to the beak. Area of socket-valve narrow, cardinal process small. Surface covered with very fine linear radial striæ of two sizes, four or five of the smaller between each pair of larger; smaller striæ nearly microscopic; several indistinct concentric undulations near the hinge-line. — Near Southwest Point, Anticosti. Division E, Canada Geological Survey.

Brachyprion geniculatum SHALER.

Shell semi-elliptical or sub-trigonal; greatest width at hinge-line; hinge-line straight; about one third greater than from beak to border. Socket-valve plane or slightly concave over the visceral disk, suddenly deflected at two thirds the distance from beak to border. Surface of shell with a number of rounded radial striæ (twenty to fifty). Those on the centre much larger than those on the sides; between each pair from five to nine very fine striæ, two or three of which become larger than the others as they approach the border. The finest striæ are scarcely visible to the naked eye. — Jumper's Cliffs, near Southwest Point, Anticosti.

Plectambonites Pander.

Plectambonites glabra Shaler.

Syn. *Leptæna sericea* Billings, Can. Geol. Survey, 1853–56, p. 252.

Shell elongate semi-oval; distance from beak to border about one half as long as hinge-line; hinge-line usually equal to the greatest width of shell; outline evenly rounded. Toothed valve strongly convex; depth about two fifths (sometimes one half) the length from beak to border; most convex point one third the distance from beak to border; a little flattened near the lateral border; strongly ventricose in the middle; umbo rising above the hinge-line; slightly incurved; beak not distinct; area narrow; in the same plane with the lateral margin; teeth small, slightly projecting. Socket-valve curved to fit the toothed valve; area a little less in width.

Surface of valves, with very numerous nearly microscopic radial striæ, closely set, of nearly equal size, scarcely distinguishable upon the centre, but distinct upon the borders of the shell. The socket-valve has distinct radial striæ of a larger size interspersed among these, like the radii on the toothed valve.

This form differs from its representatives of the Lower Silurian by its great convexity, as well as by many other characters. — Ellis Bay, Anticosti.

Plectambonites arca Shaler.

Syn. *Leptæna transversalis* Billings.

Shell semi-elliptical; greatest width at hinge-line; hinge-line one third longer than from beak to border. Toothed valve in adult specimens very ventricose; depth equal to one third the length of hinge-line; area narrow, almost linear; fissure very small, equilaterally triangular; muscular impressions indistinct. Socket-valve concave, flattened towards the extremities of the hinge-line; area narrow, linear; cardinal process very small; muscular impressions very slight. Surface of shell with twelve to twenty distinct radii, with very fine radii between. — Near Southwest Point, Anticosti.

Plectambonites tenera Shaler.

Very closely allied to the form called by Hall *Leptæna transversalis*, from the Niagara Lime of New York; it is, however, less convex, and more flattened towards the extremities of the hinge-line. The area of the toothed valve is in the same plane as the margin. The umbo scarcely extends above the hinge-line in many of the specimens. Interior has not been compared. — Near Southwest Point, Anticosti.

Leptæna Dalman.

Leptæna Julia Shaler.

Syn. *Strophomena Julia* Billings.

This species possesses all the important characters of the group, — sudden deflection of the valves, corrugated surface, together with the ridge around the visceral disk on the internal surface of the socket-valve. — Near Southwest Point, Anticosti.

Leptæna quadrilatera Shaler.

Syn. *Strophomena depressa* Billings.

Shell margin broadly semi-oval; greatest width at hinge-line, which is one half longer than from beak to border. Tooth-valve with the visceral disk nearly rectangular; laterally about two sevenths wider than from beak to point of deflection; disk convex near the umbo, concave near the deflected margin; umbo rather prominent, broadly rounded, scarcely rising above the hinge-line; radii fine, with even interspaces, somewhat irregular on the deflected margin; concentric undulations about six in number, wanting on a space about one fifth of an inch wide near the umbo; hinge area very narrow, almost linear near the extremities; socket-valve nearly flat or slightly convex over the visceral disk, usually with a distinct mesial sinus; hinge area narrow, not over one twenty-eighth of an inch in width; cardinal process minute.

This species may prove identical with the form from the Niagara group of New York, but there are several constant exterior differences. The interiors have not been examined. — Ellis Bay, Anticosti.

Orthis Dalman.

Orthis laurentina Billings, Report Can. G. S. for 1857, p. 297. — Junction Cliff, Anticosti.

Orthis media Shaler.

Syn. *Orthis elegantula* Billings.

Shell orbicular; hinge-line one half less than width of shell. Toothed valve evenly convex; depth in adult specimens about one fourth the height, in young specimens proportionately a little greater; umbo slightly elevated, rising above the hinge-line one eighth the distance from beak to border, slightly compressed, occupying at the hinge-line about one fourth the diameter of the valve; beak small, distinct, slightly recurved, a little overhanging the area; area small, rather broad. Fissure triangular, one third as wide as length of hinge-line. Socket-valve transversely flattened, a slight mesial depression dividing the surface into two lobations.

Differs from its European representatives, being more orbicular, having a less projecting umbo, less incurvation of beak, much finer radial striæ, closer approximation of the brachial supports of the socket-valve, and less length of the adductor impressions in the same valve. — Southwest Point, Anticosti.

Orthis anticostiensis Shaler.

Syn. *Orthis porcata* Billings (*non* McCoy), Can. Geol. Sur., 1862, p. 135. — Ellis Bay.

Orthis æquivalva Shaler.

Syn. *Orthis hybrida* Billings.

Shell somewhat lenticular; one fifth wider than from beak to border; valves nearly equal in convexity; toothed valve a little the most prominent; hinge-line rather more than half the width of shell. Toothed valve strongly evenly convex, a little depressed opposite the umbo; umbo rising above the hinge-line about one sixth the distance from beak to border, a little laterally compressed; beak minute, scarcely projecting beyond the hinge-line, a little recurved; area about twice as wide as that of socket-valve; width one sixth of length; steeply sloping; most convex point of valve a little nearer the beak than border. Socket-valve nearly evenly convex; very slight mesial depression, extending from the umbo to the centre of valve, where it fades out, and is succeeded by a slight ridge, which extends to the border, beak distinct; not rising as far above the hinge-line as that of opposite valve by the width of socket-valve area. Surface with fine dichotomous striæ, with interspaces as wide as the ridges. — Junction Cliff, west end of Anticosti.

Orthis rhynconelliformis Shaler.

Form varying from sub-circular to pentagonal; usually with the transverse one fifth greater than the diameter from beak to border; hinge-line very short, scarcely one half the width of shell. Toothed valve moderately convex, with a very broad, shallow mesial sinus beginning near the centre, and rapidly widening to the border; umbo somewhat laterally compressed; rising above the hinge-line; acutely pointed; not recurved; beak minute, very distinct. Socket-valve evenly convex; highest point near the middle of valve; usually a faint mesial sinus near the beak, fading out in the centre of the shell. Fissure of toothed valve wider than long, sides curved; teeth small, laterally compressed; muscular impressions extending to or beyond the middle of valve, very lobate; lobes pointed.

Surface with numerous angular radii; bifurcating twice from beak to border; about four in the space of one line on the centre of border; interspaces about as wide as ridges. — Gull Cove, eastern end of Anticosti.

Orthis alata Shaler.

Shell nearly semi-oval, sometimes slightly quadrate; hinge-line a little less than diameter of shell; both valves slightly, nearly equally convex. Toothed valve a little the deepest. Transverse diameter a little greater than from beak to border. Area of both valves narrow. Muscular impressions of toothed valve broader than long, extending about one fifth the distance from beak to border. Surface with from eighteen to twenty-two heavy, rounded ribs; the interspaces on the border double as wide as the ridges.

This species may be identical with *O. flabellulum* var. HALL from New York, but is certainly distinct from the *O. flabellulum* SOW. — Salt Lake Bay, upper part of Division E, Canada Geological Survey.

Orthisina D'ORB.

Orthisina diversa SHALER.

SYN. *Orthisina Verneuilli* BILLINGS.

Toothed valve usually pentagonal; socket-valve quadrate; hinge-line usually equal to the greatest width of shell. Toothed valve very strongly projecting; depth about one half the width; deepest point about the height of hinge-line; umbo somewhat laterally compressed, usually rising high above the plane of the hinge-line, but very variable in this respect; umbo always laterally inclined, indifferently towards either extremity of the hinge-line. Surface near the extremities of the hinge-line a little depressed and slightly recurved; area very large, nearly half as wide as long. Fissure from one fourth to one third the width of hinge-line; deltidium large, massive, rarely central, with distinct circular or oval foramen. Socket-valve with a broad and shallow mesial fold.

This form is closely related to *O. Verneuilli* EICH., but differs from it in the size of the radial striæ, and in many important internal features. — Ellis Bay, Anticosti.

Platystrophia KING.

Platystrophia regularis SHALER.

Outline much the same as that of the other members of the group. Socket-valve one fourth more projecting than the toothed valve; hinge-line a little less than diameter of shell, three fifths greater than distance from beak to border. That portion of the margin occupied by the fold and sinus is re-entering, the depth of the incurvation being about equal to the elevation of the umbo above the hinge-line. The depression of the sinus is occupied by only two plications, and the ridge by three similar folds. On either side are from eight to nine plications. These numbers seem invariable.

The muscular impression of the toothed valve is long and narrow, length being three or four times its width, extending nearly to the centre of the valve, — a feature in which this species differs from its representatives. — Junction Cliff, Anticosti.

Atrypa Dalman.

Atrypa impressa Shaler.

Syn. *Atrypa reticularis* Billings.

Outline of shell obscurely quadrate, sometimes rather sub-orbicular; about as broad as high; diameter from valve to valve about one half the distance from beak to border; valves nearly equally convex, toothed valve usually a little the greater; hinge-line straight, nearly as great as width of shell. Tooth-valve rather convex, side slopes more abrupt than central, slightly flattened or depressed opposite the hinge-line. Point of greatest convexity at one third the distance from beak to border. Umbo projecting above the hinge-line about one ninth the distance from beak to border; laterally compressed; recurved; projecting beyond the hinge-line; beak minute, pointed, distinct. Socket-valve evenly convex; most projecting point a little nearer the hinge-line than border. Originating at the beak there is a distinct, rather abruptly depressed mesial furrow, which grows more shallow towards the centre of valve. Radii branching twice from beak to border, a little larger in the centre of valve than on the border.

The adult condition of this species differs strikingly from any other form included under the name of *Atrypa reticularis.* — Near Southwest Point, Anticosti.

Atrypa flabella Shaler.

Outline sub-orbicular; transverse diameter about one fifth greater than from beak to border; the slopes on either side of the beak form an angle of about 150° at the valve. Toothed valve convex; rather ridge-like in the centre; depressed on the border opposite the beak; slightly compressed near the umbo; most convex point one third the distance from beak to border; beak not distinct from hinge-line. Socket-valve slightly convex; a distinct mesial impression divides the surface into two lobes. Surface with from twelve to eighteen rounded, club-shaped, radial ridges. Near the border of some large specimens there are a few concentric, imbricating lines of growth.

It is not unlikely that this form is specifically identical with the *A. hemispherica* Hall, from the Clinton of New York. There are several points of difference between this form and the *A. hemisphærica* Murch. — Near Southwest Point, Anticosti, upper part of Division E, Canada Geological Survey.

Rhynconella Fischer.

Rhynconella fringilla Billings. New Species of Low. Sil. Fossils; Can. Geol. Sur., 1862, p. 141, Fig. 118. — Near Gull Cape, Anticosti.

Rhynconella anticostiensis Billings. New Species of Low. Sil. Fossils; Can. Geol. Sur., 1862, p. 142, Fig. 119. — English Head, Anticosti.

Rhynconella glacialis Billings. New Species of Low. Sil. Fossils; Can. Geol. Sur., 1862, p. 143, Fig. 120. — Ellis Bay, Anticosti.

Brachymerus Shaler.

Anterior (dorsal) valve the more convex. Dental lamellæ serrate or lobed on the outside. Septa of anterior valve with two broad, thin brachial plates projecting from them near their junction with the hinge-line; exterior surface plicated.

A member of the same family as Pentamerus, to which it is very closely allied.

Type. — *Pentamerus Verneuilli* Hall.

Brachymerus reversus Shaler.

Syn. *Pentamerus reversus* Billings; Canada Geol. Survey, 1857, p. 295. — Junction Cliff, Anticosti.

Pentamerus Sowerby.

Pentamerus Barrandii Billings; Canada Geol. Survey, 1857, p. 296. — Becscie River Bay.

Athyris McCoy.

Athyris turgida Shaler.

Shell sub-circular; transverse diameter equal to distance from beak to border; from valve to valve about four fifths the transverse diameter. Toothed valve very convex; most elevated at one third the distance from beak to border; umbo rising above the hinge-line for a distance equal to one fifth the transverse diameter; closely incurved; beak indistinct; socket-valve very convex; most elevated point one third the distance from beak to border; depth equal to one third of the diameter, about two thirds as great as that of opposite valve; umbo rising above the hinge-line a distance equal to one fifth the diameter of valve. Surface with numerous distinct concentric lines of growth. Toothed valve with a narrow, shallow mesial sinus, which produces a flattening for some distance from the border.

From beak to border, seven lines; transverse diameter, seven lines; valve to valve, five lines. — Ellis Bay, Anticosti.

Athyris umbonata Billings. New Species of Low. Sil. Fossils; Canada Geol. Survey, 1862, p. 144. — Junction Cliff, Anticosti.

Athyris prinstana Billings. New Species of Low. Sil. Fossils; Canada Geol. Survey, 1862, p. 145. — Prinsta Bay.

Athyris Julia Billings. New Species of Low. Sil. Fossils; Canada Geol Survey, 1862, p. 146. — Jumper's Cliff, Anticosti.

Camerella.

Camerella ops Billings. New Species of Low. Sil. Fossils; Can. Geol. Survey, 1862, p. 148.

Spirifer Sowerby.

Spirifer tenuistriatus Shaler.

Form about the same as *Spirifer radiatus* Sow.; hinge-line straight for four fifths of the diameter of shell, then gently rounding; transverse diameter a little greater than from umbo to border; socket-valve very convex, most prominent point about middle of valve; umbo rising above the hinge-line for a distance equal to one fifth the transverse diameter; strongly recurved; area indistinctly bounded. Socket-valve about two fifths as projecting as toothed valve; umbo rising a little above the hinge-line; evenly rounded; mesial sinus rather shallow; somewhat angular. Surface covered with very fine, almost microscopic radii; eight or nine in the space of one line on the border.

This species differs from *S. radiatus* in the minuteness of the radial striæ. It is possible that this form is identical with the *S. radiatus* of Hall, from the Niagara and Clinton of New York. No comparison of specimens has been made. — Near Southwest Point, upper part of Division F, Canada Geological Survey.

Published June, 1865.

No. 5. — *The Fossil Cephalopods of the Museum of Comparative Zoölogy.* By Alpheus Hyatt.

This number of the Bulletin begins a series of notices upon the Cephalopoda, which besides fulfilling the common object of similar numbers already published, has some peculiar features of its own requiring a few explanatory remarks.

The Ammonoids, including all the Cephalopods with serrated or foliated septa, the Clymeniæ, Goniatites, Ceratites, and Ammonites proper, are separated by Professor L. Agassiz from the Nautiloids and Dibranchiate Cephalopods as a distinct order.

The typical group of this order is the so-called genus Ammonites.

De Montfort and De Haan both recognized a few new genera within the limits of this incongruous genus before Von Buch described the natural groups which continue to bear his names. Von Buch called these groups "families," but classified them under the "generic" name of Ammonites; thus plainly, although indirectly, announcing his opinion of their sub-generic value.

Professor L. Agassiz, for many years past, considered some of these groups as natural families, and deemed them capable of division into subordinate groups of generic importance.

He imparted this fundamental idea to me at the beginning of my studies upon these interesting fossils, and selected the five genera which are referred to his authority as examples of the manner in which I should treat this subject, at the time he recommended the investigation to me. Further than this, the work is my own.

I have pursued no special method in the classification, but have directed my whole attention to the verification of the groups defined by Von Buch and others, and the subsequent testing of the limits of the included genera by a careful comparison of all the minor divisions in each natural group.

The shells or mineral casts of every group have been first arranged in series of species, and the limits of these series determined the genera. The generic characteristics were selected from those peculiar to all the species of each series which were not common to the family or any more comprehensive division.

The materials in the possession of the Museum afford ample means for the successful completion of such a plan, which, more than any other, demands large numbers of specimens. They consist of collections purchased from Professors Bronn and L. de Koninck, MM. Boucault and Duval, Dr. A. Krantz, and others, besides those obtained by exchange, among which is a valuable collection, numbering many species, from the Museum of Stuttgart.

I am indebted to Professor L. Agassiz for the free use of all the specimens in these collections, and desire to express here my acknowledgment of the facilities for study given me both by himself and the Institution.

The position of the female Argonauta in its shelly case, and of the Nautilus in its shell, show conclusively that the periphery of the whorls of an Ammonite is the abdominal side, as stated by Richard Owen and Pictet. This view, therefore, has been adopted, and the outer side of the whorl is called "the abdominal," and the inner "the dorsal side," in accordance with their opinion.

No further changes have been made in the nomenclature generally employed, with the exception of the use of the words "pilæ" for ribs, and "geniculæ" for the knees of the ribs, these being found somewhat more convenient in the description of the species than the ordinary terms.

Lower Lias.

PSILOCERATIDÆ.

Shell smooth. Umbilicus open, exposing the sides of the whorls; sides depressed.

Psiloceras Hyatt.

Abdomen smooth; shell often folded; sides depressed; septa foliated. Whorls enveloped to the line of the superior lateral lobes.

Psiloceras psilonotum Hyatt.

Ammonites psilonotus Quens'dt, Die Ceph., p. 73, pl. 3, fig. 18.

Loc. Nellingen, Balingen, Rudern, and Semur; Coll. L. de Koninck, Prof. Fraas, Mus. of Stuttgart, L. Agassiz, and Boucault.

It is quite probable that *Amm. erugatus* Bean (Phil. Geol. York, p. 168, pl. 13, figs. 1–3) is identical with this species, and if so, it will become necessary to change the name to *Psil. erugatus*, and consider *Psil. psilonotus* as a synonyme.

Psiloceras planorbis Hyatt.

Amm. planorbis Sow., Min. Conch., v. 5, p. 69, pl. 448.

Loc. Semur; Coll. Boucault.

Psiloceras planilaterale Hyatt.

Loc. Semur; Coll. Boucault.

Sides flattened, but more convex than other species, and marked with transverse striæ; occasionally plicated at intervals, resembling in this respect plicated variety of *P. psilonotus*. Abdomen depressed, convex, smooth; the siphon merely indicated by a raised line in the adult. Umbilicus shallow, showing great breadth in the young.

Psiloceras acutidorsale Hyatt.

Loc. Semur; Coll. Boucault.

Closely allied to *P. psilonotus*, but with smaller whorls and a more acute abdomen. It is, also, not so gibbous, and has a greater number of whorls than either *P. planilateralis* or *P. planorbis*. The shell may be marked with very numerous plications, or smooth on the sides. Abdomen prominent, acute. Umbilicus shallow.

Note. It is probable that *Amm. latesulcatus* Hauer, Ueber d. Ceph. aus d. Lias d. Nordöstlichen Alpen, p. 44, pl. 9, figs. 1 – 3, is the type of another genus of this family, having a keeled and sulcated abdomen.

DISCOCERATIDÆ.*

Arnioceras† Agassiz.

Abdomen keeled and channelled, but both parts are variable, being sharply defined in some species and very shallow in others. Abdominal lobe shallow and broad; not so deep as the superior lateral lobe; deeper than the inferior lateral; both divided equally. Superior lateral cell equally divided. Inferior lateral cell unequally divided. The young retain the smooth character for some time during their growth, thus giving to the umbilicus a decidedly embryonic aspect. Envelopment extends laterally to the geniculæ.

Arnioceras cuneiforme Hyatt.

Loc. Semur; Coll. Boucault.

Sides regularly convex. Pilæ depressed, most prominent in the centre, and sloping gradually to either side; striæ of growth very fine and sharply bent. Abdomen obtusely angular; keel indicated by a ridge; channels obsolete or only indicated by shallow depressions. The auxiliary lobes near the umbilicus are hardly more than mere serrations.

* Equals Arietes.

† Ἀρνειός, a ram.

Arnioceras incipiens Hyatt.

Loc. Semur; Coll. Boucault.

Sides convex. Pilæ with prominent geniculæ. Abdomen obtusely angular; keel prominent, narrow; channels either absent or well defined by shallow, narrow depressions. Young, smooth as in *Arnioceras cuneiformis*, but the pilæ begin with a line of abdominal tubercles, which quickly spread into true pilæ.

Arnioceras semicostatum Hyatt.

Loc. Semur; Coll. Boucault.

Sides convex. Pilæ have square prominent geniculæ. Abdomen flattened. Keel may be a depressed ridge without channels, prominent without channels, or prominent with well-defined narrow channels; in the first variety the young retain the smooth character until a later period than in the second and third.

Arnioceras kridiforme Hyatt.

Amm. kridion D'Orb., Terr. Jurass., I., p. 205, pl. 51.

Loc. Whitby, Adnet, Semur; Coll. Prof. Bronn, Dr. Krantz, and M. Boucault.

This species differs from *A. semicostatus* in the larger number and narrowness of the whorls, and the prevalence of the deeply channelled variety. The ribs of the young are not as smooth as in *Arn. semicostatus*, and they are developed at an earlier period.

It differs also from *Amm. kridion* Ziet., in the absence of tubercles, and its contracted abdomen.

Arnioceras tardecrescens Hyatt.

Amm. tardecrescens Hauer, Die Ceph. d. Lias d. Nordöstlichen Alpen, p. 20, pl. 3.

Loc. Durrenberg, Ravensberg, Hildesheim, Thionville, and Whitby, Coll. Dr. Krantz, L. de Koninck, and Damon.

Arnioceras ceratitoides L. Agassiz.

Amm. ceratitoides Quens'dt, Die Ceph., p. 239, pl. 19, fig. 3.

Amm. ceras Giebel, Fauna der Vorwelt, Ceph., p. 757.

Amm. ceras Hauer, Die Ceph. d. Lias d. Nordöstlichen Alpen.

Loc. Whitby and Adnet; Coll. Prof. Bronn and Dr. Krantz.

Arnioceras falcaries Hyatt.

Amm. falcaries Quens'dt, Der Jura, p. 70, pl. 7, figs. 6, 7.

Loc. Bonnert, Semur, Raidwangen, and Basel; Coll. L. de Koninck, Boucault, Mus. of Stuttgart, and Prof. Bronn.

Ophioceras* Hyatt.

Keel constant, sometimes obscure. The shell has a greater number of whorls than in the preceding genus, because the young increase more slowly in size. Pilæ straight, depressed; appear at an early stage in the young, and are well defined upon the second whorl. Umbilicus open; sides exposed. Abdominal lobe deeper and narrower than the lateral lobes. Superior lateral lobes broad, shallow, and but very little longer than the inferior lateral. The auxiliary lateral lobes are cuneiform, and incline toward the umbilicus.

Ophioceras torus Hyatt.

Amm. torus D'Orb., Terr. Jurassique, I., p. 212, pl. 53.

Loc. Semur, Quedlinburg, Rinteln, and Schaumburg; Coll. Boucault, Dr. Krantz, and De Koninck.

Ophioceras raricostatum Hyatt.

Amm. raricostatus Ziet., Verst. Würt., p. 18, pl. 13, fig. 4.

Amm. raricostatus Quens'dt, Der Jura, p. 105, pl. 13, figs. 16–18.

Loc. Semur, Boll, and Balingen, Würtemberg; Coll. Boucault, Dr. Krantz, Mus. of Stuttgart, and De Koninck.

Ophioceras Johnstoni Hyatt.

Amm. Johnstoni Sow., Min. Conch., v. 5, p. 70, pl. 449.

Amm. arietis Ziet., Verst. Würt., p. 3, pl. 2, fig. 4, but not figs. 2 and 3.†

Amm. raricostatus D'Orb., Terr. Jurassique, I., p. 212, pl. 54.

Loc. Lyme Regis, Semur, and Balingen; Coll. Wright, Damon, Boucault, and De Koninck.

Ophioceras kridioides Hyatt.

Loc. Basle; Coll. Prof. Bronn.

Abdomen like that of *O. Johnstoni*, but rounder than in *O. raricostatus*, and the young increase more rapidly than in either of these species. The pilæ are most prominent near the abdomen, and in the young they are more numerous than in the adult, numbering about twenty-four on the third whorl, and about twenty on the fifth whorl.

Abdominal and superior lateral lobes broad and shallow, the latter equally divided. There are two pointed auxiliary lobes on each side, and the superior lateral cells are equally divided.

Ophioceras commiscens Hyatt.

Loc Lyme Regis; Coll. B. M. Wright.

* Ὄφις, a serpent.

† Figs. 2 and 3 are identical with Discoceras spiratissimus *Hyatt* (Amm. spiratissimus *Quens'dt*).

Sides convex; pilæ depressed. The pilæ and the form of the whorl in the young, greatly resemble those of adult *raricostatus*, but in the adult they closely resemble those of the adult shell of *O. Johnstoni*.

Septa unknown.

Ophioceras tortile Hyatt.

Amm. tortilis D'Orb., Terr. Jurassique, I., p. 201, pl. 49.

Loc. Semur; Coll. Boucault.

Ophioceras deciduum Hyatt.

Amm. Nodotianus Hauer, Ceph. d. Lias d. Nordöstlichen Alpen, p. 24, pl. 6, figs. 1 – 3.

Loc. Whitby; Coll. Dr. Krantz.

Amm. Nodotianus D'Orb. is probably generically different, since it has a more acute abdomen.

Discoceras * Agassiz.

Abdomen keeled and channelled. Both characters are constant, although the channels are sometimes nearly obsolete. Pilæ smooth. Geniculæ curved forwards. Umbilicus open. Sides flattened, exposed. Abdomen depressed. Abdominal lobe deep and narrow. Superior lateral, and inferior lateral, narrow and irregularly pointed with minor lobes.

Superior lateral cell equally divided. Inferior lateral, unequally divided. First auxiliary cell well developed, and nearly as long as the inferior lateral.

Discoceras? laqueus Hyatt.

Amm. laqueus Quens'dt, Der Jura, p. 43, pl. 3, fig. 5.

Loc. Nellingen, Würtemberg; Coll. Mus. of Stuttgart.

The abdomen of the specimen examined is so obscured by its matrix of limestone, that the reference of the species to this genus must be considered doubtful.

Discoceras ophioides Hyatt.

Ammonites ophioides D'Orb., Terr. Jurassique, p. 241, pl. 64.

Loc. Semur; Coll. Boucault.

Discoceras carusense Hyatt.

Amm. carusensis D'Orb., Terr. Jurassique, I., p. 284, pl. 8, figs. 3 – 6.

Amm. spiratissimus Hauer, Ceph. d. Lias d. Nordöstlichen Alpen, p. 18, pl. 3, figs. 1 – 3.

Loc. Semur, Balingen; Coll. Boucault, L. de Koninck, and Prof. Bronn.

* *Δίσκος*, a quoit.

Discoceras spiratissimum Hyatt.

Amm. arietis Ziet., Verst. Würt., p. 3, pl. 2, fig. 3, not figs. 2 and 4.*

Amm. spiratissimus Quens'dt, Hand. Pet., p. 355, pl. 27, fig. 9.

Loc. Filder, Vaihingen, Metzingen, Hohenheim, and Stuttgart; Coll. De Koninck, Dr. Krantz, Mus. of Stuttgart, and Boucault.

Discoceras Conybeari L. Agassiz.

Amm. Conybeari Sow., Min. Conch., v. 1, p. 70, pl. 131.

Amm. obliquecostatus Ziet., Verst. Würt., p. 20, pl. 15, fig. 1.

Amm. Conybeari Ziet., Verst. Würt., p. 35, pl. 26, fig. 2.

Amm. Conybeari D'Orb., Terr. Jurass., I., p. 202, pl. 50.

Amm. Conybeari Hauer, Ceph. d. Lias d. Nordöstlichen Alpen, p. 16, pl. 2, figs. 1 – 6.

Loc. Semur, Waltzing, and Balingen; Coll. Boucault and L. de Koninck.

Coroniceras† Hyatt.

Keels prominent, constant; channels well-defined. Pilæ tuberculated and bent. Umbilicus open. Sides of the whorls exposed.

Pilæ preceded by a line of tubercles in the young, which gradually elongate to form the tuberculated pilæ of the adult. Ventral lobe deep and narrow. Lateral lobes unequally divided. Superior lateral cell irregularly divided; abrupt on the siphonal side; sloping rapidly on the opposite side. Inferior lateral cell exceedingly variable in form, but unequally divided.

Coroniceras latum Hyatt.

Loc. Semur and Tübingen; Coll. Boucault and Dr. Krantz.

Abdomen very broad, overhanging. Tubercles prominent. Keel varies from thick to attenuated; and channels, from well-defined to almost obsolete. Septal lobes broad and shallow, irregularly divided. Superior lateral cell upon the abdomen. Inferior lateral cell broad and short.

Coroniceras kridion Hyatt.

Amm. kridion Hehl. Ziet., Verst. Würt., p. 4, pl. 3, fig. 2.

Amm. kridion Quens'dt, Der Jura, p. 70, pl. 7, fig. 8.

Loc. Semur and Stuttgart; Coll. Boucault and Mus. of Stuttgart.

Coroniceras bisulcatum Hyatt.

Amm. bisulcatus Brug., Ency. Meth., v. 1, p. 39, pl. 13.

Amm. bisulcatus D'Orb., Terr. Jurass., p. 187, pl. 43.

Loc. Semur and Balingen; Coll. Boucault and De Koninck.

* Figs. 2 and 4 have already been referred to Ophioceras Johnstoni.

† Κορωνίς, a crown.

Coroniceras multicostatum HYATT.

Amm. multicostatus Sow., Min. Conch., v. 5, p. 76, pl. 454.

Amm. multicostatus Ziet., Verst. Würt., p. 35, pl. 26, fig. 3.

Amm. multicostatus Quens'dt, Der Jura, p. 67, pl. 7, fig. 2.

Loc. Leicestershire and Semur; Coll. Sir C. Lyell and M. Boucault.

Coroniceras coronaries HYATT.

Amm. coronaries Quens'dt, Der Jura, p. 68, pl. 7, fig. 5.

Loc. Semur, Boll, Balingen, and Stuttgart; Coll. Boucault, Dr. Krantz, L. de Koninck, and Mus. of Stuttgart.

Coroniceras lyra HYATT.

Loc. Balingen, Aalen, and Tübingen; Coll. L. de Koninck and Dr. Krantz.

Abdomen prominent, rounded. Keel and channels well defined. Tubercles well defined. Pilæ depressed laterally near the tubercles and swelling out below. Radial diameter of the whorl increases faster in proportion to the transverse than in *C. coronaries*. Superior lateral lobe unequally divided by deep, narrow minor lobes into three branches. Superior lateral cell on the abdomen. Inferior lateral cell long and deeply indented by minor lobes.

Coroniceras rotiforme HYATT.

Amm. rotiformis Sow., Min. Conch., v. 5, p. 76, pl. 453.

Amm. rotiformis Ziet., Verst. Würt., p. 35, pl. 26, fig. 1.

Amm. rotiformis D'Orb., Terr. Jurass., 1, p. 293, pl. 89, figs. 1–3.

Amm. caprotinus D'Orb., Terr. Jurass., 1, p. 240, pl. 64, figs. 1, 2.

Loc. Semur, Vaihingen, and Stuttgart; Coll. Boucault, Mus. of Stuttgart, and L. de Koninck.

Coroniceras sinemuriense HYATT.

Amm. sinemuriensis D'Orb., Terr. Jurass., p. 303, pl. 95, fig. 1.

Loc. Semur and Schaichof; Coll. Boucault and Mus. of Stuttgart.

The old of this species is frequently described as *Amm. Bucklandi.*

Coroniceras orbiculatum HYATT.

Amm. Bucklandi Ziet., Verst. Würt., p. 35, pl. 27, fig. 1.

Amm. Bucklandi Quens'dt, Der Jura, p. 67, pl. 7, fig. 3.

Loc. Basel, Schippenstadt, and Balingen; Coll. Prof. Bronn, Dr. Krantz, and L. de Koninck.

Coroniceras Bucklandi HYATT.

Amm. Bucklandi Sow., Min. Conch., v. 2, p. 69, pl. 130.

Amm. Bucklandi Phil. Geol. York., p. 1, pl. 14, fig. 13.

Loc. Lyme Regis and Semur; Coll. B. M. Wright and M. Boucault

Coroniceras Brookei Hyatt.

Amm. Brookei Sow., Min. Conch., v. 2, p. 203, pl. 190.

Loc. Lyme Regis; Coll. B. M. Wright.

Asteroceras* Hyatt.

Keel well defined, but varies from prominent and narrow to depressed and broad. Channels obscure to deep and well defined. Pilæ smooth, depressed; often bent on the sides, and appear in the young as lateral folds or large tubercles. Sides in some species not enveloped; in others, covered to fully one half of their breadth. Ventral lobes very deep. Lateral lobes very shallow. Superior and first auxiliary cells short and broad Inferior lateral cell very prominent.

Asteroceras tenue Hyatt.

Loc. Semur, Aargau, Aalen, and Göppingen; Coll. Prof. Bronn and Dr. Krantz.

Abdomen narrow. Dorsal region broad, angular at its junction with the sides. Keel narrow and prominent; channels large. Superior lateral cell almost obsolete. Inferior lateral unequally divided.

Asteroceras trigonatum Hyatt.

Amm. Brookei Ziet., Verst. Würt., p. 36, pl. 27, fig. 2.

Loc. Aalen; Coll. Dr. Krantz.

Transverse section of the whorl obtusely triangular. Pilæ prominent internally, decreasing gradually externally. Tubercles are not constantly found in the adult as in *Amm. Brookei*, and it differs, also, from the latter in the narrowness of the abdomen, the greater proportional breadth of the dorsal region, and the decided inclination of the sides of the adult whorls.

Asteroceras obtusum Hyatt.

Amm. obtusus Sow., Min. Conch., v. 2, p. 151, pl. 167.

Amm. redcarensis Young and Bird, Geol. York., pl. 14, fig. 15.

Amm. obtusus D'Orb., Terr. Jurass., p. 191, pl. 44.

Amm. stellaris D'Orb., Terr. Jurass., p. 191, pl. 45.

Amm. Turneri Ziet., Verst. Würt., p. 15, pl. 11, fig. 5.

Loc. Lyme Regis, Whitby, Robin Hood's Bay, Semur, Boll, Balingen, Bempflingen, Stuttgart, and Adnet; Coll. L. Agassiz, Robert Damon, Marder, B. M. Wright, L. de Koninck, Dr. Krantz, M. Boucault, and Mus. of Stuttgart.

The identification of Zieten's *Turneri* with *Amm. obtusus* Sow., was made with authentic specimens from Zieten's former collection sent to this Museum by the Museum of Stuttgart, and although the characteristics are

* Ἀστήρ, a star.

widely divergent, the series between the two forms showed them to be one species with only local differences.

Asteroceras stellare Hyatt.

Amm. stellaris Sow., Min. Conch., v. 1, p. 211, pl. 93.

Amm. Turneri Sow., Min. Conch., v. 5, p. 75, pl. 452.

Amm. stellaris Hauer, Ceph. d. Lias d. Nordöstlichen Alpen, p. 22, pl. 5, figs. 1, 2.

Loc. Lyme Regis, Gloucester, and Semur; Coll. B. M. Wright, Marder, Dr. Krantz, and M. Boucault.

Asteroceras Collenotii Hyatt.

Amm. Collenotii D'Orb., Terr. Jurass., 1, p. 305, pl. 95.

Loc. England and Semur; Coll. Marder and M. Boucault.

LIPAROCERATIDÆ Hyatt.

Microceras* Hyatt.

Abdomen flattened; sides rounded or flattened. The pilæ in the adult are undivided upon the abdomen, and are continuous with the large, single lateral pilæ, which last may be ornamented with either one or two rows of small tubercles, or be bare.

The envelopment only covers the abdomen of each internal whorl, reaching no farther than the first row of tubercles, umbilicus is consequently exposed in all the species. The increase of the radii is slow, the species have a greater number of whorls than in succeeding genera, and are also of smaller size. The septa are remarkable for their unequally divided lobes and cells, the large size of the abdominal lobe, the insignificant size of the two lateral lobes, especially the inf. lateral, and the great breadth of the cells.

Microceras biferum Hyatt.

Amm. bifer bispinosus Quens'dt, Der Jura, p. 104, pl. 13, figs. 10, 11, and 13.

Amm. bifer nudicosta Quens'dt, Der Jura, p. 104, pl. 13, fig. 14.

Loc. Gloucester, Pleinsbach, Balingen, Boll; Coll. L. de Koninck, Dr. Krantz, Mus. of Stuttgart.

Microceras confusum Hyatt.

Amm. confusus Quens'dt, Der Jura, p. 127, pl. 75, figs. 8, 9.

Loc. Lansdown Station, near Cheltenham, and Gloucester; Coll. L. de Koninck.

* Μικρός, small.

Microceras mixtum Hyatt.

Amm. polymorphus mixtus Quens'dt, Der Jura, p. 128, pl. 15, fig. 12.

Loc. Gloucester; Coll. L. de Koninck.

Is not the same as *polymorphus mixtus* Quens'dt, Die Ceph., p. 87, pl. 4, fig. 10. This has a keel and must be of a different genus from the specimens here described, which appear to be identical with the figure in "Der Jura," as quoted above.

DEROCERATIDÆ.*

Deroceras† Hyatt.

Whorl circular; pilæ depressed; linear between and bifurcated on the tubercles. Tubercles large, prominent, pointed, and in a single row. Septal lobes with numerous pointed, deeply cut, irregularly shaped minor lobes. Abdominal lobe very deep, and level with superior lateral lobe. Siphonal cell long and narrow.

Deroceras ziphius Hyatt.

Amm. ziphius Ziet., Verst. Würt., p. 6, pl. 5, fig. 2.

Amm. arnatus sparsinodus Quens'dt, Die Ceph., p. 82, pl. 4, fig. 5.

Amm. ziphius Quens'dt, Der Jura, p. 97, pl. 12, fig. 2.

Loc. Löppingen; Coll. Mus. of Stuttgart.

Note. The foregoing descriptions of the Discoceratidæ, Liparoceratidæ, and Deroceratidæ comprehend all the species in the Museum collections from the Lower Lias, except *Amm. Birchii* Sow., which I was unable to assign to its proper place.

Middle Lias.

LIPAROCERATIDÆ.

There is throughout the three genera of this family a positive agreement in the septa and the mode of development.

The young of *Liparoceras indecisus* resemble the adult of *Androgynoceras*, and the young of *Androgynoceras* in turn closely resemble the adults of *Microceras*.

Abdominal lobe is large and not generally so deep, but of less width than the superior lateral. Inferior lateral lobe very narrow, and of insignificant size; one auxiliary lobe is usually visible on the side. The minor lobes are particularly sharp or pointed; penetrate deeply into the cells. Both cells and lobes unequally divided by three minor lobes.

Microceras.

Microceras planicosta Hyatt.

Amm. planicosta Sow., Min. Conch., v. 1, p. 167, pl. 73.

* Includes the Dorsati.

† Δέρας, skin.

Amm. planicosta D'Orb., Terr. Jurass., Ceph., p. 242, pl. 65.

Loc. Whitby, Yeovil, Semur, Besançon, Gundershofen; Coll. Sir C. Lyell, L. de Koninck, Prof. Bronn, and M. Boucault.

Microceras crescens Hyatt.

Loc. Whitby and Rautenberg bei Schöppenstadt; Coll. L. de Koninck, Dr. Krantz, and Prof. Bronn.

This species is closely allied to *Microceras arcigerens;* it differs, however, in being more robust, the young are larger, the radii of the spiral increase faster, and the septa differ in having a very deep ventral, and very shallow, superior lateral and inferior lateral lobes. The minor lateral lobes are also of the simplest kind, the superior and inferior lateral cells being but slightly indented by them.

Microceras arcigerens Hyatt.

Amm. arcigerens Phil. Geol. York, p. 163, pl. 13, fig. 9.

Loc. Whitby, Semur, St. Cyr bei Lyon and Aargau; Coll. L. de Koninck, Prof. Bronn, and M. Boucault.

Microceras maculatum Hyatt.

Amm. capricornus nudus Schlot. Petrefactenkunde.

Amm. maculatus Young and Bird, Geol. York, pl. 14, fig. 12.

Amm. maculatus Phil. Geol. York, p. 135, pl. 13, fig. 11.

Amm. capricornus nudus Ziet., Verst. Würt., p. 6, pl. 4, fig. 8.

Amm. capricornus nudus Bronn, Leth, Geog., Sh. 4, p. 340, pl. 22, fig. 1.

Amm. capricornus nudus Quens'dt, Der Jura, p. 96, pl. 12, fig. 3.

Loc. Lyme Regis, Whitby, Semur, Pouilly, Besançon, Milhaud Dep. L'Aveyron, Gundershofen, Rautenberg bei Schöppenstadt, and Gegenberg; Coll. Sir C. Lyell, Damon, L. Agassiz, Dr. Krantz, and M. Boucault.

Microceras sinuosum Hyatt.

Loc. Pouilly en Auxois, Venarey près Semur, Gundershofen, Reutlingen, and Brunswick; Coll. M. Boucault, Dr. Krantz, and L. de Koninck.

This species differs from *Planicosta* in its development, acquiring the pilæ at an earlier age of growth, and from *M. arcigerens* and *M. maculatus* in the forward bend of the abdominal pilæ, the double row of tubercles ornamenting the lateral pilæ of the adult, and the more complicated character of the septa.

Abdominal lobe with abrupt sides. Minor lobes long and narrow. Superior lateral lobe broad and shallow; inferior lateral, proportionately very narrow. Superior lateral cell very broad; inferior lateral, much longer and narrower, and very irregularly and deeply cut by minor lobes, resembling in this respect the upper portion of the superior lateral cell.

Androgynoceras* Hyatt.

The sides of the adult whorl slope outward and are ornamented with pilæ, usually single and set with two rows of tubercles. Abdomen narrow. The large pilæ of the young are split into smaller pilæ on the abdomen of the adult, but usually retain the characteristics of *Microceras* until a late period of growth. The septa are more complicated than in *Microceras*, and the increase by growth in the radii of the spiral is much greater, the species consequently have fewer whorls and are of larger size. The envelopment may cover up only the abdomen of each internal whorl, or extend over the whole side to the internal line of tubercles.

Androgynoceras hybridum Hyatt.

Amm. androgynoceras D'Orb., Terr. Jurass., Ceph., p. 285, pl. 85.

Loc. Semur; Coll. M. Boucault.

Androgynoceras appressum Hyatt.

Loc. Rautenberg; Coll. Dr. Krantz.

This species is very much flatter than *Liparoceras Bechei*, and differs also in the development of the shell. The pilæ for a long time resemble those of *Microceras*, the peculiar pilæ of this genus are not brought out distinctly until the fifth whorl is attained.

Envelopment extends laterally to the internal line of tubercles. The external tubercles are larger and more prominent than the internal row. Abdominal lobe is deeper than the superior lateral, which last is deeper but hardly broader than the inferior lateral. Lateral lobes and lateral cells unequally divided.

Liparoceras† Hyatt.

This genus differs from both of those previously described in the greater breadth of the abdomen, the greater increase of the radii of the spiral, the consequently smaller number of whorls, and the larger size of the species.

The envelopment may cover only the abdomen of each internal whorl, or extend to the inner row of tubercles.

The pilæ of the adult are split into numerous smaller pilæ, and are ornamented on the sides with two rows of tubercles. The young are smooth on the first two or three whorls, the pilæ never appear to assume, except to a very slight degree, the characteristics of *Microceras*, but at once take on the less prominent and diffuse character of *L. Bechei*.

The septa also at an early period are more complicated than those of the adult *Microceras*. The superior lateral cell is narrower proportionately to the inferior lateral, than in the preceding genera.

* Ανδρόγυνος, hermaphrodite. † Λιπαρός, shining.

Liparoceras indecisum Hyatt.

Loc. Lyme Regis, Balingen, and Rautenberg bei Schöppenstadt; Coll. B. M. Wright, L. de Koninck, and Dr. Krantz.

This species is closely allied to *Liparoceras Henleyi*, but differs in the form of the whorls which are much flatter on the sides, do not spread laterally so rapidly, and are more numerous.

The tubercles and lateral pilæ are hardly so prominent, but more numerous than in *Henleyi*. The specimen from Rautenberg, which apparently belongs to this species, has the tubercles and displays the characteristics of *Microceras* in the abdominal pilæ on the fourth whorl. The envelopment barely covers the external line of tubercles, which are larger and more prominent than the internal line of tubercles. Septa were not observed.

Liparoceras Henleyi Hyatt.

Amm. Henleyi Sow., Min. Conch., v. 2, p. 164, pl. 172.

Naut. striatus Rein, Naut. et Argo, p. 85, pl. 8, figs. 65, 66.

Amm. striatus Ziet., Verst. Würt., pl. 5, fig. 6.

Amm. Henleyi Bronn, Leth. Geog., p. 419, pl. 23. fig. 7.

Loc. Hewlitt's Hill, Stonehouse, Lyme Regis, Bourgogne, Milhaud, St. Thibault, Venarey, Evrecy in Normandy, and Reschnau in Lippe; Coll. L. de Koninck, B. M. Wright, M. Boucault, Dr. Krantz, and Prof. Bronn.

Liparoceras Bechei Hyatt.

Amm. Bechei Sow., Min. Conch., v. 3, p. 143, pl. 280.

Amm. Bechei Ziet., Verst. Würt., p. 37, pl. 28, fig. 4.

Loc. Lyme Regis, Semur, Milhaud, St. Amand, Balingen, and Rautenberg: Coll. B. M. Wright, M. Boucault, L. de Koninck, and Dr. Krantz.

DEROCERATIDÆ.

Deroceras Hyatt.

Deroceras Davōei Hyatt.

Amm. Davōei Sow., Min. Conch., v. 4, p. 71, pl. 350.

Amm. Davōei Ziet., Verst. Würt., p. 19, pl. 14, fig. 2.

Amm. Davōei D'Orb., Terr. Jurass., 1, p. 276, pl. 81.

Amm. Davōei Quens'dt, Die Ceph., p. 91, pl. 5, fig. 6.

Loc. Semur, Ardèche, Vassy, Gmund, Elsass, and Durrenberg; Coll. M. Boucault, Dr. Krantz, Prof. Bronn, and Mus. of Stuttgart.

Deroceras densinodum Hyatt.

Amm. armatus densinodus Quens'dt, Der Jura, p. 105, pl. 13, figs. 9, 10.

Loc. Zurmiethen bei Holtzmünden; Coll. Mus. of Stuttgart.

Deroceras armatum Hyatt.

Amm. armatus Sow., Min. Conch., v. 1, p. 215, pl. 95.

Loc. Lyme Regis, Dorsetshire; Coll. Damon.

Peronoceras * Hyatt.

Abdomen depressed; pilæ depressed; linear between the tubercles; usually, but not invariably, bifurcated by the tubercles on the sides, though invariably bifurcated on the abdomen. Tubercles depressed, often obtuse upon the casts, but pointed and prominent upon the shell. Septa not closely crowded as in *Deroceras*, or so profusely branching.

Peronoceras fibulatum Hyatt.

Amm. fibulatus Sow., Min. Conch., v. 4, p. 147, pl. 407, figs. 3, 4.

Loc. Whitby, Boll, Plateau de Larzac, Robin Hood's Bay, St. Quentin près de la Verpiller; Coll. Dr. Krantz, L. Agassiz, Prof. Bronn, and L. de Koninck.

Peronoceras subarmatum Hyatt.

Amm. subarmatus Sow., Min. Conch., v. 4, p. 146, pl. 407.

Amm. subarmatus Young and Bird, Geol. York., p. 250, pl. 13, fig. 3.

Loc. Whitby; Coll. Dr. Krantz.

Peronoceras muticum Hyatt.

Amm. muticus D'Orb., Terr. Jurass., 1, p. 274, pl. 80.

Loc. Semur and St. Amand; Coll. Boucault and L. de Koninck.

Peronoceras nodogigas Hyatt.

Amm. nodogigas Quens'dt, Der Jura, p. 125, pl. 15, fig. 8.

Loc. Göppingen; Coll. Mus. of Stuttgart.

Peronoceras fraudulentum Hyatt.

Loc. Lyme Regis; Coll. Damon.

Abdomen rounded, and much broader than the back; tubercles prominent, salient; pilæ single, thick, depressed. Young resemble *Planicosta*, having the flattened abdomen and pilæ of the latter until a late period. Abdominal lobe narrow and deep. Superior lateral cell narrow and deeply cut by pointed minor lobes. Siphonal cell long, narrow, serrated.

Peronoceras alternum Hyatt.

Loc. Milhaud, Dép. de l'Aveyron; Coll. L. de Koninck.

Whorls much flattened; sides gibbous; tubercles depressed, widely separated by numerous intervening smooth pilæ. Tuberculated pilæ, large

* Περόνη, a clasp.

and most prominent, divided on the abdomen. The young are smooth for the first two or three whorls; tubercles occupy the whole next whorl, extending gradually into tuberculated pilæ between which the smooth pilæ finally appear. Abdominal lobe larger and deeper than superior lateral lobe. Inferior lateral lobe small, shallow; both unequally divided. Superior lateral cell entirely on the abdomen. Inferior lateral cell on the side.

THYSANOIDÆ.

This family includes the Fimbriati, Ligati, and Heterophylli, which agree in the foliaceous character of the septa.

Thysanoceras.*

Abdomen rounded; whorls exposed; the envelopment does not extend laterally over more than one third of each interior whorl.

Abdominal lobe about the same depth, but narrower than the superior lateral lobe; the latter is equally divided by a peculiar minor cell of a lobiform aspect. The siphonal cell is cuneiform, and the superior and inferior lateral cells equally divided.

Thysanoceras fimbriatum Hyatt.

Amm. fimbriatus Sow., Min. Conch., v. 1, p. 145, pl. 164.

Amm. fimbriatus D'Orb., Terr. Jurass., Ceph., p. 313, pl. 98.

Amm. fimbriatus Bronn, Leth. Geog., p. 441, pl. 23, fig. 2.

Loc. Lyme Regis, Semur, Plateau de Larzac, Milhaud, Dép. de l'Aveyron, Balingen, Gundershofen, Schomberg, Falkenhagen, Lippe, and Sondelfingen; Coll. Mus. of Stuttgart, B. M. Wright, M. Boucault, Dr. Krantz, L. de Koninck, and Prof. Bronn.

Rhacoceras† Agassiz.

Abdomen rounded; sides of the whorls flattened; envelopment extends about two thirds over each of the interior whorls, or entirely encloses them, covering up the umbilicus.

The lobes and cells gradually decrease in size inwardly, and are remarkable for the profusion and peculiar foliaceous aspect of the minor cells.

Rhacoceras Loscombi Hyatt.

Amm. Loscombi Sow., Min. Conch., v. 1, p. 183, pl. 183.

Amm. heterophyllus numismalis Quens'dt, Die Ceph., p. 100, pl. 6, fig. 5.

Amm. Loscombi D'Orb., Terr. Jurass., Ceph., p. 262, pl. 75.

Loc. Lyme Regis and Semur; Coll. Damon, Wright, Boucault, and L de Koninck.

* Θύσανος, fringe. † Ῥάκος, ragged.

In some individuals the abdomen is crenulated, resembling in this respect *R. Boblayei*.

Rhacoceras Boblayei Hyatt.

Amm. Boblayei D'Orb., Terr. Jurass., Ceph., p. 25, pl. 69.

Loc. St. Thibault près de Semur; Coll. Boucault.

The character of the septa allies this species closely with *Loscombi*, and the abdominal crenulations are of the same character as those of some individuals in that species.

DACTYLOIDÆ.

This family includes the Planulati and part of the Macrocephali.

Cœloceras* Hyatt.

Pilæ on the abdomen bifurcated; lateral pilæ single or bifurcated with one external row of tubercles, occurring regularly on each pilæ, or at intervals on widely separated pilæ. The young are very much flatter than the adult, and the sides consequently very narrow. They are smooth for the first one or two whorls, subsequently becoming tuberculated.

The tubercles almost immediately spread, forming the pilæ; they may enlarge and remain distinct, or become absorbed and disappear upon alternate pilæ. The abdomen remains perfectly smooth for some time after the lateral pilæ are developed, not acquiring the abdominal pilæ until the third whorl is reached. Septa close together and very intricate in the adult. Abdominal lobe broader and deeper than the superior lateral. The inferior lateral is nearly the same in size, and both are unequally divided into three shallow, minor lobes. Superior lateral cell lobiform and together with the inferior lateral, unequally divided by two minor lobes.

Cœloceras centaurus Hyatt.

Amm. centaurus D'Orb., Terr. Jurass., Ceph., p. 266, pl. 76, fig. 3 – 6.

Loc. St. Amand, Semur, and Balingen; Coll. L. de Koninck and M. Boucault.

Cœloceras pettos Hyatt.

Amm. pettos Quens'dt, Flotzge., p. 178.

Amm. pettos Quens'dt, Der Jura, p. 135, pl. 16, fig. 14.

Amm. crenatus Ziet., Verst. Würt., pl. 1, fig. 4.

Loc. Venarey, Milhaud, Balingen, Metzingen, Hinterweiler; Coll. Boucault, L. de Koninck, Prof. Bronn, and Dr. Krantz.

* Κοῖλος, hollow.

PHYMATOIDÆ.*

Phymatoceras Hyatt.†

Abdomen may be flattened or rounded, but never acute; has no channels in the adult. Envelopment covers the abdomen of each internal whorl. Radii of the spiral increase more slowly than in the succeeding genera. The young are smooth on the first or second whorl, the tubercles begin either on the second or third whorl, and, gradually dividing, spread themselves out upon the abdomen as bifurcated pilæ, which disappear on the borders of the channels. The keel makes its appearance at an early stage, probably on the second whorl, but the channels are not visible until a much later period, and disappear in the adult.

Abdominal lobe broad and deep. Superior lateral broader, but of about the same depth; inferior lateral, very shallow. Superior and inferior lateral cells equally divided; both are short, broad, and but slightly indented by the minor lobes.

Phymatoceras robustum Hyatt.

Loc. Plateau de Larzac; Coll. Dr. Krantz.

The abdomen of this species is flattened, the sides of the whorls gibbous and narrow, and the keel very prominent. The channels in the young are shallow, and the whorls unusually broad. Superior lateral cell is deeper than the inferior lateral, and the latter is straight; the auxiliary cell is divided by one small auxiliary lobe.

Hammatoceras‡ Hyatt.

Abdomen may be either rounded or acute, always keeled, but never sulcated. Pilæ are prominent and straight. Envelopment may extend over one half the sides, or only cover the abdomen of each internal whorl. The young develop as in *Phymatoceras*, but are generally much broader; the pilæ, also, do not become prominent so soon. Nor do they invariably begin by the development of tubercles on the sides, but may make their appearance as fine, raised lines, and afterwards become tuberculated.

During the earlier stage of growth the different species have a very close resemblance to the adult *Macrocephali*. The lobes are more complicated than in *Phymatoceras*. Abdominal lobe broad and deep, and continued into two long, narrow, minor lobes. Superior lateral narrower than the abdominal. Inferior lateral hardly wider than the minor lobes of the superior lateral, and of about the same depth. Abdominal cell blunt. Superior lateral and inferior lateral very narrow and deeply indented by the minor lobes.

* Includes part of the Falciferi. † Φῦμα, a swelling. ‡ Ἅμμα, a knot.

Hammatoceras insigne Hyatt.

Amm. insignis Schlot. Ziet., Verst. Würt., p. 20, pl. 15, fig. 2.
Amm. insignis D'Orb., Terr. Jurass., Ceph., p. 347, pl. 112.
Amm. insignis Quenstdt, Die Ceph., p. 280, pl. 40, figs. 4, 5.
Loc. Uhrweiler and Gundershofen; Coll. Dr. Krantz and L. de Koninck.

Hammatoceras variabile Hyatt.

Amm. variabilis D'Orb., Terr. Jurass., Ceph., p. 350, pl. 113.
Loc. Bantz; Coll. Dr. Krantz.

AMALTHEOIDÆ.

Pleuroceras* Hyatt.

Abdomen flat, with keel and channels well defined; keel crenulated; channels vary from obsolete to deep and well defined. Pilæ swelling below, tuberculated; genicular bend prominent. Tubercles lateral, arranged along the line of envelopment. Umbilicus open.

Ventral lobe narrow and but slightly deeper than lateral lobes; the latter unequally divided. Inferior lateral lobe small, shallow, equally divided. Superior lateral cell only partly exposed on the side, and together with the inferior lateral unequally divided.†

Sub-Genus No. 1.

Sides of whorls exposed.

Pleuroceras hawskerense Hyatt.

Amm. hawskerensis Y. and B., Phil. Geol. York., p. 164, pl. 13, fig. 8.
Loc. Yeovil; Coll. H. W. Marder.

Pleuroceras spinatum Hyatt.

Amm. spinatus Brug., Ency. Meth., t. 1, p. 40, pl. 14.
Amm. spinatus D'Orb., Terr. Jurass., I., p. 209, pl. 52.
Loc. Whitby, Yeovil, Avallon, Quedlinburg, Coburg, Franconia, Banz, Gundershofen, and Canal du Danube; Coll. Mus. of Stuttgart, Dr. Krantz, L. de Koninck, Bronn, Marder, and Boucault.

Pleuroceras costatum Hyatt.

Amm. costatus Schlot., Pet., p. 66, pl. 12.
Naut. costatus Rein., Naut. et Argo., p. 87, figs. 68, 69.
Amm. costatus Ziet., Verst. Würt., p. 5, pl. 4, fig. 7.
Amm. costatus Bronn, Leth. Geog., pl. 22, fig. 12.

* Πλευρόν, a rib.
† Septa are described from one species only, — *Pleuroceras spinatum.*

Loc. England, Tours, Weimar, Bantz, Uhrweiler, and Bas-Rhin; Coll. Sir C. Lyell, M. Boucault, Bronn, Dr. Krantz, and L. Agassiz.

Sub-Genus No. 2.

Sides of whorls partially covered and flatter, especially in the young.

Pleuroceras pseudo-costatum Hyatt.

Amm. costatus nudus Quens'dt, Die Ceph., p. 95.

Amm. costatus nudus Quens'dt, Der Jura, p. 171, pl. 21, fig. 3.

Loc. Yeovil, Dumbleton near Cheltenham, Rogueport, Canal du Danube, Plateau de Larzac, Goslar, Gundershofen, Baiern; Coll. Bronn, L. de Koninck, and Dr. Krantz.

Pleuroceras pseudo-spinatum Hyatt.

Amm. costatus spinatus Quens'dt, Der Jura, p. 171, pl. 21, fig. 1–3.

Amm. costatus spinatus Quens'dt, Die Ceph., p. 95, pl. 5, fig. 10.

Loc. Vassy (Dép. Yonne), Milhaud (Dép. de l'Aveyron), and Courcy; Coll. Boucault and L. de Koninck.

Pleuroceras vittatum Hyatt.

Amm. vittatus Phil. Geol. York.,.p. 161, pl. 13, fig. 1.

Loc. Whitby; Coll. Dr. Krantz.

Amaltheus De Montfort.

Abdomen acute, keeled, and channelled; whorls compressed laterally. Keel crenulated, well defined. Tubercles, when present, are in a single row along the line of envelopment. Umbilicus open, with the sides of the whorls exposed or only partially covered.

Amaltheus gloriosus Hyatt.

Amm. amaltheus coronatus Quens'dt, Der Jura, p. 169, pl. 20, figs. 9–12.

Loc. Milhaud, Balingen, Pliensbach, Boll, and Ofterdingen; Coll. L. de Koninck, Bronn, and Dr. Krantz.

Amaltheus salebrosus Hyatt.

Amm. amaltheus spinosus Quens'dt, Die Ceph., p. 95, pl. 5, fig. 4.

Amm. amaltheus spinosus Quens'dt, Der Jura, p. 168, pl. 20, fig. 8.

Loc. Whitby, Semur, Strasburg, Mühlhausen (Bas-Rhin), Pliensbach, Boll, Geyslingen, Balingen, and Gundershofen; Coll. Dr. Krantz, Boucault, Bronn, L. Agassiz, and L. de Koninck.

Amaltheus turgidus Hyatt.

Amm. Amaltheus gibbosus Schlot., Pet. p. 10.

Amm. Amaltheus gibbosus Ziet., Verst. Würt., p. 4, pl. 4, fig. 2.

Amm. paradoxus Stahl, Ziet., Verst. Würt., p. 15, pl. 11, fig. 6.

Loc. Plateau de Larzac, Heiningen, Boll, Lutzude bei Hanover, Semur, Göppingen, Ofterfeld bei Goslar, and Pliensbach; Coll. Mus. of Stuttgart, Dr. Krantz, L. de Koninck, Prof. Bronn, L. Agassiz, and Boucault.

Amaltheus margaritatus De Mont.

Amaltheus margaritatus De Montfort, Conch. Sys., p. 91.

Amm. acutus Sow., Min. Conch., v. 1, p. 51, pl. 17, fig. 1.

Naut. rotula Rein., Naut. et Argo., p. 59, pl. 1. fig. 5.

Amm. Stokesi Sow., Min. Conch., v. 2, p. 205, pl. 191, figs. 9, 10.

Amm. clevelandicus Phil. Geol. York., pl. 14, fig. 6.

Amm. amaltheus Ziet., Verst. Würt., p. 4, pl. 4, fig. 1.

Amm. margaritatus D'Orb., Terr. Jurass., I., p. 246, pl. 67.

Loc. Whitby, Avallon, Semur, Milhaud (Dép. de l'Aveyron), Bas-Rhin, Lutzude bei Hanover, Eislingen, Rezingen, Wasseralfingen, Gundershofen, Mühlhausen, Boll, Ubstadt bei Bruchsal, Falkenhagen in Lippe, Balingen, and Göppingen; Coll. Mus. of Stuttgart, L. de Koninck, Prof. Bronn, L. Agassiz, and Boucault.

Amaltheus præstabilis Hyatt.

Amm. amaltheus nudus Quens'dt, Der Jura, p. 167, pl. 20, fig. 4.

Amm. amaltheus nudus Quens'dt, Die Ceph., p. 94.

Loc. Robin Hood's Bay, Scarborough, Whitby, Mende in Lozère, Venarey près Semur, Milhaud, St. Cyr près de Lyon, Metzingen, Lutzude bei Hanover, Balingen, Geislingen, and Göppingen; Coll. Mus. of Stuttgart, Dr. Krantz, L. de Koninck, M. Boucault, Prof. Bronn, and L. Agassiz.

CYCLOCERATIDÆ.

This family is remarkable for containing species which on the one side ally it with the *Liparoceratidæ*, and on the other with the higher *Hildoceratidæ*. There is, however, a general agreement in the development and in the septal characteristics, which unite them in one family. The form is much more compressed laterally than in the *Liparoceratidæ* and the tuberculations of the pilæ separate them from the *Hildoceratidæ*. The young of *Tropidoceras Actæon* resemble the adults of *Cycloceras Valdani*, and the young of the last in their turn are like the adults of *Platypleuroceras latæcosta*; thus all three genera are closely connected by development. The abdominal lobe is of about the same depth as the superior lateral; the latter is unequally divided into three minor lobes of variable length, and there is only one auxiliary lobe exposed to view on the side. Superior lateral cell is generally equally divided, and of great breadth. Inferior lateral, narrower and more prominent.

Platypleuroceras * Hyatt.

Abdomen nearly as broad, or broader, than the dorsal side of the whorl. Pilæ single, tuberculated, and extending across the rounded abdomen, as in *Planiceras*. The septa are minutely divided by minor lobes, very closely set. The abdominal lobe is deep; sides abrupt. Superior lateral very narrow, deeper than the abdominal, and profusely branching. Inferior lateral not as deep as superior lateral, and of about the same breadth and general aspect. Abdominal cell large and serrated. Superior lateral very broad, about the same height as the inferior lateral.

Platypleuroceras latæcosta Hyatt.

Amm. latæcosta Sow., Min. Conch., v. 6, p. 106, pl. 556.

Amm. laiæcosta Ziet., Verst. Würt., p. 36, pl. 27, fig. 3.

Amm. natrix-rotundus Quens'dt, Die Ceph., p. 85, pl. 4, fig. 17.

Loc. Gegenberg, Hinterweiler, Welflingen, Rentlingen, and Balingen; Coll. Mus. of Stuttgart, L. Agassiz, Dr. Krantz, and L. de Koninck.

Cycloceras † Hyatt.

Abdomen rounded or keeled, not so broad as the dorsal side of the whorl. Pilæ single, tuberculated, and not extending across the abdomen in the keeled species. Young smooth for the first two or three whorls, then become ribbed. Keel appears at an earlier stage of growth than the pilæ. Septa not so minutely divided by minor lobes, and the large lobes less dendritic than in *Platypleuroceras*. The abdominal lobe of medium depth, and quite broad. Superior lateral of medium breadth and considerable depth. Inferior lateral about two thirds as broad and deep as superior lateral. One small auxiliary lobe exposed laterally. Superior lateral cell broad and depressed. Inferior lateral more prominent and narrower; small auxiliary cell exposed on the side.

Cycloceras molare Hyatt.

Amm. natrix oblongus Quens'dt, Die Ceph., p. 85, pl. 4, fig. 16.

Loc. Balingen; Coll. L. de Koninck.

Cycloceras natrix Hyatt.

Amm. natrix Schlot., Petrefaktenkunde.

Amm. natrix Ziet., Verst. Würt., p. 5, pl. 4, fig. 5.

Loc. Balingen and Rentlingen; Coll. L. de Koninck and Dr. Krantz.

Cycloceras Valdani Hyatt.

Amm. Valdani D'Orb., Terr. Jurass., Ceph., p. 255, pl. 71.

Amm. compressus Quens'dt, Die Ceph., p. 90, pl. 5. fig. 3.

* Πλατύς, flat, and Πλευρόν, rib. † Κύκλος, circle.

Amm. Valdani Quens'dt, Der Jura, p. 131, pl. 16, fig. 2 – 3.

Loc. St. Amand, Semur, Balingen, Reutlingen, and Gagenberg; Coll. Mus. of Stuttgart, L. de Koninck, M. Boucault, and L. Agassiz.

Tropidoceras * Hyatt.

Abdomen invariably keeled, much narrower than the dorsal side of the whorl. Pilæ single, smooth or tuberculated in the same species, do not extend across the abdomen in any species.

Young are smooth for one or two whorls. Keel and pilæ appear simultaneously. Septa have a more complicated aspect than in the preceding genus, the minor lobes being deeper and more numerous. The abdominal very broad at the bottom, narrower above. Superior lateral lobe narrow, and about the same depth as the abdominal. Inferior nearly the same, but less branching than the superior lateral. One auxiliary lobe exposed on the side. Abdominal cell very broad. Superior lateral and inferior lateral cells very irregularly divided by minor lobes. One small auxiliary lobe exposed on the side.

Tropidoceras Actæon Hyatt.

Amm. Actæon D'Orb., Terr. Jurass., Ceph., p. 232, pl. 61, fig. 1 – 3.

Loc. Semur and Schöppenstadt; Coll. Dr. Krantz and L. de Koninck.

Tropidoceras Ægæon Hyatt.

Amm. Ægæon D'Orb., Terr. Jurass., Ceph., p. 234, pl. 61, fig. 4 – 6.

Loc. Près de Semur; Coll. M. Boucault.

Tropidoceras Masseanum Hyatt.

Amm. Masseanus D'Orb., Terr. Jurass., Ceph., p. 225, pl. 58.

Amm. Masseanus Quens'dt, Die Ceph., p. 90, pl. 5, fig. 2.

Loc. Scarborough in Yorkshire, Près de Semur, and Balingen; Coll. Dr. Krantz, L. de Koninck, and M. Boucault.

Upper Lias.

DISCOCERATIDÆ.

Ophioceras.

Ophioceras Levesquei Hyatt.

Amm. Levesquei D'Orb., Terr. Jurass., Ceph., I., p. 230, pl. 60.

Amm. solaris Ziet., Verst. Würt., p. 19, pl. 14, fig. 7.

Amm. radians quadratus Quens'dt, Die Ceph., p. 113.

Loc. Niort, Salins, Heiningen, and Metzingen; Coll. Mus. of Stuttgart, Dr. Krantz, and L. de Koninck.

* Τροπίς, a keel.

DEROCERATIDÆ.

Deroceras.

Deroceras minatum Hyatt.

Loc. Plateau de Larzac ; Coll. Dr. Krantz.

Abdomen depressed. Sides flattened or inclining toward umbilicus. Septal lobes and cells very simple, with but few minor lobes. Abdominal lobe broad and shallow. Superior lateral the same, and of nearly the same size. Inferior lateral pointed and very small. Superior lateral and inferior lateral cells equally divided by minor lobes. Young are smooth for the first two or three whorls. Tubercles usually make their appearance on the third whorl and on the fourth ; these spread out into pilæ, and other untuberculated pilæ arise between them. The pilæ are often slightly depressed or concave along the siphonal line.

Deroceras subarmatum Hyatt.

Amm. subarmatus Sow., Min. Conch., v. 4, p. 146, pl. 407.

Amm. subarmatus Young and Bird, Geol. York., p. 250, pl. 13, fig. 3.

Loc. Milhaud (Dép. de l'Aveyron) ; Coll. M. Boucault.

Deroceras acanthopsis Hyatt.

Amm. acanthopsis D'Orb., Prod. Pal. Stratigraph., p. 247.

Loc. Villebois (Dép. Ain) ; Coll. Prof. Bronn.

DACTYLOIDÆ.

Cœloceras.

Cœloceras Grenouillouxii Hyatt.

Amm. Grenouillouxii D'Orb., Terr. Jurass., Ceph., pl. 96.

Loc. Fontaine Étoupe and Fours in Calvados, Plateau de Larzac, Cheville in Sarthe, and Semur ; Coll. Dr. Krantz, L. de Koninck, and M. Boucault.

Cœloceras Desplacei Hyatt.

Amm. Desplacei D'Orb., Terr. Jurass., Ceph., p. 334, pl. 107.

Loc. Avallon (Dép. Yonne) ; Coll. M. Boucault.

Cœloceras crassum Hyatt.

Amm. crassus Phil., Geol. York., p. 12, fig. 15.

Amm. crassus Quens'dt, Der Jura, p. 251, pl. 36, fig. 1.

Amm. raquinianus D'Orb., Terr. Jurass., p. 332, pl. 106.

Loc. Whitby, Milhaud, Laumière, Cheville in Sarthe, St. Cyr bei Lyon. Plateau de Larzac, Villebois (Dép. de l'Ain), Salins (Dép. Jura), Semur, Montpellier, St. Quentin, and Près de Verpillier ; Coll. L. de Koninck, Dr. Krantz, L. Agassiz, Prof. Bronn, and M. Boucault.

Cœloceras mucronatum Hyatt.

Amm. mucronatus D'Orb., Terr. Jurass., Ceph., p. 328, pl. 104, fig. 4–8.

Loc. Whitby, Milhaud, Laumière, Mende in Lozère, Donau-Main Canal, Salins in Jura, Près d'Avallon, Montpellier; Coll. Dr. Krantz, L. de Koninck, Prof. Bronn, and M. Boucault.

Dactylioceras* Hyatt.

The abdomen is either equal in breadth, or less than the back, instead of being broader than, or equal in breadth to, the back, as in the preceding genera. The lateral pilæ in the adult are smooth and invariably single; the abdominal pilæ may be either bifurcated or single. The young have the same development as the young of *Cœloceras crassum*, but the tubercles are dispensed with before the adult state is attained. (The tubercles are hardly distinguishable in the young of some species, such as Holandrei and Braunianum, especially on the fossil casts, but are, nevertheless, present in all the shells.) Septa do not differ materially from those of the preceding genus, except perhaps in the greater simplicity of the lobes and cells, which are hardly so close together or so complicated.

Dactylioceras commune Hyatt.

Amm. communis Sow., Min. Conch., v. 2, p. 9, pl. 107, fig. 23.

Naut. annularis Rein., Naut. et Arg., p. 79, pl. 6, figs. 56, 57.

Amm. annularis Ziet., Verst. Würt., p. 14, pl. 10, fig. 10.

Loc. Whitby, Boll, Amberg, and Langenbrücken; Coll. Dr. Krantz, L. de Koninck, and Prof. Bronn.

Dactylioceras Holandrei Hyatt.

Amm. Holandrei D'Orb., Terr. Jurass., Ceph., p. 330, pl. 105.

Loc. Whitby, Cheville in Sarthe, Fontaine Étoupe Fours in Calvados; Coll. L. de Koninck and M. Boucault.

Dactylioceras annulatum Hyatt.

Amm. annulatus Sow., Min. Conch., v. 3, p. 41, pl. 222.

Amm. annulatus D'Orb., Terr. Jurass., Ceph., p. 265, pl. 76, figs. 1, 2.

Argo. anguinus Rein., Naut. et Arg., p. 89, No. 1, pl. 12, fig. 73.

Amm. æquistriatus Ziet., Verst. Würt., pl. 12, fig. 5.

Loc. Whitby, Illminster, St. Amand, Fontaine Étoupe Fours; Coll. L. de Koninck and Dr. Krantz.

Dactylioceras Braunianum Hyatt.

Amm. Braunianus D'Orb., Terr. Jurass., Ceph., p. 327, pl. 104.

Loc. Milhaud and Plateau de Larzac; Coll. L. de Koninck and Dr. Krantz.

* Δακτυλίος, a ring.

THYSANOIDÆ.

Thysanoceras Hyatt.

Thysanoceras fimbriatum Hyatt.

Amm. fimbriatus Sow., Min. Conch., v. 2, p. 145, pl. 164.

Loc. Pouilly in Côte d'Or and Plateau de Larzac; Coll. L. de Koninck and Dr. Krantz.

Thysanoceras Germainii Hyatt.

Amm. Germainii D'Orb., Terr. Jurass., Ceph., p. 320, pl. 101.

Amm. interruptus Ziet., Verst. Würt., pl. 15, fig. 3.

Amm. oblique-costatus Ziet., Verst. Würt., pl. 15, fig. 4.

Loc. Milhaud (Dép. de l'Aveyron), Semur, Pouilly in Côte d'Or, and Gundershofen; Coll. Dr. Krantz, M. Boucault, and L. de Koninck.

Thysanoceras articulatum Hyatt.

Amm. articulatus Sow., De la Bèche, Geol. Manual, p. 276, fig. 63.

Loc. Spezzia; Coll. Prof. Bronn.

Thysanoceras Phillipsii Hyatt.

Amm. Phillipsii Sow., De la Bèche, Geol. Manual, p. 275, fig. 57.

Loc. Spezzia; Coll. Prof. Bronn.

Thysanoceras cornucopia Hyatt.

Amm. cornucopia Young and Bird. Geol. York., pl. 12, fig. 6.

Amm. cornucopia D'Orb., Terr. Jurass., Ceph., p. 316, pl. 99.

Loc. Semur, St. Quentin, près de Verpillier, Plateau de Larzac, and Milhaud (Dép. de l'Aveyron); Coll. L. Agassiz, M. Boucault, Dr. Krantz, and L. de Koninck.

Thysanoceras torulosum Hyatt.

Amm. torulosus Schub. Ziet., Verst. Würt., p. 19, pl. 14, fig. 1.

Amm. scutatus Von Buch, Pet. remarq., pl. 8, fig. 1.

Amm. torulosus D'Orb., Terr. Jurass., Ceph., p. 322, pl. 102.

Loc. Plateau de Larzac, Zillhausen, Metzingen, Schomberg, and Durwangen; Coll. Mus. of Stuttgart, Dr. Krantz, and L. de Koninck.

Thysanoceras jurense Hyatt.

Amm. jurensis Ziet., Verst. Würt., pl. 68, fig. 1.

Amm. jurensis D'Orb., Terr. Jurass., Ceph., p. 218, pl. 100.

Amm. phyllocinctus Quens'dt, Der Jura.

Loc. Semur, Plateau de Larzac, Milhaud (Dép. de l'Aveyron), Hechingen in Würtemberg, Uhrweiler in Elsass, Adnet bei Salzburg, Sondelfingen, Balingen, Reutlingen, Metzingen, and Gundershofen; Coll. Mus. of Stuttgart, M. Boucault, Dr. Krantz, Prof. Bronn, and L. de Koninck.

Thysanoceras hircinum Hyatt.

Amm. hircinus Schlot., Pet., p. 72.

Amm. hircinus Quens'dt, Der Jura, p. 280, pl. 40.

Loc. Semur, Donau-Main Canal, and Mistlegau bei Bayreuth; Coll. M. Boucault and Prof. Bronn.

Rhacoceras L. Agassiz.

Rhacoceras calypso Hyatt.

Amm. calypso D'Orb., Terr. Jurass., I., p. 167, pl. 52, figs. 7–9.

Loc. Plateau de Larzac, Monte de Aquasparta bei Cesi in Umbria, Milhaud, Laumière, Digne in Basses Alpes, and Erba bei Como; Coll. Dr. Krantz, L. de Koninck, and Prof. Bronn.

The abdomen is broader than in *R. heterophyllus*, and the septa different, but, nevertheless, the varieties of this species which are devoid of the annular depressions caused by the permanent mouths, are frequently identified with that species.

Rhacoceras heterophyllum L. Agassiz.

Amm. heterophyllus Sow., Min. Conch., v. 3, p. 119, pl. 266.

Amm. heteraphyllus D'Orb., Terr. Jurass., I., p. 339, pl. 109.

Loc. Whitby, Boll, Vassy près d'Avallon, Erzingen (Dép. du Doubs), Balingen and Bruchsal; Coll. Dr. Krantz, M. Boucault, and Prof. Bronn.

Rhacoceras cylindricum Hyatt.

Amm. cylindricus De la Bèche, Man. Geol., p. 275, fig. 55.

Loc. Schöppenstadt; Coll. Dr. Krantz.

Rhacoceras mimatense Hyatt.

Amm. mimatensis D'Orb., Terr. Jurass., p. 344, pl. 110, figs. 4–6.

Loc. Plateau de Larzac (Dép. de l'Aveyron) and Boll; Coll. L. de Koninck and Dr. Krantz.

PHYMATOIDÆ.

Phymatoceras Hyatt.

Phymatoceras enervatum Hyatt.

Loc. Plateau de Larzac and Villenotte près de Semur; Coll. Dr. Krantz and M. Boucault.

The abdomen is much flatter in this species than in the succeeding *P. robustum*, and in the young the channels are deeper and more distinct. The increase of the radii of the spiral is also less, and there are therefore a greater number of whorls in specimens of the same size. The sides of the whorls are also less gibbous than in *P. robustum*, and auxiliary cells differently formed, being comparatively but slightly indented by the minor lobes, and the inferior lateral cell inclined toward the umbilicus, instead of being straight.

Phymatoceras robustum Hyatt.

Loc. Plateau de Larzac, Milhaud, and Semur; Coll. Dr. Krantz, L. de Koninck, and M. Boucault.

Ammatoceras.

Ammatoceras insigne Hyatt.

Amm. insignis Schub., Ziet., Verst. Würt., p. 20, pl. 15, fig. 2.
Amm. insignis D'Orb., Terr. Jurass., Ceph., p. 347, pl. 112.
Amm. insignis Quens'dt, Die Ceph., p 280, pl. 40, figs. 4, 5.
Loc. Gundershofen (Bas-Rhin); Coll. M. Boucault.

Ammatoceras variabile Hyatt.

Amm. variabilis D'Orb., Terr. Jurass., Ceph., p. 350, pl. 113.
Loc. Laumière, Salins, Plateau de Larzac, St. Julien de Croix in Saone et Loire, Besançon, Evrecy bei Caen, Boll, and Balingen; Coll. Mus. of Stuttgart, L. de Koninck, Dr. Krantz, and M. Boucault.

Pelecoceras * Hyatt.

Having but one species of this genus, it would be exceedingly hazardous to give the generic characters. They will, however, probably be found to be distinguished by the peculiarly pointed aspect, shallowness and breadth of the lobes and cells; the limits of the envelopment, which last is greater than in other genera of this family; the acute form of the back, and the breadth of the whorls.

Pelecoceras attenuatum Hyatt.

Loc. Plateau de Larzac, Milhaud, and Besançon; Coll. Dr. Krantz and L. de Koninck.

Abdomen acute. Sides very broad and flat. Envelopment covers over one half the side of each internal whorl. Pilæ are curved forward on the abdomen. The young have no channels, and the development does not differ from *Amm. variabilis* or *Amm. insignis*, except in the size of the young, the whorls of these not being proportionately so large or broad. All the lobes and cells are broad and shallow, especially the pointed abdominal and the serrated auxiliary cells.

* Πέλεκυς, an axe.

HILDOCERATIDÆ.*

Hildoceras† Hyatt.

Abdomen keeled and channelled. Ribs large and broad. The young continue smooth throughout first whorl. Ribs, keel, and channels appear on the second whorl. The ribs are not preceded by a line of tubercles, but begin as folds, bent much in the same way as in the adult, but with the abdominal bend inclined more toward the apex. The abdominal lobe is shallow and broad. Superior lateral much deeper than either the abdominal or inferior lateral lobes, the last named very narrow and shallow, minor lobes small and pointed.

Hildoceras bifrons Hyatt.

Amm. bifrons Brug., Ency. Meth., Amm. No. 15.

Amm. bifrons D'Orb., Terr. Jurass., Ceph., p. 219, pl. 56.

Loc. Whitby, Dumbleton, Dorsetshire, Fontaine Étoupe Fours, Poillé in Sarthe, Laumière, Mende in Lozère, Verpillier, Milhaud, Plateau de Larzac, Cesi in Umbria, Mussy près de Semur, Chary près de Privas, Amayer sur Orne, Boll, and Metzingen; Coll. L. de Koninck, Dr. Krantz, M. Boucault, and Prof. Bronn.

Hildoceras Walcotii Hyatt.

Amm. Walcotii Sow., Min. Conch., v. 2, p. 7, pl. 106.

Amm. Hildensis Young and Bird, Geol. York., pl. 12, fig. 1.

Loc. Illminster, Niort, Fontaine Étoupe Fours, Plateau de Larzac, Cesi in Umbria, Milhaud, Vieux Ponts, and Guadalaviar in Aragon; Coll. B. M. Wright, Dr. Krantz, and L. de Koninck.

Grammoceras‡ Hyatt.

Abdomen keeled, but not channelled. Whorls flattened, laterally giving a discoidal aspect to the shells. Ribs finer and less prominent than those of *Hildoceras*. The young also continue smooth much longer, and channels never appear; they take, however, the same rounded form of the whorl. Septa differ but slightly from *Hildoceras* in the higher species, such as *Grammoceras serpentinum*; and not all generically in the lower, such as *Grammoceras striatulum*.

Grammoceras striatulum Hyatt.

Amm. striatulus Sow., Min. Conch., v. 5, p. 23, pl. 421, fig. 1.

Amm. Thouarsensis D'Orb, Terr. Jurass., Ceph., p. 222, pl. 57.

Amm. radians depressus Quens'dt, Der Jura, p. 281, pl. 40.

* Includes all the Falciferi proper with smooth pilæ.

† After St. Hilda.

‡ Γραμμή, a line.

Loc. Whitby, Robin Hood's Bay, Milhaud, St. Julien du Cray in Saone et Loire, Niort, Plateau de Larzac, Près de Lyon, Boll, Keulwagen, Redangen, Heiningen, Aalen, Falkenhagen in Lippe, Metzingen, and Uhrweiler; Coll. Mus. of Stuttgart, L. de Koninck, Dr. Krantz, Prof. Bronn, and M. Boucault.

Grammoceras radians Hyatt.

Amm. radians Schlot., Pet. p. 78, No. 34.

Naut. radians Rein., Naut. et Arg., p. 71, No. 17, figs. 39, 40.

Amm. radians Ziet., Verst. Würt., p. 5, pl. 4, fig. 3.

Amm. lineatus Ziet., Verst. Würt., p. 12, pl. 9, fig. 7.

Amm. radians compressus Quens'dt, Die Ceph., p. 112, pl. 7, fig. 9.

Loc. Niort, Plateau de Larzac and Carnus in Cevenen, St. Cyr bei Lyon, Villebois in Ain, Salins in Jura, Milhaud, Mende, Besançon, Vaches Noires in Calvados, Uhrweiler, Falkenhagen, Boll; Coll. Dr. Krantz, Prof. Bronn, L. de Koninck, and M. Boucault.

Grammoceras aalense Hyatt.

Amm. aalensis Ziet., Verst. Würt., p. 37, pl. 28, fig. 3.

Amm. aalensis Quens'dt, Die Ceph., p. 114, pl. 7, fig. 7.

Amm. aalensis D'Orb, Terr. Jurass., Ceph., p. 238, pl. 63.

Loc. Trocester Hill, Milhaud, St. Vigor, St. Julien du Cray, La Verpillière in Ain, St. Quentin, Aalen, Heiningen, Neumarkt, Balingen, Mistlegau, Amberg, Wiesenthal, and Gundershofen; Coll. Mus. of Stuttgart, L. de Koninck, Sir C. Lyell, L. Agassiz, Prof. Bronn, M. Boucault, and Dr. Krantz.

Grammoceras costulatum Hyatt.

Amm. costulatus Schlot., Pet., p. 78, No. 33.

Amm. costula Krüg., Uhrwelt. Naturgesch., p. 27.

Naut. costula Rein, Naut. et Argo., p. 68, pl. 3, fig. 33.

Amm. radians costula Quens'dt, Die Ceph., p. 113, pl. 7, fig. 11.

Loc. Aalen, Amberg, and Metzingen; Coll. Mus. of Stuttgart, L. de Koninck and Prof. Bronn.

Grammoceras serpentinum Hyatt.

Amm. serpentinus Schlot., Pet., p. 64, No. 6.

Argo serpentinus Rein., Naut. et Argo., p. 89, pl. 13, fig. 74.

Amm. serpentinus Ziet., Verst. Würt., p. 16, pl. 12, fig. 4.

Amm. serpentinus D'Orb, Terr. Jurass., p. 215, pl. 55.

Amm. Strangewaysii Sow., Min. Conch., v. 3, p. 99, pl. 25, fig. 1–3.

Loc. Whitby, Somerset, Dorsetshire, Bannington, Milhaud, Fontaine

Étoupe Fours, Thouars, Près de Semur, Vassy in Yonne, Amayer sur Orne, Boll, and Metzingen; Coll. L. de Koninck, Dr. Krantz, M. Boucault, Prof. Bronn, Duval, and Damon.

Leioceras* Hyatt.

Abdomen keeled, acute. Sides of the whorls flattened. Envelopment uniformly greater than in *Grammoceras*. The young differ, however, in being much flatter at the corresponding periods of growth. The lobes and cells, also, are less obtuse, shallower, and much more numerous.

Leioceras lythense Hyatt.

Amm. lythensis Young and Bird, Phil. Geol. York., p. 164, pl. 13, fig. 6.
Loc. Whitby; Coll. Prof. Bronn.

Leioceras opalinum Hyatt.

Naut. opalinus Rein., Naut. et Argo., p. 55, pl. 1, fig. 1.
Naut. comptus Rein., Naut. et Argo., p. 57, pl. 1, figs. 5, 6.
Amm. primordialis Schlot., Pet., No. 7, p. 67.
Amm. erratus Young and Bird, Phil. Geol. York., pl. 13, fig. 7.
Amm. primordialis Ziet., Verst. Würt., p. 5, pl. 4, fig. 4.
Amm. primordialis D'Orb., Terr. Jurass., Ceph., p. 235, pl. 62.
Amm. opalinus Quens'dt, Die Ceph., p. 115, pl. 7, fig. 10.
Loc. Robin Hood's Bay, Whitby, Trocester Hill, La Verpillière in Ain, St. Quentin près Verpillièr, Szaflary, Amberg près de Goslar, Neuffen, Quedlinburg, Teufelsloch, Gundershofen, and Metzingen; Coll. Mus. of Stuttgart, Dr. Krantz, Prof. Bronn, L. Agassiz, and M. Boucault.

Leioceras elegans Hyatt.

Amm. elegans Sow., Min. Conch., v. 1, p. 213, pl. 94, fig. 1.
Loc. Whitby; Coll. Dr. Krantz.

Leioceras complanatum Hyatt.

Amm. complanatus Brug., Encycl., p. 38, No. 11.
Amm. mulgrarius Young and Bird, Phil. Geol. York., p. 251, pl. 13, fig. 8.
Amm. elegans Phil. Geol. York., pl. 13, fig. 2.
Amm. elegans Ziet., Verst. Würt., p. 22, pl. 16, fig. 5.
Amm. complanatus D'Orb, Terr. Jurass., p. 353, pl. 114.
Loc. Whitby, Lyme Regis, Villebois in Ain, Mussy près de Semur, Avallon, Privas, Boll, and Ubstadt bei Bruchsal; Coll. Prof. Bronn, Dr. Krantz, M. Boucault, and Damon.

* Λεῖος, smooth.

Leioceras discoides Hyatt.

Amm. depressus Schlot., Pet., p. 80, No. 80.

Amm. discoides Ziet., Verst. Würt., p. 21, pl. 16, fig. 6.

Amm. depressus Ziet., Verst. Würt., p. 7, pl. 5, fig. 15.

Loc. Milhaud, Mende, Plateau de Larzac, and Balingen; Coll. L. de Koninck and Dr. Krantz.

Bruguière (Encyclop., 1789), having described a different species by the name "depressus," Zieten's name "discoides" is necessarily the correct name of this species.

Leioceras cumulatum Hyatt.

Amm. bicarinatus Ziet., Verst. Würt., p. 21, pl. 15, fig. 9.

Loc. Milhaud, Laumière, Mende, Plateau de Larzac (Dép. de l'Aveyron), Montpellier, and Zillhausen; Coll. L. Agassiz, L. de Koninck, Dr. Krantz, and M. Boucault.

Zieten's "bicarinatus" differs specifically from Münster's figure, Beit. zur Pet., v. 4, p. 138, pl. 15, fig. 30, and therefore it becomes necessary to adopt a new name for this species.

Leioceras concavum Hyatt.

Amm. concavus Sow., Min. Conch., v. 1, p. 215, pl. 94, fig. 2.

Loc. Semur, Salins, and Heiningen; Coll. Dr. Krantz and M. Boucault.

Leioceras capellinum Hyatt.

Amm. capellinus Schlot., Pet., p. 65.

Amm. capellinus Quens'dt, Die Ceph., p. 206, pl. 7, fig. 2.

Amm. lythensis lineatus Quens'dt, Die Ceph., p. 107, pl. 7, fig. 1.

Loc. Metzingen and Holzmünden; Coll. Dr. Krantz.

No. 6. — *Contributions to the Fauna of the Gulf Stream at great depths.* By L. F. de Pourtales, Assist. U. S. Coast Survey.

(Communicated by the Superintendent of the U. S. Coast Survey.)

The study of the constitution and of the inhabitants of the bottom of the sea is a field of research which has attracted the attention of naturalists in comparatively recent times. What Humboldt did with regard to the distribution of life at different heights in the atmosphere, was done by Edward Forbes for the different depths of the ocean. The former's diagrams of the zones of vegetation on the slopes of the Andes are considered indispensable in every atlas of physical geography. But what one man could do where his glance embraced miles of country in height and breadth and where the types of vegetation could frequently be recognized as far as the eye could reach, an investigator even as zealous as Forbes could but sketch in broad though happily drawn lines for the marine animals.

Much has been done in this direction since Forbes's death, particularly in England, where dredging has become a favorite occupation of many naturalists; the Scandinavian seas have also been explored with much success, chiefly by the Norwegian naturalists; but much more remains to be done in a field in which the areas to be explored can, as Jeffreys remarks, be reckoned in square degrees, whilst the research extends only over square yards.

It is particularly in the greater depths, in the so-called abyssal region, that our knowledge is deficient. This is easily understood, since on many coasts the sea is comparatively shoal for a considerable distance from land, and the outfit for deep-sea dredging is beyond the means of but few private individuals. Government expeditions are generally fitted out for other duties, and can rarely devote their time to operations occasioning a delay of many hours. Furthermore, owing to the scantiness of the material, the impression generally prevailed, until recently, that animal life was soon reduced to a minimum with an increase of depth, or at least reduced to the lowest forms, so that the incentive of a rich harvest seemed denied to those who would have undertaken such researches.

Excepting the investigations of Dr. Stimpson on the coast of New England, the dredge has been as yet very little used along our shores. The character and constituents of the bottom are however pretty well known, thanks to the care of the late Superintendent of the Coast Survey, Professor A. D. Bache, who, during his whole administration of that work, required the hydrographical parties to preserve the specimens brought up by the lead. From eight to nine thousand specimens have thus been accumulated at the Coast Survey Office, from a region comprised between the shore and the outer edge of the Gulf Stream, and reaching nearly to 1500 fathoms. But, of course, aside from the Foraminifera and Diatomaceæ, for the study of which this material has proved of high interest, not much was contributed to our knowledge of the animals of the higher classes, the instrument used being only adapted to procure a small quantity of sand or mud.

The present Superintendent of the Coast Survey, Professor B. Peirce, has lately directed the resumption of the investigations of the Gulf Stream, so successfully inaugurated by his predecessor, but interrupted for several years by the war. Besides observations of the depth, velocity, and direction of that current, and the temperature and density of the water at different depths, the researches will be extended to the Fauna of the bottom, of the surface, and of the intervening depths. Not only will an insight be thus obtained into a world scarcely known heretofore, but that knowledge will have a direct bearing on many of the phenomena of that great current. Thus a new light may be thrown on its powers of transportation from shallow to deeper water, or along its bed, on its action in forming deposits in particular localities, or on its possible influence on the growth of coral reefs on its shores.

The first campaign on this plan was organized in 1867, the field of research being in a section between Key West and Havana, incidentally with the purpose of sounding out the line for the telegraph cable, shortly afterwards laid between these two points. The Coast Survey Steamer Corwin was assigned to the work; and here I wish to express my thanks to my colleague, Assistant H. Mitchell, charged with the physical part of the campaign, and to Captain Platt and his officers for the interest they showed to my work, and for their valuable practical aid.

The expedition was unfortunately interrupted by the breaking out of yellow fever on board, so that the dredgings were few in number.

However, short as the season's work was, and few as were the casts of the dredge, the highly interesting fact was disclosed, that *animal life exists at great depths, in as great a diversity and as great an abundance as in shallow water.*

The identifications of the species have been made by me at the Museum of Comparative Zoölogy at Cambridge, in the rich collections of which I have found abundant material for comparison; facilities of every sort were afforded me by Professor Agassiz, for which I wish to express my heartfelt thanks, as also for this opportunity of prompt publication.

The first dredgings were made on May 17th, on the Florida side of the Gulf Stream, about 5 miles S.S.W. of Sand Key, in depths varying from 90 to 100 fathoms, on a bottom of calcareous mud. The following list comprises the animals obtained: —

ARTICULATES. A number of small Crustacea were brought up, which have not yet been determined. They belong to the following or allied genera: *Dromia*, *Ilia*, *Mithrax?* (a mutilated specimen), *Pagurus*, *Euphausia*, and *Orchestia*.

The tubes of several species of Annelids were obtained, but the animals were in most cases too defective for identification. The largest and best preserved is *Marphysa floridana*, nov. sp. (see description). There are also tubes of one or more species of *Serpula*.

The Gephyreans are represented by *Sipunculus corallicola*, Pourt. (Proc. Am. Assoc., 1851).

MOLLUSCS not determined specifically. They are mostly immature specimens or fragments of dead shells, and belong to the following genera: *Murex* (dead), *Turbo?* (operculum), *Leda* (living), *Astarte* (living), *Tellina* (dead). Of Pteropods dead shells of the following species: *Hyalea tridentata*, *Hyalea trispinosa*, *Cuvieria columella*, *Cleodora lanceolata*. The shells of this order are very common in deep-sea soundings. The Bryozoa are represented by *Vincularia margaritacea*, nov. sp. (see description).

RADIATA. Of Echinoderms were obtained an *Ophiurian* (an arm, undetermined) and a number of specimens of *Comatula Hagenii*, nov. sp. (see description).

A *Zoanthus*, rather small, was obtained also, but not having been noticed when alive, it would be somewhat uncertain to determine.

Hydroids: *Antennularia triseriata*, nov. sp.; *Thoa pulchella*, nov. sp.; *Th. capillaris*, nov. sp. (see descriptions).

The Foraminifera had nearly all been washed out of the dredge; only the following were noticed: *Textilaria conica* D'O. (very large); *Operculina*

(*Spirillina*) *incerta* D'O.; *Rotalina cultrata* D'O.; and *Globigerina rubra* D'O.

The total for this locality is therefore twenty-nine species, to which a few ought to be added for the undetermined fragments of Annelids.

No dredgings were had in mid-channel; this part had been reserved for the return trip, but the unfortunate interruption of the cruise prevented the execution of the project, at least for this season.

The next casts were obtained off Havana in 270 fathoms on May 24th and 29th, on both days as nearly as possible on the same spot, as the little that was obtained at the first date had given much promise.

The results of the two casts are combined below: —

ARTICULATES. The Crustacea are not determined, but of or near the following genera: *Stenopus*, *Axia*, *Callianassa*, *Orchestia*, and *Idotea*, all living. Annelids: *Marphysa tibiana*, n. sp., and *M. antipathum*, n. sp. (see description). Tubes and fragments of four or five other species.

Of the *Molluscs* the Gasteropods and Acephala have not yet been determined, with one exception.

The following genera are represented: *Mitra?*, *Fusus*, *Turbo*, *Emarginulina*, *Dentalium*, *Nucula*, and *Spondylus*, all dead; *Pedicularia decussata*, Gould (see remarks), and a very small *Anomia*, both living. The Pteropods and Heteropods were all dead; they are: *Hyalea trispinosa*, *affinis* D'Orb., *gibbosa* Rang, and *uncinata* Rang; *Creseis spinifera* Rang; *Cleodora pyramidata* Pér. and Les.; *Spirialis rostrata* Eyd. and Soul.; and *Atlanta Peronii* Les. Of Brachiopods we obtained *Terebratula cubensis*, n. sp., and *Terebratulina Cailleti* Crosse; both living and apparently abundant. The Bryozoa are: *Farcimia cereus*, n. sp.; *Vincularia margaritacea*, n. sp.; *Cellepora reticulata*, n. sp.; *C. sigillata*, n. sp.; *Canda retiformis*, n. sp.; *Canda cornigera*, n. sp., *Idmonea flexuosa*, n. sp. (see descriptions).

RADIATA. Echinoderms are represented by the following species: *Spatangus* (dead, fragments); *Fibularia* (dead); *Cidaris annulosa* Gray (probably, young, living); *Tripneustes ventricosus* (living, very young); *Asterias*, sp. (very young, living); *Ophiurians*, at least three species, immature and difficult to determine; *Comatula brevipinna*, n. sp., living; *Pentacrinus*, sp. (fragments of stem, among which some appear quite fresh).

Of Zoantharia the following were brought up: *Antipathes humilis*, n. sp.; *Antipathes filix*, n. sp.; *Acanthogorgia aspera*, n. sp.; *Gorgonia exserta* Ellis; *Swiftia exserta* Duch. and Mich.; *Hyalonema* (spicules); *Caryophyllia formosa*, n. sp.; *Deltocyathus Agassizii*, n. sp.; *Stylaster complanatus*, n. sp.; *Errina glabra*, n. sp.; *Errina cochleata*, n. sp.; *Crypthelia Peircei*, n. sp.;

Distichopora sulcata, n. sp.; *Heliopora? tubulata*, n. sp.; *Heliopora? carinata*, n. sp.; *Isis?* (base of stem); *Sarcodyction rugosum*, n. sp.

Hydroids: *Thoa pulchella*, n. sp.; *Tubularia crinis*, n. sp. Foraminifera: *Lagena striata* Mont., rare; *Nodosaria pyrula* D'O., rare; *Dentalina communis* D'O., rare; *D. (agglutinans?)*; *Lingulina carinata* D'O.; *Textularia trochus* D'O., common, very large, also abundant in shoaler water; *T. agglutinans* D'O., rare; *Nonionina scapha*, rare; *Nonionina umbilicatula* Montg., rare; *Cristellaria crepidula* F. and M., rather common; *Orbiculina adunca* D'O., rare and only in a worn state, its proper habitat is in the littoral zone; *Amphistegina gibbosa* D'O., rare and only young specimens; it is very common throughout the Gulf of Mexico in deep water; *Globigerina rubra* D'O., very abundant, also in the Orbulina form; *Gl. Dutertrei* D'O., common; *Pullenia obliquiloculata* P. and J., rather common; *Pullenia coarctata*, n. sp., rather common; *Sphæroidina dehiscens* P. and J., not common; *Rotalina cultrata* D'O., very common; *Rot. truncatulinoides* D'O., common; *Rot. Poeyi* D'O., rather common; *Rotalina*, 2 other species in single and imperfect specimens; *Biloculina*, sp.; *Triloculina Brongniartiana* D'O., rare; *Quinqueloculina bicostata* D'O., rare.

Many of the specimens of Foraminifera are filled with a yellow mass, like the first stage of transformation into greensand, but the process seems to stop here.

Of Sponges quite a number were obtained, at least a dozen species, which have not yet been determined. Some of the detached spicules are remarkable for their size; one, for instance, of the slender rectangulated sexradiate type of Bowerbank measuring more than half an inch.

The vegetable kingdom was represented in this dredging by a single specimen of a minute alga, *Centroceras clavulatum* Agardh., which Harvey says is found abundantly at low water mark at Key West. In its branchlets was entangled a chain of a species of *Biddulphia*. Other Diatomes are rather scarce and have not yet been determined. We therefore find here also a confirmation of the remark made in European seas, that vegetable life does not extend to depths as great as are reached by animals, and that therefore the greater number of deep-sea animals must be carnivorous.

The dredge contained also a number of nodules of a very porous limestone, similar in color and texture to the limestone forming the range of low hills along the shore of Cuba, but composed apparently of the remains of the same animals which were found living. Thus our Deltocyathus, Caryophyllia, the various Pteropods were recognized in the stone, and found also in various stages of fossilization. The interstices between the larger forms are generally filled up with Foraminifera.

On May 25th the dredge was sent down in 350 fathoms, outside of the locality occupied on the 24th and 29th. It brought up only a few dead corals: *Caryophyllia formosa*, *Deltocyathus Agassizii*, *Diplohelia profunda*, the latter in numerous specimens (see description). Also a fragment of the siliceous skeleton of a sponge, forming a regular network somewhat like that of Euplectella as figured by Bowerbank, but lacking the spines.

The soundings made during this cruise seem to indicate a kind of submarine terrace, on which the dredgings of the 24th and 29th were made. The cast of the 25th was probably made on the edge of it, and the dredge no doubt touched bottom only for a short time, after which the ship drifted off into water too deep for the line attached.

Remarks and Descriptions of New Species.

Marphysa floridana Pourt.

Head small, with 5 antennæ; no tentacles on the buccal ring. Branchiæ pectinated, with 5 to 7 lobes, small, beginning about the 7th or 9th ring. The composite bristles with a small lancet-shaped appendage. Two eyes, rather large. Superior cirrhi longest, inferior short and conical. Teeth of the labrum large, broad, enamelled, white. Caudal cirrhi two, short. The first ring of the body has only the two superior cirrhi, which are nearly dorsal.

Body rings about 115. Color reddish, iridescent. Length 3 or 4 inches (contracted). Inhabits large deformed paper-like tubes, with lateral openings irregularly placed, though in general alternate, bordered by laciniate and fimbriate flaps.

Off Sand Key in 100 fathoms.

Marphysa tibiana Pourt.

All the characters as in the preceding, but the whole animal is more slender, and in some parts of the body the rings are considerably elongated, which may possibly be due to its position in the tube at the time of death. The branchiæ are almost rudimentary, in the shape of small club-like appendages to the upper cirrhi. It differs particularly from the former by its tubes, which are horny, dark brown, regularly serpentine; at every bend there is a tubulated aperture directed backwards, with an expanded fimbriated border. Similar tubes have been figured by Ellis, and on them Lamarck founded the genus Tibiana, which he placed among the polyps. (See figure in Ellis, also copied by De Blainville.) In this species the tubes are free and appear to have been buried in the mud by their smaller end. Abundant in 270 fathoms off Havana.

Marphysa antipathum. Pourt.

Animal not observed; tubes differing from those of the preceding species in being attached by their whole length to the stems of a small species of Antipathes. They are also somewhat smaller, and the tubular apertures are entire, without fimbriæ, and only slightly widened.

Found, with the preceding, off Havana in 270 fathoms.

Tubes of various forms were also found, but not containing the animal, or only insufficient fragments of it, so that they cannot be determined. One tube deserves mention; it is white, parchment-like, straight and flattened; it is armed densely with spicules of sponges placed transversely, and stiffened by the long threads of a Hyalonema attached longitudinally; it contained only a very small fragment of the inhabitant. Obtained in 270 fathoms off Havana.

Pedicularia decussata Gould. (Proc. Bost. Soc. Nat. Hist., Vol. V. p. 127.)

As I have not Dr. Gould's specimens at hand for comparison, I refer with some hesitation to this species, a small living shell dredged on May 29th. As it is immature it is difficult to determine by the description alone.

Terebratula cubensis Pourt.

Shell globose, thin, light horn-colored, translucent, obscurely pentagonal, smooth, or showing faintly the lines of growth; the inferior margin of the transverse portion of the loop with three indentations, differing in this respect from *T. vitrea*, in which this part is entire; otherwise these two species resemble each other very closely. The largest specimen is $1\frac{1}{10}$ inch long, $\frac{9}{10}$ of an inch broad, and $\frac{7}{10}$ high.

It may prove to be identical with an undescribed *Terebratula*, from a recent formation of Guadaloupe, mentioned in Bull. Soc. Geol. de France, Tom. xx. 1863.

Several specimens, mostly large, were obtained off Havana in 270 fathoms.

Terebratulina Cailleti Crosse.

A number of specimens of this species, of all ages, were obtained with the former. They are all smaller than the Guadaloupe specimen, figured by Crosse, and perhaps on that account show the depression in the middle of the dorsal valve less distinctly than the figure.

Vincularia margaritacea Pourt.

Irregularly branching, generally at a large angle. White, pearly. Cells set round the axis in six rows alternating by threes, oval, smooth. Aperture rounded, with a small notch on inferior border for the attachment of the horny operculum, which is thin and round. Some of the cells have an accessory upper chamber (*ovarian vesicle*) inflated and cribriform. About 1 inch high; rather abundant off Sand Key in 100 fathoms, and off Havana in 270.

Farcimia cereus Pourt.

Frustules long, cylindrical, branching laterally from the middle of the older ones. Cells in six rows, alternating three and three, concave, oval Aperture small, horseshoe-shaped, with a pore on each side. In old and worn specimens the operculum giving the shape to the aperture is lost and the latter becomes oval. The space between the cells is then also deprived of a kind of epidermis, and shows rows of pores forming lozenges around the cells. Articulating peduncles horny; sometimes strengthened by radicles. Rather abundant in 270 fathoms off Havana.

Cellepora reticulata Pourt.

Flabellate, much anastomosing, pearly; apertures alternate, directed obliquely upward, all on the same side of flabellum, rounded, with small knob on lower part, on which is a small pit for the articulation of the operculum. (The latter all lost from specimen on hand.) About three quarters of an inch high. Off Havana in 270 fathoms.

Cellepora sigillata Pourt.

Flabellate, anastomosing, all the cells opening on the same side of the flabellum. Aperture oval, somewhat truncated towards the top, above which rise four short bristles. Cells irregularly alternate, crowded, concave. Operculum large, pearly, convex with a somewhat turned-up lip.

Only a small fragment was obtained off Havana in 270 fathoms.

Canda* retiformis Pourt.

Flabellate, irregularly dichotomous. Membranous tubular radicles connecting the branches with each other at about every fourth cell, giving the whole the appearance of network. Cells elongated, thin, half-membranous, alternate, opening on the same side of flabellum, punctated, two short blunt spines at the top. Aperture large, occupying about two thirds of the cell, protected by a broad T-shaped shield rising from the side of the aperture. About one inch high. Off Havana in 270 fathoms.

* Cellarina, Van Beneden.

Canda cornigera Pourt.

Flabellate and resembling the former, but the branches are not so dense, and not connected by radicles, which are only numerous near the foot and attached to foreign bodies. Cells as in the other species, but the shield is ramified like a pair of elk horns. Off Havana in 270 fathoms.

Idmonea flexuosa Pourt.

Branching irregularly, calcareous, white. Branches variously curved or flexuous. Cells long, cylindrical, striated; aperture rounded at the end of a curved tubular projection, almost opposite, with a slight tendency to become alternate. Resembles closely the fossil species *Idmonea coronopus*.

Off Havana in 270 fathoms.

Comatula (Alecto) Hagenii Pourt.

Ten arms. Mouth central, with the five brachial grooves radiating from it. Centre of disc convex, surrounded by about 30 cirrhi, each of which is composed of 18 to 20 articulations, much longer than broad, smooth, of nearly equal size throughout the whole length of the cirrhus. Cirrhi in several circles. A small part of the second radial only visible, so that the axial radial appears almost sessile. The radials of two contiguous arms, and the first brachials of the same pair well separated down to the angle. Arms convex on dorsal side. Syzygia composed of three or seldom four articulations, with very oblique joints, and very finely denticulated edges, better recognized by the touch than by the eye. The first three or four pinnules of the arms long and nearly equal, the pinnules of the middle of the arm shorter than those of the base or extremity. Arms about three inches long. Color pale greenish, turning white in alcohol. All the specimens had the pinnules filled with eggs. Quite abundant in 100 fathoms off Sand Key.

Comatula brevipinna Pourt.

Ten arms. Mouth and anus not seen in the only specimen obtained. About 15 cirrhi, with the same number of long articulations. Seven or eight articulations to every syzygium. The two radials are visible, and have, as well as the axial radials and the two first brachials, a smooth tubercle in the middle. The same pieces are denticulated on the sides, the denticulations meeting those of the collateral radials and brachials, so as to close up the angle between them. A row of very small tubercles on the proximal border of the radials and radial axials. The articulations of the arms somewhat imbricate. First pinnule longest, with about twelve joints. The other pinnules very short, having only five or six joints in the middle of the arm, but lengthening out again near the end of the arm, the last ones being tipped with a hook like the cirrhi.

In the only specimen obtained one of the arms is abortive and divided into three very short branches; to compensate, one of the arms of the next pair is divided into two from its origin.

In 270 fathoms off Havana.

Antipathes filix Pourt.

Main stem erect and straight, pinnate, the pinnules set off nearly at right angles, rather short, alternate, covered with spines or short stiff hairs, and showing a succession of slight swellings and contractions. Axis tough and corneous, nearly black, dark amber color by transmitted light. About 3 inches high. Soft parts not observed.

In 270 fathoms off Havana.

Every specimen obtained served as support to the tubes of an Annelid (*Marphysa antipathum*).

Antipathes humilis Pourt.

Differs from the former by its mode of branching, which is dense and irregularly subflabellate, like a spray of heather; more expanded laterally than in height, which is 3 or 4 inches, whilst the spread is 4 or 5. Every swelling corresponds to a polyp. Polyps all on the same side of the flabellum, six-armed, with very elongated calicle in the younger branches, so that the tentacles appear almost like two parallel rows of three tentacles each. It differs from *A. Boscii* in having rather thicker and more hispid branches, curved somewhat downwards, as the branches of an elm.

Abundant in 270 fathoms off Havana.

Gorgonia exserta Ellis.

Two specimens of this species, 3 or 4 inches high, were obtained off Havana in 270 fathoms. They agree very well with the figures in the different authors. One of them has all the polyps retracted and the calicles closed, the other has them all expanded as usually represented. The whole cortical substance is filled with spindle-shaped spicules, by which character it is distinguished from *Thesea guadalupensis* Duch. and Mich., in which the spicules are covered by a squamose layer.

In 270 fathoms off Havana.

Swiftia exserta Duch. and Mich.

I refer to this species a few specimens of a very small Gorgonian, not more than one inch high, which at first sight does not appear different from the preceding species. Under the microscope the cortical substance appears studded with rough irregular calcareous pieces, without spindle-shaped spicules. The polyps are perhaps a little more verrucose than those of the Gorgonia exserta. Off Havana in 270 fathoms.

Acanthogorgia aspera Pourt. (The generic name given by Gray has priority over the name *Blepharogorgia* Duch. and Mich.)

Slender, flabelliform, few-branched, sparsely beset with short spines. Polyps rather scattered, long verruciform (length equal to four or five times the diameter), with eight rows of spines longest at the base and at the summit of the polyp. Tentacles black, the rest of the polyps translucent. Stem dark brown. The whole polypidom not more than two inches high. By its spiny stem, and spines at the base of the polyps, and by the greater length of the latter, it differs decidedly from *A. hirsuta* Gray, *A. Grayi* and *atlantica* Johnson, and from *A.* (Blepharogorgia) *Schrammi* Duch. and Mich.

In 270 fathoms, off Havana.

Sarcodyction rugosum Pourt.

Small polypidoms rising from creeping stolons, on pebbles. Like little knobs, fragile, rough, closed by the contraction of the polyp by means of about six irregular rough pieces meeting together. When opened, the cavity shows six or eight membranous septa, nearly meeting in the centre. Stolons covered with irregular calcareous pieces. Color dirty white. Diameter of polyps one tenth of an inch. In 270 fathoms off Havana.

Caryophyllia formosa Pourt.

More or less turbinate, on a rather thin curved, or straight stem. Costæ equal, distinct only near the calicle. Calicle circular or subovate, moderately deep. Columella formed of four to six very flexuous or twisted laminæ. Six complete systems of septa. Four cycles. Septa thin, prominent, sharp and rounded on the edge; sparsely granulated. Those of the third order sometimes flexuous near the inner end in some specimens. Twelve pali, opposed to the third order, equal, large, flexuous, ornamented with tubercles disposed in horizontal lines on the convexity of the flexures. The young are rather variable, sometimes long and cylindrical, with the septa little developed and showing neither pali nor columella, and sometimes very small and cup-shaped and showing pali and columella.

The largest are $1\frac{1}{4}$ inches high; calicle $\frac{1}{2}$ inch in diameter.

Abundant in 270 fathoms, off Havana. Specimens mostly alive and growing singly or attached to each other.

It differs from *C. Berteriana* which has the costæ more prominent and a different number of septa. I have not seen specimens or figures of *C. Guadulpensis*, which is fossil in volcanic formations of Guadaloupe, and may not be extinct.

Deltocyathus Agassizii Pourt.

Corallum discoidal, free at all ages. Wall nearly horizontal, sometimes with a nipple-shaped projection in the centre. Costæ well marked, covered with spiny or smooth granules; the six primary costæ in one specimen much broader than the others and forming a star. Septa in six complete systems, with four cycles; covered with small spinous tubercles. Pali of the first, second, and third cycles projecting generally higher than the septa, to which they are soldered at the base. The pali of the first cycle short, those of the third joined to those of the second, as in the fossil species, but the point of junction not being exsert the V or delta is not as apparent. Columella papillose and small, rising from the primary and secondary pali which meet in the centre.

Dredged from 270 fathoms off Havana, in numerous specimens of all ages, but none apparently alive.

Platytrochus coronatus Pourt.

This species, not belonging properly to the region under discussion, is based on a specimen brought up by the sounding lead from a depth of 460 fathoms in lat. 30° 41′ N., and long. 77° 3′ W., by one of the hydrographical parties of the Coast Survey. It is in a bad state of preservation, the outer wall and base being so corroded as to make the characters drawn from the epitheca and costæ very doubtful; the septa and columella are also rather imperfect.

Corallum free, base horizontal, with a tubercle in the centre. The costæ of the primary and secondary order alone distinct, forming a crown of twelve large tubercles around the base, but vanishing towards the edge of the calicle. Wall vertical, almost at a right angle with the base and the circular calicle. Six complete systems of septa, in four cycles. Septa meeting in the centre Those of the tertiary cycle frequently but not regularly coalescing with the primary or secondary ones. Columella probably papillose (nearly destroyed). Diameter $\frac{6}{10}$ of an inch, height (without the central tubercle) $\frac{4}{10}$ of an inch.

Diplohelia profunda Pourt.

Corallum branching, cylindrical, finely granulated or striated, particularly on younger branches and around the calicles, which are projecting, very deep and pocket-shaped. Septa 24, nearly equal, not exsert, finely serrated and tuberculated, nearly meeting at the bottom of the fossa. Columella formed of six or seven club-shaped styles, not very distinct from the septa. The specimens obtained were all in fragments 2 or 3 inches long. Diameter $\frac{2}{10}$ inch.

This species resembles the fossil *Dipl. raristella*, but has deeper calicles and somewhat rougher surface.

Dredged from 350 fathoms off Havana; all the specimens dead; also brought up by the lead in same condition in 1050 fathoms, lat. 28° 24′ N., long. 79° 13′ W.

Crypthelia Peircei Pourt.

Corallum arborescent and subflabellate, irregularly dichotomous, slender, finely striated. Calicles subpedicellate, always of a larger diameter than the stem, facing to one side only of the corallum. Septa 12 to 16, thick, not extending far into the calicle. Columella not seen. The lower border of the calicle prolonged into a rounded lip folded over so as to hide the fossa. Some of the calicles are inflated and globular, perhaps from the presence of parasites. Size: $\frac{1}{2}$ an inch long (broken), diameter of stem from $\frac{1}{20}$ to $\frac{1}{50}$ of an inch, of the calicles $\frac{1}{30}$ to $\frac{1}{40}$.

This very pretty coral was dredged off Havana in 270 fathoms, but appears to be rather rare, only a few small fragments being obtained. It differs from the species described by Milne-Edwards in having a smaller lip, hiding only the fossa of the calicle, whilst in the species from the Pacific the lip is as large as the whole calicle. I have also found worn fragments in a specimen of bottom from 600 fathoms in lat. 31° 32′ N., and long. 78° 20′ W.

Stylaster complanatus Pourt.

Corallum branching, flabellate, not coalescing, slender. Calicles terminal, pedicellate; gemmating from the edge of the preceding calicle, generally on alternate sides, so as to give a zigzag form to the branch, but sometimes two or even three new corallites rise from the border of one. They are directed slightly more towards one side of the plane of the corallum than the other. Calicles compressed in the same plane, moderately deep, the styliform columella appearing at the bottom rising out of a small round fossa, and surrounded by rudimentary pali. Septa 12, appearing like folds of the wall, not extending far into the calicle, and punctured with small pores on the edge. When the branch rising out of a calicle increases in size, the calicle becomes hidden by the plicated lip raised against the stem, and at length becomes obsolete. Spiny ampullæ scattered along the stems, more abundantly on the rear side. It is white, about $1\frac{1}{2}$ inches high; the diameter of the calicles about $\frac{1}{30}$ of an inch.

Obtained in 270 fathoms off Havana.

It approaches nearly to *Stylaster elegans* Duch. and Mich., which has however nearly circular calicles with shorter pedicles and thicker branches. (The name *St. elegans* has been anticipated by Verrill for a species from the Kingsmill Islands, in Bull. Mus. Comp. Zoöl., Cambridge, 1864; I would propose therefore the name of *St. Duchassaingii* for the species from Guadaloupe.) From *Allopora maderensis* Johnson, to which it is very closely allied, it differs also by the compressed form of the calicles.

By its scale-like lip hiding the fossa in the older calicles, and by its transversely elongated terminal calicles, this species forms a passage to the genus Errina as defined below. It is here retained among the Stylasters on account of its distinct septa and the absence of tubular pores having a longitudinal fissure below. On the other hand the passage through *St. flabelliformis* to the Stylasters with round scattered calicles appears natural. When I have had more opportunity of examining the allied forms, it may be necessary to separate *S. complanatus* generically from the true Stylasters. The whole group of corals comprising the genera Stylaster, Errina, Allopora, and Distichopora, all closely allied, requires careful revision.

Genus Errina.

A comparison of specimens of *Errina aspera* Gray, in the Museum of Comparative Zoölogy in Cambridge, with the two species described below, showed very plainly that Gray has overlooked the true calicles and mistaken for them the tubular pores scattered over the younger branches. In his species these pores are very large and numerous, and the calicles small and concealed; in the new species, here described under the name of *St. cochleatus*, the reverse is the case. The structure of the latter species being once well understood, it is very easy to recognize the same parts in the other; of both I have furthermore made careful sections for the microscope. Whilst retaining the name adopted by Gray, I propose the following generical definition.

Corallum branching, subflabellate, finely granulated or obscurely striated, the younger branchlets more or less studded with tubular pores, split downwards into a furrow. Calicles at first terminal, in shape of a transverse slit, of which one lip continues to grow in a conical shape to repeat the process, whilst the other expands in the shape of a bract or spoon, hiding the calicle after it has become lateral. Fossa circular and very deep; septa obscure or none; pali rudimentary in the shape of small beads; columella pistilliform. Ampullæ as in Stylaster.

Errina cochleata Pourt.

Corallum branching, very slender, subflabellate, finely granulated and striated, studded with echinulated ampullæ. Branchlets almost filiform; the pores on them are sometimes tubular with a longitudinal fissure below. Fossa round and deep, the spoon-shaped lip hiding it entirely. Columella pistilliform and somewhat hirsute, very deep seated. Septa few and indistinct, formed by folds of the wall.

Compared with *Errina aspera* from Fayal, it is found to differ from it in having slenderer branches, with fewer and smaller furrowed tubercles and fewer echinulated ampullæ, whilst the calicles are larger and more conspicuous. The whole corallum is about one inch high. Found in 270 fathoms off Havana.

Fragments of an Errina, closely resembling *E. aspera*, have been also found by me in a specimen of bottom from 600 fathoms, in lat. 31° 32′ N. and long. 78° 20′ W.

Errina glabra Pourt.

Corallum flabellate, not coalescing, with the older parts of the stem massive, faintly granulated and striated; a row of very small perforated tubercles on each side of the branches. Calicles very small, terminal on branchlets, obsolete on larger branches, and their place indicated by a small scale. Septa indistinct. Columella styliform in a deep fossa. Ampullæ scarce and small, smooth. Color white. Two or three inches high.

It differs from *Errina cochleata* in having much thicker branches, even when young, forming smaller angles with the stems. The ampullæ are not spinous. The tuberculated pores are confined to the sides of the branches and have seldom a distinct furrow. From *Errina aspera*, although resembling it in general habitus, it differs in having slenderer branches, less numerous ampullæ, and lacking the large furrowed pores on the younger branches.

Distichopora sulcata Pourt.

Corallum dendroid, much compressed, somewhat rugose. The calicles on the edge, mostly confluent; fossa a deep round hole. Septa about 12, very rudimentary; the border of the calicle pierced by about eight or ten pores which form lateral rows when the calicles are joined. Columella deep seated, seldom visible, styliform, hirsute, similar to the columella of the Stylasters. The interior of the calicle is studded with bead-like tubercles.

This species differs from other known species of the genus in being more compressed, having the pores larger, more distant, and when confluent forming a much deeper furrow. When the calicles are isolated, they present all the characters of Allopora, as shown in *A. oculina*, Ehr.

Found in 270 fathoms off Havana; rather scarce. Also in the shape of worn fragments in a specimen brought up by the lead from 600 fathoms in lat. 31° 32′ N. and long. 78° 20′ W., which is near the outer edge of the Gulf Stream off the coast of Georgia.

Of the close relationship of Distichopora with the Stylasters, and still more with the Alloporas, I entertain no doubt, after a careful examination. Indeed, I can see no reason for separating generically Allopora and Distichopora, which appears to differ only by the confluence or non-confluence of the calicles, both of which characters are found in the same individual in the species described above.

Heliopora tubulata Pourt.

I refer with great doubt to that genus, a form of small corals of which I have obtained but a few fragments, representing two species. Corallum small, branching, cylindrical, with pores of three kinds: small microscopical, somewhat larger and tubulated, and large round holes. The latter are rather distant, in irregular longitudinal rows. No trace of septa or columella. The internal structure shows a net-work of round canals communicating with the pores and with each other. The larger holes communicate with a cavity in the centre, not communicating with the next except through the small canals; the walls of these cavities are closely perforated. No floors or tabulæ were to be seen in the only section I was able to make. The largest specimen is one inch high.

Off Havana in 270 fathoms.

Heliopora carinata Pourt.

This species differs from the preceding by its much slenderer branches, on which every tubulated pore is at the extremity of a keel or ridge. The larger round pores are proportionally scarcer and smaller.

Off Havana in 270 fathoms.

Antennularia triseriata Pourt.

Tubular stems rising from a clustered root, straight, erect, not branching, corneous, translucent. Hair-like branchlets in three rows. Polyp cells very small, scattered sparsely on the stem, more plentiful but not dense on the branchlets, campanulate, very short on a longer, conical caliciform stem. Aperture entire. Ovarian cells in the axillæ of the branchlets, compressed, semi-lunar or long kidney-shaped, with the aperture on the inside of the upper horn, looking towards the peduncle.

Eight inches high, dark amber color. Off Sand Key in 100 fathoms.

Thoa pulchella Pourt.

Erect, rooted; stem composed of irregularly twisted tubes, regularly pinnate; branchlets alternate. Cells regularly alternate on the stem and branches, moderately distant, more or less corrugated, slightly contracted towards the four-sided aperture, the four angles of which form obtuse teeth. Ovarian cells long campanulate, regularly scolloped on the border with square teeth. Peduncles as long as the cells.

Off Sand Key in 100 fathoms and off Havana in 270.

Thoa capillaris Pourt.

Erect, irregularly branching. Branches almost capillary. Cells alternate, distant, small, tubular, bi- or tri-articulate; aperture terminal and entire. Ovarian cells large, elongated campanulate, denticulate margin, teeth rounded; peduncles as long or longer than the cell, connected with the latter by a small knob-like joint. One inch high. Off Sand Key in 100 fathoms.

Thoa siphonata Pourt.

Stem composed of irregularly twisted tubes; branches irregularly pinnate. Polyp-cells very small and scarce, tubular, at the base of the peduncle of the very long, tubular ovarian cells. The latter are bent at right angle near the top and terminate in a round aperture. Half an inch high, on Terebratulæ.

Off Havana in 270 fathoms.

Tubularia crinis Pourt.

Irregularly branching; branches rather smaller than horsehair, of dark horn-color, wrinkled at intervals; polyps terminal, large, not retractile. About two inches high, attached to tubes of Annelids. Off Sand Key in 100 fathoms.

In determining the Hydroid polyps, I have made use of the older generic names. The newer subdivision of these genera being based chiefly on characters derived from the softer parts, it is almost impossible to assign a polyp to its proper place in them, unless observed alive.

It would be premature to compare this deep-sea Fauna with the animals inhabiting the regions of lesser depth on the coast of Cuba or Florida. In the first place, many of the smaller forms of animals, such for instance as the Bryozoa or the Hydroid polyps of those shores, are not yet sufficiently known to enable us to say if any of the species dredged exist in any other than the abyssal region. Then, a very different value must be assigned to the different classes of animals under examination. Thus, the dead shells must be left out of the question, at least the smaller ones, for they may have been dropped with the excrements of fishes, or, in the case of Pteropods, have sunk from the surface after the death of the animal. The Crustacea and Annelids being abundant and generally sedentary will, when better known, afford good characteristics of the regions of inequal depth. The same remark applies to the Sponges and the Foraminifera; the great abundance of the latter and the ease with which they may be procured with the sounding-lead renders them particularly useful.

The Echinoderms appear to have a wide range in depth; at least we have two species (*Cidaris annulosa* and *Tripneustes ventricosus*) which are common to the shore and to the depth of 270 fathoms. The upper and lower limits of Pentacrinus are not yet known.

Of the corals, none of the species found in our dredgings are known to exist in lesser depths; nor have any of the common species of the reefs been brought up from a considerable depth. The Gorgonians however are represented in 270 fathoms by at least two species known to belong to the West Indian Fauna in moderate depths.

Farther researches in all the zones of depth are much needed; and we hope to have an early opportunity of continuing our researches in the Gulf of Florida, so as to throw more light upon this interesting subject.

Cambridge, December 26, 1867.

No. 7. — *Contributions to the Fauna of the Gulf Stream at great depths (2d series).* By L. F. de Pourtales, Assist. U. S. Coast Survey.

(Communicated by the Superintendent of the U. S. Coast Survey.)

The researches of which an account was given in the preceding number of the Bulletin were continued in the spring of the present year (1868) in connection with the regular explorations of the Gulf Stream by the Coast Survey. The few dredgings obtained in 1867 had given results of so rich and promising a character, that Professor Peirce, the Superintendent of the U. S. Coast Survey, directed me to accompany the party again, and to dredge on all the lines of deep-sea soundings off the Florida reef.

The U. S. Steamer Bibb, Acting Master R. Platt, U. S. N., was assigned to the work. The means of working were much more complete, a small engine having been set up on deck, by which not only a great economy of time and labor was obtained in hauling up the lead or dredge, but it was found perfectly practicable to work both at the same time; so that our estimate of time, based on the plan of sounding out a line one day and dredging over the same ground the next, was reduced one half, — an advantage which will be understood by those who know the value of a calm day for such work. For the perfection of the mechanical arrangements, and the difficult task of keeping the reckoning in the current with very scanty landmarks, I am again deeply indebted to Captain Platt and his officers.

The region to be explored this season comprised a section of the Gulf Stream from Sombrero, or Dry Rocks Light-house, on the Florida reef, to Elbow Light-house on the Double-headed Shot Keys; a section of the St. Nicholas Channel from Salt Key to the opposite coast of Cuba; a section of Santaren Channel from Anguilla Keys to the edge of the Great Bahama Bank; and a more detailed examination of the slope extending from the Florida reef to the trough of the channel from Sand Key to Sombrero Light. The sections across St.

Nicholas and Santaren channels were quite successful, as far as the soundings and current observations were concerned; but the few dredgings with which we had to be contented, for want of time and good weather, did not produce much of interest. We were more successful on the slope or so-called *apron* of the reef. Here the great advantage of having a safe anchorage every night inside the reef, and within half a mile of the field of work, allowed the soundings and dredgings to be carried on with great rapidity and success.

The six lines run (as far as possible normally to the reef) were the following: Off Coffin's Patches with only two dredgings; off Sombrero Light with seven dredgings, between 111 and 517 fathoms; off Bahia Honda thirteen dredgings, from 19 to 418 fathoms; off the American Shoal fourteen dredgings, from 16 to 266 fathoms; off the Samboes nineteen dredgings, from 13 to 298 fathoms; and off Sand Key twenty dredgings, from 23 to 306 fathoms. Besides these, numerous casts were made in 100 and 120 fathoms off Sand Key, whilst current observations were in progress.

The figures and the character of the bottom developed by the different lines were found quite concordant. At an average the slope, after leaving the reef, is uniform for four or five miles, and the bottom is composed of more or less comminuted shells and corals, with a rather scanty living Fauna. This we may call the first region. The next extends in the form of a band parallel to the reef, ten to twenty miles broad, beginning at a depth of about 90 fathoms, and extending to about 300; the slope being much less inclined than in the first region, and in fact deserving in a great part of its extent the name of a submarine plateau. The bottom is rocky, rather rough, and consists of a recent limestone, continually though slowly increasing from the accumulation of the calcareous *débris* of the numerous small Corals, Echinoderms, and Mollusks living on its surface. These *débris* are consolidated by the tubes of Serpulæ, the interstices filled up by Foraminifera, and further smoothed over by Nullipores. It is not unreasonable to suppose that we have here the foundation of a future reef, which, when in the course of ages it shall have approached the surface, will be covered with a growth of Madrepores and Astreans, such as we find on the present barrier reef, and as have lived on the former reefs constituting the chain of the Florida Keys, the border of the main-land of the peninsula, and probably some older as yet unexplored ones in the Everglades.

This region ceases at a depth varying from 250 to 350 fathoms; the third region begins with a more rapid slope, and extends over the whole trough of the channel, the depth of which in this part does not much exceed 500 fathoms. This is the great bed of Foraminifera, and more specially of Globigerinæ, which covers so great an extent of the bottom of the ocean, and which, as we shall see, is not destitute of living representatives of the higher branches of the animal kingdom.

The Fauna of the three regions is very distinctly marked. The first region is singularly barren, and shows that the rich Fauna of the Florida reef extends but very little to seaward or into depth. The greater number of the shells brought up are dead and broken, and can scarcely be regarded as characteristic, as large numbers of them have evidently served as food for turtles and fishes, and may have been thus transported some distance. Crustaceans and Annelids are more common. The Echinoderms are represented by a few Ophiurians, and the Corals chiefly by *Balanophyllia floridana*, nov. sp., very abundant in some places, particularly near Sand Key.

The second region, on the contrary, is remarkably rich in animal forms, which may be in part attributed to the hard and rough bottom offering points of attachment and shelter. If this formation were emerged, the geologist would find it to consist of beds of limestone full of fossils, of which we shall point out the most characteristic ones; remarking, however that though the great majority of the animals furnishing those remains now live on the bottom, a few contribute by sinking after death from the higher regions of the superincumbent water (teeth of fishes and shells of Pteropods), and others are brought by currents from littoral regions (bones of Manatee, fragments of littoral plants).

The *Vertebrates* are represented by the bones of the Manatee, chiefly fragments of the ribs. These are quite abundant, no less than ten or twelve casts of the dredge having brought them up, generally several pieces at a cast. Until we are better acquainted with the set of the currents on the west coast of Florida and the coast of Cuba, the former *habitat* of these animals cannot be guessed at with much certainty, as their carcasses, either floated out of the estuaries of those coasts, or when very numerous, as they evidently were, the animals may have been in the habit of migrating across the straits, and may have been frequently destroyed by sharks on the passage. As no fresh addition of these bones is now made to the bottom, nor has been since these coasts have been settled upon by white men, we have a proof that the deposit due to other causes is very slow, since the dredge finds the bones still lying loose on the bottom.

The other vertebrate remains are teeth of sharks and eggshells of skates. Living fishes were obtained in only two instances at about 100 fathoms: one was a Phycis; another, a small fish of the Lophioid family, not yet determined.

The *Crustacea* are rather abundant, but, the specimens not having been fully examined, we can only give now an imperfect list of the genera represented: *Stenorhynchus*, *Inachus*, *Amathia*, *Pisa*, *Mithrax*, *Lupa*, *Ethusa*, *Pilumnus*, *Dromidia*, *Eupagurus*, *Paguristes*, *Galathea*, *Thysanopoda*, *Alima*, *Caridine*, &c.

Of the *Mollusks*, the most abundant in individuals are the Brachiopods, particularly *Terebratula cubensis*, Pourt. (Bulletin Mus. Comp. Zoöl. No. 6), of which over 1,200 specimens were collected, and *Waldheimia floridana*, nov. sp., a little less common. The *Terebratulina Cailleti*, common on the coast of Cuba, was found very rarely on the coast of Florida, and always dead. The Gasteropods are more numerous than the Acephala, but, as well as the latter, are represented by small species. The largest ones are the *Voluta junonia*, and a *Trochus* of about the same size. As the Mollusks of the collection have not yet been determined, a list of the genera must suffice for the present: *Murex* (2 species), *Fusus*, *Nassa*, *Pedicularia*, *Cassis*, *Dolium*, *Pleurotoma*, *Voluta*, *Marginella*, *Natica*, *Vermetus*, *Trochus*, *Monodonta*, *Delphinula*, *Scissurella*, *Fissurella*, *Rimula*, *Emarginulina*, *Pileopsis*, *Dentalium*, *Chiton*, *Marsenia*, *Eolis*; — *Cucullea*, *Pectunculus*, *Nucula*, *Leda*, *Lucina*, *Mactra*, *Neæra*.

The only ones among these abundant in individuals are a Pleurotoma, a Marginella, a Vermetus, a Monodonta, and a Cucullea.

Bryozoa are also frequent in individuals; but there are less species apparently than on the coast of Cuba in similar depths.

The *Radiates* form perhaps the most interesting part of the collection, being represented in many cases by new or little known genera. The Echinoderms have not yet been determined, with the exception of the Holothurians, of which only three species are found; one of them, *Cuvieria operculata*, nov. sp., is tolerably common; the others are a *Thyonidium*, and another which the imperfection of the specimen has not allowed us to recognize with confidence. Of *Echinida* there are five or six species, of which a *Cidaris* is very abundant, and an *Echinus* rather common. Both are new species, and the immature specimens found on the coast of Cuba, and referred to *Cidaris annulosa* and *Tripneustes ventricosus*, in the Bull. Mus. Comp. Zoöl. No. 6, belong in reality to them. The genera *Echinocyamus*, *Amphidetus*, and a new genus near *Parasalenia*, are also represented. The *Asteridæ* are also represented by several new forms of *Ophidiaster*, *Pteraster*, *Asterias*, and *Luidia*, and among the Ophiurians of genera near *Asteroschema*, *Asteroporpa*, and *Astrophyton*. The *Comatula Hagenii*, Pourt., is found in great abundance. The Gorgonians and Corals will be described at the end of this paper. They belong to the following genera: *Nephthya*, *Primnoa*, 2 sp.; *Gorgonia*, 2 sp.; *Acis*, *Antipathes*, 3 sp. *Cœnocyathus*, *Paracyathus*, *Thecocyathus*, *Rhizotrochus*, *Lophohelia*, *Allopora*, *Distichopora*, *Errina*, *Thecopsammia*, n. gen. 2 sp.; *Diaseris*, *Haplophyllia*, n. g. *Pliobothrus*, n. g.

It will be remarked that among the Corals the families of Madreporidæ and Astræidæ are entirely unrepresented, whilst the greater number belong to the families of Caryophyllidæ and Oculinidæ, as defined by Milne-Edwards, or, as we believe, to a new family to be separated from the Oculinidæ, and called Stylasteridæ.

The Sponges are found in this region in numerous forms; they are in general very abundantly provided with siliceous spicula, so much so as to be unpleasant to handle.

The third and last region is characterized by the great Globigerina deposit. No trace of Vertebrates is found here, the accidental remains being probably soon buried in the soft bottom. But other branches of the animal kingdom are still represented as deep as 517 fathoms, beyond which limit we had no occasion to dredge. The Crustaceans are confined to a few small and peculiar forms of Pagurians inhabiting shells of Dentalium and Pteropods. Annelids appear to be comparatively abundant and varied. Of living Mollusks only three species were obtained, — a *Phorus*, a *Dentalium*, and a *Limopsis*, the two latter more numerously; and of dead shells, Pleurotoma, Rimula, and Neæra, besides several kinds of Pteropods, not inhabitants of the bottom. The Radiates comprise a few small *Ophiurians*; *Bourgueticrinus Hotessieri*, D'Orb. (which will be described further on); *Primnoa*, *Gorgonia*, *Chrysogorgia*, *Acanthogorgia*, *Isis*, *Mopsea*, *Caryophyllia*, *Stephano-*

phyllia, and dead fragments of some of the Corals of the preceding region. Sertularians and Sponges are also found sparingly.

A few general remarks on the deep-sea Fauna may not be inappropriate. First, with regard to dimensions: almost all the species are of small size, compared with the allied forms of the littoral and shoal-water regions in general; the Voluta junonia, the largest shell found, is small for that genus. The only exception is an Echinus, which is nearly of the average size, and an Actinia. The prevailing colors are white, pink, — sometimes playing into orange, — and a pale green. Blue was only seen in a small incrusting Sponge. What proportion of light reaches a certain depth we shall try to determine during our next exploration. It is certain, however, that the deep-sea animals have generally well-developed eyes, larger if anything than those of their congeners of shallow water.

It is rather a matter of surprise to find so great a difference between the Fauna of similar depths on the coasts of Cuba and of Florida, separated as they are by a strait of no great width, and bathed by the same current. The few dredgings obtained on the former coast do not allow us to draw conclusions from the absence of Florida species, but they give still more weight to the inverse. Thus, to restrict our remarks to the Corals, — more carefully studied than the other classes, — of ten species of true Corals from Cuba described in the preceding number of this Bulletin, only two have been found on the Florida coast, and they only in very rare fragments. Something may be due to the gregariousness of Corals in certain spots and their rarity in others. The dredge may come up full of a certain species at one time, and it may never be found again, even in close proximity. This happened to us with regard to Lophohelia affinis, n. sp. The botanist is familiar with such instances among land plants.

We hoped to give in this paper a full catalogue of the species collected; but as time is insufficient, it is thought best to publish the following descriptions as far as completed, and, as the dredgings are to be continued throughout the straits of Florida, the descriptions of the other species will be reserved for a more extended final work.

I take this opportunity again to acknowledge the help I have received from Professor Agassiz in the way of advice and of facilities afforded to me in the Museum of Comparative Zoölogy.

Description of Species.

Waldheimia floridana Pourt.

Shell ventricose, triangular, smooth, wider than long, the widest part being across the front; horn-color. Both valves very convex, the larger one with a shallow longitudinal sinus near the front. Lateral margin of larger valve convex, frontal margin angularly sinuous, and deeply indenting the smaller valve in the middle. Front straight and flattened. Beak prominent and compressed laterally, with a round and rather large foramen. Deltidium small, in two pieces. Loop very long, reaching nearly to the frontal margin of the shell, formed of very thin crura, and a very broad ribbon-shaped reflexed portion. Septum well developed. Lines of growth distinct. Length of shell $\frac{7}{8}$ of an inch, breadth 1 inch.

Very young specimens are flatter, rounder, and have a straight margin; they could scarcely be distinguished from the young of Terebratula cubensis, if it was not for the loop and septum seen by transparency. There is also some variety of form in the old; in some specimens the length is greater than the breadth, and there is considerable diversity in the sinuosity of the frontal margin.

This species is quite common off the Florida reef, between 110 and 200 fathoms, on rocky bottom; it is always associated with Terebratula cubensis, the latter being still more common (in the proportion of about three to one), and making its first appearance in 100 fathoms.

Cuvieria operculata Pourt.

Body oval, flattened, covered with finely and sparsely granulated scales, very compactly imbricated, but overlapping very little except near the mouth and anus. A double row of suckers surrounds the soft abdominal disc, those of the outer row perforating the marginal plates; sometimes two or three suckers indicate a tendency towards a median row near the anterior end. Ten tentacles, of which two are much smaller than the rest. Œsophagial ring of ten pieces shaped like the letter T. The aperture through which the head and tentacles are retracted is closed by five large triangular plates, alternating with and covering five narrow, tooth-shaped ones. In the young the five plates form a very regular pentagonal shield. In the old they close less accurately, and their outside edges are covered by some overlapping body plates. The anus is closed in the same way, but the plates are much less regular or constant.

Length $1\frac{1}{4}$ inches; breadth $\frac{3}{4}$ of an inch. Color light gray.

Not uncommon; in 120 to 150 fathoms off Sand Key.

Thyonidium conchilegum Pourt.

Body very flaccid. Eighteen to twenty tentacles of unequal size, very little ramified, short, with conical papillæ; they are quite difficult to count, as some of them are so small that they may be mistaken for lobes of the larger ones. Suckers in five double rows, with others scattered between. The outer layer of the very thin skin contains a large number of calcareous bodies of the usual type; the base being a square plate with more or less rounded corners, perforated by a round central hole surrounded by eight smaller ones, those at the corners being smaller than those corresponding to the sides of the square. From this plate rise four cylindrical processes, converging towards and supporting a small spiny plate, which projects on the surface of the skin like small warts. These bodies are also plentiful in the suckers up to the terminal disc. In the muscular subcutaneous layer there are patches of smaller bodies formed of agglomerations of round granules. Œsophagial ring provided with retractor muscles, and composed of ten pieces alternately in the shape of a broad letter X and a thin letter T loosely connected. Anus unarmed. Color white, hyaline. Length 2 or 3 inches.

This animal covers itself with shells of Pteropods, particularly those provided with points, one of which seems to be held by every sucker of the body.

It is probably closely allied to T. pellucidum of the northern seas. Not being able to compare specimens, I base this species chiefly on the difference of the number of perforations in the calcareous plates of the skin, the T. pellucidum having four large holes surrounded by twelve smaller ones.

Bourgueticrinus Hotessieri D'Orb.

Several specimens of a living Crinoid were obtained by dredging in 237, 248, and 306 fathoms off the Samboes and off Sand Key, in a bottom of Globigerinæ and other deep-sea Foraminifera. They undoubtedly belong to the genus Bourgueticrinus, as defined by D'Orbigny. I refer them provisorily to the species named above, founded on some small fragments of the stem discovered in the recent breccia of Guadaloupe, which contained the well-known human skeleton now in the British Museum. D'Orbigny gives it as his opinion that his species is probably still living in the West Indian seas; but his figures are insufficient either to prove or disprove the identity of our species with his. A comparison with his specimens even would leave the matter in doubt. It is to be hoped that further researches in the Guadaloupe formation will bring to light specimens perfect enough to settle the question.

The following description is not as full as could be wished, as the specimens are not numerous or perfect enough to warrant a complete dissection.

The *calicle* is in the shape of a regular elongated inverted cone. It is composed of a cycle of elongated basal (pelvic) pieces, followed by the much shorter first radials (costals) alternating with them. These pieces are all so intimately connected with each other that the sutures are seen with difficulty. The surface is perfectly smooth. The first brachials are flat and square, and connected laterally by a membrane. The arms generally break off between these and the second brachials, and the first might therefore be called second radials, as they in a measure contribute to the formation of the calicle; still, as they are movable on the first radials, and similar in shape to the next two joints, it is more natural to name them as we have done. The next two joints, or second and third brachials, are similar, and but little smaller than the first. The arms contract suddenly at the fourth brachial; they are five in number, simple, and composed of forty joints, every pair of which forms a syzygium. The pinnules arise from the side of the upper joint of each syzygium, alternately on one side and on the other. There are none, however, on the four or five first syzygia. The inner side of the arm is channelled, and the middle of the channel is protected by a row of very thin alternate scales.

The *pinnules* are composed of from ten to fourteen somewhat imbricated plates, of which the first two are narrower than the subsequent ones. The inner side is provided with a row of rounded alternate scales similar to those on the inside of the arms.

The *stem* is composed of a variable number of joints; our largest specimen having fifty-nine and the smallest but thirty. The generic character of having the joints flattened at their two ends in planes alternately at right angles to each other is well marked, particularly near the root; it is less apparent near the calicle, though this conformation may still be recognized to within half a dozen articulations of it; the last joints are sensibly round. The length of a joint is on the average about three times its diameter, except the four or five joints preceding the calicle, which are much shorter. The joints are connected by a ligament passing through the central canal, also by two strong ligaments lodged in parallel oval cavities in the articulating surfaces, and finally by a membrane along the edge. This threefold connection is so strong that by applying force it is more easy to break through the body of the joint than to disconnect the articulation.

The *root* is variable; sometimes all its ramifications start from a single joint, whilst in other specimens some five or six joints send out roots from their upper compressed edges. Each root promptly subdivides into a large number of rootlets; the whole is formed of articulated joints, which become much elongated as they become thinner.

The stem and the outside of the calicle are covered with a rough brown skin, which, under the microscope, presents the appearance of a rough, corrugated reticulation. It contains thin calcareous plates without definite shape, and is very liable to fall off. No muscular fibres could be detected under it. J. Müller denies the power of voluntary motion to the stem of Pentacrinus, on account of the total absence of muscles. In Bourgueticrinus the stem has indeed no great flexibility, but the complication of the ligaments of the articulations, and the hinge-like arrangement of the latter in two alternate directions would seem unnecessary if the motion is to consist merely in a passive swaying to and fro with the oscillations of the water.

Two specimens have, in place of a calicle, a small conical button, composed of two or three joints. I am not prepared to say whether this is an undeveloped form, or the result of an effort to reproduce a lost head.

The length of the largest stem obtained is $5\frac{1}{8}$ inches, exclusive of root and calicle. The smallest and most complete specimen has a stem measuring only $1\frac{1}{2}$ inches. This specimen has three small stylifers adhering to the outside of its calicle. Small round holes, bored probably by these parasitic mollusks, can be seen also on the calicles of some of the other specimens.

Nephthya nigra Pourt.

Corallum rising from a membraneous expansion, and forming several small tufts of elongated, costate cells, densely grouped. Every part filled with spicules; those of the polyp-cells being long, fusiform, and particularly numerous in the costæ of the cells. Every corallum bears from 150 to 200 polyps. Height 1 inch; color black. Rather common off Sand Key, Florida, from 120 to 152 fathoms.

Primnoa verticillaris Ehrbg.

I refer to this species several branches eight or ten inches long, obtained in 120 fathoms, off Sand Key, Florida. Compared with specimens from the Azores, in the Mus. Comp. Zoöl., some slight differences in the length of the calicles and size of the scales were noticed, but they are not deemed sufficient to warrant a specific separation.

Primnoa trilepis Pourt.

Branches irregularly and sparsely dichotomous, subflabellate. Branchlets very thin and flexible. Calicles in verticils of four, or more generally five, formed of three large cylindrical scales, joined angularly to each other, like the elbows of a stove-pipe. Aperture closed by eight triangular scales. The distance between the verticils is equal to or a little less than the length of the single polyps. The cœnenchyma is very thin, and covered with irregular imbricated scales. Axis hard and brittle, brown in the thicker branches and yellow in the younger. By its simplified scales, this species makes an approach to the genus *Calyptrophora*, Gray.

A few small branches, five or six inches long, were obtained in 324 fathoms off the Florida reef.

Gorgonia miniata Val.

A small dark crimson Gorgonian, obtained between 100 and 200 fathoms, may perhaps belong to this species. A comparison of the specimens could alone decide, as the description is rather scanty.

My specimens are 3 or 4 inches high, subflabellate; branchlets somewhat flattened at the end. Polyps in two rows, on moderately prominent verrucæ, more closely set than in *G. exserta*. Cœnenchyma rather thick, with fusiform spicules.

Gorgonia exserta Ellis and Solander.

The same Gorgonia which was obtained in the preceding year on the coast of Cuba, and referred to this species, was also brought up from 324 fathoms on the coast of Florida. Having no specimens for comparison, I do not feel quite sure of the determination.

Acanthogorgia hirta Pourt.

Corallum branching irregularly, subflabellate. Stem and branches of about equal thickness. Branchlets flattened and expanded at the end. Cœnenchyma covered with rough fusiform spicules, the upper end of which is free, and raised in the shape of small spires. Verrucæ rather distant on the stems, more numerous towards the ends of the branchlets, irregularly alternate, prominent, lobed, somewhat spinous. Polyps large, filled with long spicules, arranged in a regular pattern, being horizontal near the base, and at length in eight vertical rows, not as long as in most other species. Height about 4 inches; color gray. Dredged in 324 fathoms off the Florida reef.

This species differs from *A. aspera* Pourt. by its thicker stem and branches, less prominent, though thicker, verrucæ, and larger polyps with shorter spines.

Chrysogorgia Desbonni Duch. and Mich.

The specimens obtained by me in 324 fathoms appear to be more loosely branched, and to bear more numerous polyps, than the species to which I provisorily refer them. The figure given by the above authors is too deficient in details for a conclusive comparison.

The cœnenchyma is very delicate, filled with irregular scales, not imbricated. The sclerenchyma is rather brittle, smooth, yellow, of metallic appearance, resembling brass wire. The polyps are alternate, subpedunculate, numerous, though not contiguous, covered with scales like those of the stem, and closed by eight blunt lancet-shaped scales.

Acis solitaria Pourt.

Corallum never branching, five or six inches long. Cœnenchyma thick, covered with large, elongated, flat spicules, which become smaller and converging on the not very prominent verrucæ. Polyps in two rows, rather closely set; a few scattering ones out of line. No longitudinal furrow. Length 5 or 6 inches; color whitish.

In 200 fathoms.

Isis flexibilis Pourt.

Irregularly branching, subflabellate; branches very long and slender; calcareous joints cylindrical, nearly smooth, or with a few faint striæ, about four times as long as the corneous ones in the thicker branches, but proportionally much longer in the branchlets. Polyps rather thickly set, generally alternate, short, campanulate, armed with short spines. The thickest stems about $\frac{1}{16}$ of an inch in diameter, the branchlets not much thicker than horsehair; the main stems were not obtained. Color dark brown, from a thin cœnenchyma covering the younger branches.

In a few instances the branches appear to arise from the corneous joints.

In 324 fathoms off the Florida reef.

Mopsea eburnea Pourt.

Arborescent, slender, dichotomous. Calcareous joints long, cylindrical, faintly striated, seldom quite straight, not swollen at the ends. Corneous joints very short. (In one case a long straggling branch entirely corneous has grown from a calcareous joint, and bears four polyps.) Polyps scattered, bright orange, generally arising from the calcareous joints, but also, occasionally, from the corneous ones, surrounded by a spirally twisted bundle of strong spicules, of which eight longer ones project around the tentacles. The latter are pinnate, and strengthened in their whole length by a chain of blunt cylindrical spicules. The color of the whole corallum, with the exception of the corneous joints and the polyps, is pure white.

A fine specimen, 4 inches high, was obtained in 517 fathoms off Sombrero Light, Florida! — The diameter of the thickest part is $\frac{1}{16}$ of an inch; the root was not brought up.

Antipathes tetrasticha Pourt.

Corallum a simple stem, pinnate; the branchlets alternate and double, i. e. two branchlets starting from the same spot at an acute angle, thus forming four rows, two on each side of the main stem. Towards the base one of the branchlets of a pair is frequently abortive. Sclerenchyma black, nearly smooth, showing short spines only under the magnifier. No successive swellings on the branchlets as in *A. filix* Pourt. Polyps small. Height of the corallum 3 or 4 inches.

In 116 and 120 fathoms off Sand Key and the Samboes, Florida.

Antipathes sp.

Fragments of a very slender species were obtained off Sand Key in 26 fathoms, but not sufficient for identification. They are as thin as horsehair, and less, with short blunt spines, and small distant polyps.

Antipathes sp.

Irregularly branching, loosely subflabellate; sclepenchyma black, with very short and scarce spines. Polyps large, as in *A. arborea*, Dana.

Of this species, fragments were dredged up in 195 and 324 fathoms, presenting no very characteristic features in its mode of branching. I shall postpone its identification until an opportunity offers of comparing it with specimens of some of the other described species from the West Indies.

Caryophyllia cornuformis Pourt.

Corallum simple, conical, always regularly curved, distinctly but faintly costate. Calicle circular, rather shallow. Septa very little exsert, thin, and somewhat wavy; in six systems of four cycles. Pali opposite the secondary septa only, sometimes twisted. Columella of one or two twisted processes. Height $\frac{1}{4}$ of an inch; diameter of calicle $\frac{1}{8}$ of an inch. Dredged in 237 and 248 fathoms off Sand Key and the Samboes, Florida, on a bottom consisting of Foraminifera.

This species resembles a Ceratotrochus more than a Caryophyllia, but the single row of pali separates it from the latter genus.

All the specimens obtained have the base broken and apparently decayed, even when living, so that they are probably free when adult. One of them, still alive, was attached to the shell of a Xenophorus by the convex part of its wall.

Cœnocyathus vermiformis Pourt.

Corallum very elongated, cylindrical. Costæ indicated only by lines of very flat tubercles. Calicle circular, shallow. Septa rather thick, flexuose, not exsert in six systems of three cycles. Pali thick, flexuose, in front of the secondary septa. Frequently one of the systems remains incomplete, and there are then only five pali. Columella of a single twisted lamellar process. The older parts of the corallum are nearly filled up by the thickening of the septa, but the process is never carried out to a total obliteration of the chambers, which can be traced in the shape of slender canals to the very base. Height 1 to $1\frac{1}{2}$ inches; diameter $\frac{1}{16}$ to $\frac{1}{10}$ of an inch.

This small coral is easily mistaken for a tube of an annelid; it is placed in the genus Cœnocya thus, although I have no decided proof of its propagation by budding; in only one case have I found two corallites rising from a common base.

Dredged in 150 to 180 fathoms off Sombrero and Bahia Honda, Florida.

Paracyathus confertus Pourt.

Corallum turbinate, pedicellate. Costæ distinct to the base, not prominent, granulated. Calicle oblong, concave. Septa crowded, thin, entire, slightly exsert, in five cycles, but with considerable irregularity in some of the systems. Pali numerous, difficult to distinguish from the papillæ of the columella.

It resembles *P. De Filippii*, Duch. and Mich., but has a more contracted base and a more elongated calicle.

Rather rare in 50 to 100 fathoms off the Florida reef.

Thecocyathus cylindraceus Pourt.

Corallum attached by a broad base, short, cylindrical. Costæ generally visible through the epitheca which reaches to the border of the circular calicle. Fossa shallow. Septa entire, slightly sinuous, granulated, not exsert, forming six systems of four cycles; one of the systems often incomplete. Pali thick, with sinuous surfaces, fronting all the septa but those of the fourth and fifth order; those of the second order largest. Columella thick; formed of seven or eight papillose processes. Height $\frac{1}{2}$ to $\frac{3}{4}$ of an inch, diameter about $\frac{3}{8}$ of an inch.

Not rare between 100 and 200 fathoms off the Florida reef.

Rhizotrochus fragilis Pourt.

Corallum simple, pedicellate, straight or slightly curved, regularly conical. Calicle subelliptical, deep. Six complete systems of septa, four cycles. Septa very thin, not exsert, finely granulated; those of the first and second order meeting in the centre, and united for about half their height. Costæ not prominent. From the costæ of the second order rudimentary hollow roots arise in pairs at about one third or one half the height of the corallum, and descend along the pedicle to its foot; they are never detached. The wall and the septa are very thin and fragile. Height 1 inch; greater diameter $\frac{3}{4}$, smaller $\frac{1}{2}$ of an inch.

The color of the polyps is generally greenish, sometimes pale brick red.

Dredged in considerable number from 91 to 324 fathoms off the Florida reef; most abundant about 120 fathoms. It is frequently found growing on a living Cucullæa, much smaller than its parasite.

Oculina disticha Pourt.

Mode of branching unknown. Branchlets slender, with alternate calicles, distant about one diameter from each other. Costæ giving a plicated appearance to the border of the slightly prominent and moderately deep calicles. General surface faintly striated. Septa of the first and second order well developed, those of the third rudimentary, all finely granulated and dentate. Pali fronting the septa of the first and second order. Columella formed by one or two papillæ.

A few dead branchlets only were obtained in 43 fathoms off the American shoal, Florida. They bear a general resemblance to the fossil *Diplohelia raristella*, but the presence of pali prevents the generic association of these corals.

Diplohelia profunda Pourt. (Bull. Mus. Comp. Zoöl. No. 6.)

A few small pieces of this coral were obtained in 324 fathoms off Bahia Honda, Florida. They are in rather a decayed condition, like nearly all the specimens of this species that I have ever seen.

Lophohelia affinis Pourt.

Corallum branching irregularly, sometimes coalescing; the polyps budding in alternate series from the border of the calicle. Surface smooth, or very finely granulated. Calicles very deep. Septa smooth, entire, exsert. Systems unequal. No columella. Color white; polyps flesh-colored, with about twelve club-shaped tentacles, hiding the mouth when contracted. Dredged in some quantity in 195 fathoms off Coffin's Patches, Florida, but no trace of it was found in the numerous other dredgings in the vicinity.

I am unable at present to distinguish this coral from *Lophohelia prolifera* Edw. & Haime (*Madrepora prolifera* Pallas), except that the latter has the calicles a little less expanded, as figured by Ellis. It is rather singular that the largest coral of northern Europe has never been figured since Esper, whose representation is much inferior to Ellis's.

Stylaster erubescens Pourt.

Branching densely, flabellate, not coalescing; younger branchlets slender, with rather dense alternate calicles; older branches much thickened with calicles in irregular rows on one surface, interspersed with ampullæ. Cœnenchyma smooth. Calicles slightly prominent, about $\frac{1}{30}$ of an inch in diameter, deep. Septa nine to twelve, most commonly eleven, equal, shaped like folds of the wall, joined with each other at a little distance below the edge of the calicle, and thus forming pitlike interseptal chambers. Each one of these chambers encloses a small secondary septum in the shape of a dense vertical fringe of small points resembling hairs, which, when seen foreshortened from above, appears like a small columella.* Columella deep sunk, rounded, and hirsute. Color white, with a delicate pink blush when fresh. Dimensions, 4 to 6 inches in length and breadth of flabellum. Rather common between 120 and 324 fathoms off the Florida reef.

Some of the branches are thickened and hollow, with openings near the end; and the cavities are inhabited by annelids, as has also been noticed by Professor Verrill, in *Allopora californica*. In our specimens the tube seems to be entirely formed by the coral, the annelid contributing nothing himself.

Allopora miniata Pourt.

Corallum branching, flabellate, the main trunk rather massive and flattened. Surface finely and sharply granular. Branchlets thick and obtuse. Calicles irregularly but densely distributed on one surface of the branches, becoming obsolete on the main trunk. Small ampullæ abundant between the calicles on the younger branches. Calicles slightly prominent about half a line in diameter, fossa deep, columella spherical, deeply immersed, hirsute. Septa from seven to ten, generally eight, formed as in *Stylaster erubescens*, but the enclosed secondary septa are much larger and distinct, giving the appearance of a calicle surrounded by a number of smaller ones, all provided with columellæ. The edge of the calicle and of the folds is crowded with small sharp points.

The branches seem to have grown in a horizontal trailing manner, as the lower surface often shows signs of contact with foreign bodies.

Color brick red; length, 5 or 6 inches; breadth, 3 or 4 inches. Dredged in depths from 100 to 324 fathoms off the Florida reef, not as frequently as *Stylaster erubescens*.

This species is the most massive of our deep-sea corals; it undoubtedly belongs to the genus Allopora as defined by Milne-Edwards & Haime, if

* This arrangement is particularly apparent in *Allopora miniata* next described, where it was first noticed. It is very distinct also in *Stylaster complanatus* Pourt. I have seen it also in *St. roseus*, Edw. & Haime, *elegans*, Verrill, *tenuis*, Verrill, and *Allopora californica*, Verrill (very distinct); but I failed to see the small septum in *Allopora bella*, Dana, where it is probably more deeply seated, as is the small columella. The character of closed interseptal chambers, containing or not small secondary (or tertiary?) septa, being so general, I see no necessity for separating the genus *Cyclopora*, Verrill, from the true *Stylasters*. This character, furthermore, unites still more closely the genera *Stylaster* and *Distichopora*; in *Errina*, also, the pores mistaken by Gray for calicles are probably only interseptal chambers, soon separated from the calicle by the irregular growth of the cœnenchyma.

we leave out from their generic characters the absence of ampullæ. The two genera Stylaster and Allopora are, however, very closely allied, and in very young specimens the difference in the mode of germination is hardly to be distinguished.

Distichopora foliacea Pourt.

Corallum branching, flabellate, much compressed, finely striated and granulated. The calicles in a somewhat irregular row a little on one side of the edge, which is sharp and finely serrated. One of the rows of lateral pores on the summits of the denticulations, the other not well defined, represented by scattered tuberculated pores. The plane towards which the calicles are situated is thickly studded with ampullæ, each of which has a small lateral opening. They are less numerous on the other surface. Columella deep-seated, but long, hirsute, in the shape of a pointed club. Color orange pink. Height about 2 inches; breadth of the branches about $\frac{1}{4}$ of an inch; thickness $\frac{1}{20}$ of an inch.

This species differs from *D. sulcata* Pourt., from the coast of Cuba, by its smaller calicles not placed in a furrow, irregular lateral pores, and serrated edge.

Dredged rather frequently between 100 and 200 fathoms off the Florida reef.

Errina cochleata Pourt.

Of the two species of Errina found quite abundantly on the coast of Cuba, only this one is found on the Florida side, and that is exceedingly rare, only one small specimen having been obtained in 183 fathoms off Sombrero Light-house.

Balanophyllia floridana Pourt.

Corallum elongated, conical, straight, pedicellate. No epitheca; wall porous, costate to the foot. Calicle rather deep, elliptical. Septa entire, slightly exsert, finely granulated, in six unequal systems of four cycles, with rudiments of the fifth in some of the systems. The septa of the fourth cycle, bent and united in front of the tertiaries, and protracted as one septum to the columella, which is flattened and papillose.

The polyps are red; the mouth very oblong; height about 1 inch; longer diameter $\frac{1}{2}$, shorter $\frac{3}{8}$ of an inch.

Dredged in abundance off Sand Key, Florida, in 26 fathoms. I refer also to this species some dead and worn specimens obtained off the coast of Cuba in 270 fathoms.*

* A *Dendrophyllia* was also obtained in the same dredging off the coast of Cuba, but too much worn to be identified or described.

Genus Thecopsammia Pourt.

Corallum simple, attached, without costæ, covered with a complete epitheca. This genus is intermediate between Balanophyllia and Heteropsammia; like the latter, it is destitute of costæ, but it has an epitheca like some of the Balanophyllia, but still more developed.

Thecopsammia tintinnabulum Pourt.

Corallum subcylindrical, or almost hemispherical, with turbinate base and small, abruptly constricted peduncle. Wall thick, very porous and vermiculated. Epitheca well developed, seldom rising quite to the border of the calicle, its tissue penetrating the mural pores and solidifying the wall. Calicle slightly elliptical, moderately deep. Septa in six unequal systems and four cycles, entire, thin, not exsert, covered with fine granulations; those of the fourth and fifth order scarcely bent towards those of the third, and not connected with the latter or with each other. The septa of the first and second order connected with the columella. The two opposite systems on the longer sides of the calicle always incomplete in one of their halves; and one or two of the other systems also sometimes incomplete in the same manner. The columella is papillose and porous, sometimes sublamellose, and forms three indistinct masses in the adult, of which the middle one is largest.

Height $\frac{3}{4}$ of an inch to an inch; longer diameter of calicle about $\frac{1}{2}$ an inch, shorter about 0.44. Common between 100 and 300 fathoms off the Florida reef.

The mouth of the polyps is elongated, and surrounded by not very numerous conical tentacles; the color, when living, is a handsome pinkish orange.

Thecopsammia socialis Pourt.

Corallum turbinate, rather long conical, with a thick, not constricted, peduncle frequently attached to each other. Wall and epitheca as in the preceding species. Calicle elliptical, fossa moderately deep. Septa entire, smooth, crowded, not exsert; thick, near the wall. Five cycles of septa in six unequal systems. The septa of the fourth cycle bent towards each other, and meeting in front of those of the third, in the deeper part of the calicle (only visible in a horizontal section). The septa of the sixth and seventh order appear only in a few of the systems in old specimens; they become larger than those of the preceding cycle; the tertiaries generally remain the smallest of all. The columella is papillose and porous, though more compact than in the preceding species, and nearly always forms three distinct masses, of which the middle one is largest.

Found in the same depths as the other, but more common towards Sombrero than near Sand Key.

Stephanophyllia folliculus POURT.

Corallum free, without mark of adherence, purse-shaped, or broader at the base than at the calicle. Costæ broad, granulated, nearly meeting at the apex, the primary ones continuous, the tertiaries uniting with the secondaries. Intercostal furrows narrow. Calicle circular or subhexagonal, slightly concave. Septa in six complete systems of three cycles, covered with large papillæ, not exsert. The primaries and secondaries meet in the centre with each other, and with an indistinct columella; the tertiaries connect with the secondaries at about half the length of the radius.

Height 0.12, diameter of calicle 0.10, diameter of base 0.11 of an inch. Dredged in 237 fathoms off the Florida reef.

I refer this coral, of which I have but one specimen, to the genus Stephanophyllia with some doubt. It has most of the characters of the genus, except the discoid shape. It is, most likely, a very young specimen.

Diaseris pusilla POURT.

Corallum subelliptical, very fragile. Wall flat or slightly concave, imperforate, very thin, finely costate. Costæ thin, alternatively large and small, finely dentate. The base shows the traces of lobes joined together, often very imperfectly. Septa strongly dentate, laciniate, and perforate, marked with strong ridges and furrows, connected with each other by synapticula near the base. Six unequal systems and five cycles of septa, one or two of the systems generally incomplete. The primary septa more lobed and much higher than the others; those of the lower cycles tending to unite with those of cycles preceding them. Fossa well marked, oblong. Columella rudimentary, in the shape of a narrow ridge. Mouth of the polyp in the shape of a long slit. Color dark brown. Diameter ½ an inch.

Numerous fragments of the living coral were obtained, but it is so fragile that only one was brought up entire. Found in 119 to 143 fathoms off Sand Key.

I suspect from some of the fragments the existence of a second species, with more equal, not lobed septa, and less distinctly costate base, but there is not enough of it for a good description.

The singular Coral next to be described strikes one at first sight by its resemblance to some of the members of the group of the Rugosa of Milne-Edwards & Haime. A closer examination tends to confirm that view, much as it seems improbable to find a living representative of a group so long extinct. In no other division of the corals is the septal apparatus subdivided into systems that are multiples of four; but such is the case in our specimen, though a little obscured by accidental causes. Another, though perhaps less important, character is the smoothness of the septa, which present neither perforations, nor synapticula, nor granulations

Tabulæ, however, there are none, the interseptal chambers being open from top to bottom. Among the Rugosa this character is only found in the family of Cyathaxonidæ, to or near which, therefore, our coral must find its place. From the genus Cyathaxonia it differs in being attached by a broad base, and also by the absence of a septal fossula. The following genus is proposed for its reception : —

Genus Haplophyllia Pourt.

Corallum simple, fixed by a broad base, covered with a thick epitheca; columella styliform, strong, (sometimes double ?) very thick at the base. Interseptal chambers deep, uninterrupted by tabulæ or dissepiments.

Haplophyllia paradoxa Pourt.

Corallum subcylindrical, short, fixed by a broad base; epitheca thick, wrinkled, reaching higher than the calicle, and forming around the latter several concentric circles, as if representing the separated borders of several superposed layers. Calicle circular, fossa deep. Septa smooth, without granulations or perforations, not reaching the border of the calicle; like all the internal parts of the calicle, their surface is like enamel. Columella formed of two smooth conical processes, very thick at the base and tending to fill up the chambers. Eight septa larger, and connected with the columella, alternating with smaller ones, which touch the columella at a much lower level. A further cycle is indicated by small ridges of the wall surface, in some of the chambers. No distinction can be made between primary and secondary septa among the eight larger ones, as they all appear equal. This arrangement seems to be the norm. In the specimen before us, the only one unfortunately, there are disturbances in two of the systems or half-systems (systems if we call the eight larger septa primaries, half-systems if we suppose them equivalent to primaries and secondaries). In one case two of the larger septa are joined by a horizontal plate at the top, thus excluding the intervening chamber from the calicle. This structure is probably abnormal, and the result of an effort to exclude a parasite or other foreign matter. A small supernumerary septum has grown out in the next chamber. Nearly on the opposite side of the calicle, one of the secondary septa (counting eight as primaries) has grown to the size of a primary one, and the adjacent tertiary to the size of a secondary, thus disturbing the symmetry.

Height about ½ an inch; diameter of calicle the same.

This coral was living when obtained; the polyp was of a greenish color, but was not otherwise examined when fresh. After having been in alcohol, it could be lifted out entire from the calicle, presenting an exact cast of the chambers. The mouth is surrounded by a circle of about 16 rather long tentacles, bluntly tuberculated at the tip. Outside the circle of tentacles extends a membranous disc with radiating and concentric folds.

This unique specimen was dredged in 324 fathoms off the Florida reef.

Genus Pliobothrus Pourt.

Tissue more compact than in Millepora; larger pores scarcer, smooth, without any rudiments of septa; smaller pores tubulated; cœnenchyma with still finer linear pores. Form generally branching regularly. Differs from Heliopora by its tissue not being prismatic. I refer to this genus two species described by me as *Heliopora tubulata* and *carinata* (Bulletin Mus. Comp. Zoöl. No. 6), and a third species.

Pliobothrus symmetricus Pourt.

Corallum ramose, rising from an incrusting base and a short trunk, branching into a regular semicircular flabellum. Branches not much divided, cylindrical, and a little flattened and expanded at the tip, which is blunt and rounded. The tendency in branching is towards considerable symmetry between the two halves of the flabellum. Three kinds of pores; very small, linear, over the whole cœnenchyma; larger tubulated, with very minute aperture when unbroken, and larger round or oval ones scattered irregularly. Internal structure somewhat like Millepora, but much coarser. Larger pores interrupted by few but massive tabulæ, but communicating laterally with other canals.

This species is much larger and more branched than *Heliopora tubulata*, and has shorter tubes to the pores.

Color gray; height $1\frac{1}{2}$ inches; spread about three inches; diameter of branches 0.63 of an inch. Not rare between 100 and 200 fathoms off the Florida reef.

Cambridge, Mass., December 8, 1868.

I deeply regret the absence of Count Pourtales from Cambridge at this moment, even though his return to the field of observations which has already yielded him such a rich harvest cannot fail to benefit science in the highest degree. My regret arises chiefly from the fact that he is thus prevented from reaching some conclusions which belong to him by right. But the very day he started on his third journey of exploration in the Gulf Stream, leaving with me the manuscript of this paper for publication, the memoir of Sars on the *Rhizocrinus* of the Lofoten reached me also, and I at once recognized the identity of the *Bourgueticrinus Hotessieri*, described above, with Sars's *Rhizocrinus lofotensis*, — as far as such relations can be predicated without a direct comparison of the specimens. The identity of animals found at great depths in the Gulf of Mexico and on the coast of Norway would show how extensive the influence of the great Atlantic current is in modifying the geographical distribution of organized beings. The close resemblance of these Crinoids will no doubt lead to a renewed comparison of the *Lophohelia affinis* Pourt. and *Lophohelia prolifera* Milne-Edw. & Haime (*Madrepora prolifera* Pallas). It is now highly probable that Pourtales's species is identical with that long known from the northernmost coasts of Europe, and to which it has very likely been transported by the Gulf Stream; and I doubt not that the identity of other species from Florida, in which a close resemblance to northern species has already been noticed, will also prove identical, as soon as an opportunity is afforded for direct comparisons. Thus happily blended with the investigation of the Gulf Stream, the study of the geographical distribution of animals at great depths cannot fail to make rapid progress, now that — thanks to the comprehensive views of the Superintendent of the Coast Survey — it will no longer be left to chance discoveries, but form a part of the systematic work of the Survey. In this connection it becomes highly important to explore the ocean floor in the vicinity of the Bermudas, as those islands form, as it were, a half-way station between Florida and Norway. On the other hand, the discovery of a coral, Haplophyllia, allied to the extinct type of the Cyathaxonidæ, foreshadows unexpected revelations, as soon as the animal population of the abysses of the ocean shall be extensively explored, instead of being obtained from a few localities only.

I may add that the Museum will supply other institutions with specimens of all the species described above of which duplicates were collected.

LOUIS AGASSIZ.

CAMBRIDGE, December 10, 1868.

No. 8. — *Catalogue of the Mammals of Massachusetts: with a Critical Revision of the Species.* By J. A. Allen.

The original design of the present catalogue was simply to contribute a few data concerning the distribution of the Mammals of New England; but in order to explain certain views entertained by the writer in respect to the character of a number of currently received species, many critical notes were gradually incorporated, until finally it was thought best to extend the paper so as also to embrace a systematic revision of the species. The catalogue is based mainly on observations made by myself at Springfield. In its faunal characteristics this locality does not differ much from those parts of the State lying east of the Connecticut River generally. A few species which occur only in the western mountainous portions have been included on data afforded chiefly by the official report on the Mammals of the State by the late Dr. Ebenezer Emmons, but in part as the result of observations and inquiries of my own recently made in that section. Respecting the marine species, I have consulted Captain N. E. Atwood, of Provincetown, a gentleman well known as a reliable observer, and whose forty years' experience along our coast has rendered him very familiar with our larger marine Vertebrata. I have thus been able to add not a little to our knowledge of some of those species least known, and the most difficult to observe, of all our Mammalia. The great obligation I am under for his kind co-operation is fully evident from the valuable notes he has furnished on the Cetaceans. I am also greatly indebted to Professor E. D. Cope, of Philadelphia, to whom I transmitted the notes of Captain Atwood, for kindly identifying the species.

Less attention seems to have been paid by our naturalists to the Mammals of the State than to the Birds, or several of the other classes of our animals. This may be owing to the greater difficulty of observing and procuring the former, arising from either their scarcity or reclusive habits.

The first general scientific notice of Massachusetts Mammalia seems to have been a simply nominal catalogue by Dr. Edward Hitchcock, published in his Report on the Geology, Mineralogy, Botany, and

Zoölogy of the State (pp. 526, 527), in 1833. Forty-five species are there given, including the two Seals and three Cetaceans. To a few only are notes added respecting their relative abundance. Dr. Emmons's first Report, under the Act of the Legislature of 1837 for a Natural History Survey of the State, was published in 1838. In 1840 a second and final Report* was presented, containing the substance of the first, and considerably increased by additions. These Reports contain descriptions of all the land Mammalia then known to inhabit the State, with interesting notes on their habits and distribution, but nothing on the marine. The whole number of species given is forty-four, two of which (*Arvicola hirsuta* = *A. riparia*, and *A. albo-rufescens* = *A. riparia*, albino) were erroneously described as new. Eliminating three that have since been reduced to synonymes (*Condylura macroura*, *Sciurus niger*, *Arvicola albo-rufescens*) leaves forty-one as the number of valid species embraced in this report. The animal now known as *Hesperomys leucopus* Baird was described as *Arvicola Emmonsii* De Kay. On the whole, however, the work is remarkable for its accuracy, and, compared with those of most recent writers, for the small number of merely nominal species it contains.

The only other special treatise on our Mammals is an article by Mr. E. A. Samuels, in the Ninth Annual Report of the State Board of Agriculture,† in which thirty-nine species are described, excluding two merely nominal (a *Blarina* and *Arvicola rufidorsum*), mainly from Massachusetts specimens in the State Cabinet of Natural History; it also contains notes on their habits, and several woodcuts of the animals. Though not assuming to give all the species of the State, Mr. Samuels includes five or six described since the publication of Dr. Emmons's Report, but omits several of that author that are not uncommon in certain sections of the State, as well as all the marine species. In Audubon and Bachman's "Viviparous Quadrupeds of North America" (three volumes, 8vo, 1846–1853) are numerous references to Massachusetts Mammals specimens of which were frequently furnished these authors by our well-known ornithologist, Dr. T. M. Brewer, of Boston. But since the publication of Dr. Emmons's Report, no one, excepting perhaps Dr. Brewer and

* Report on the Quadrupeds of Massachusetts. By EBENEZER EMMONS, M.D. 1840. 8vo. pp. 86. This is the edition cited in the following pages.

† Agr. of Mass., 1861, pp. 137–191.

Mr. Samuels, has done more to increase our knowledge of their history than Mr. J. W. P. Jenks, of Middleboro'. From this locality Mr. Jenks has sent large collections of the smaller species to the Smithsonian Institution, which have been carefully worked up by Professor S. F. Baird in his invaluable Report on the Mammals of North America,* and by Dr. H. Allen in his recent excellent Monograph of the North American Bats.† In the Journal and Proceedings of the Boston Society of Natural History, among the very few notices of our Mammals, is an important paper by the Rev. John Bachman on the Mole Shrews (genus *Scalops*),‡ in which a new species (*S. Breweri*) is described from specimens from this State contributed by Dr. Brewer. In Professor Baird's Report on North American Mammals two species of *Arvicola* (*A. Breweri* and *A. rufidorsum*) are also described as new, solely from specimens from Massachusetts ; the first was collected by Dr. Brewer on Muskeget Island. (On these see remarks beyond.) In February, 1863, Professor A. E. Verrill mentions, in a valuable contribution on the Shrews of New England,§ the first known occurrence of a *Neosorex* (*N. palustris*) in this State.

The more important publications on the Mammals of adjoining States, which in this connection demand a passing notice, are the Rev. J. H. Linsley's "Catalogue of the Mammalia of Connecticut,"‖ Dr. J. E. De Kay's well-known Report on the Mammals of New York, and Professor Zadoc Thompson's notes on those of Vermont.¶ Mr. Linsley's list numbers seventy-one species, embracing the marine and domesticated, and nine that are merely nominal. Removing the latter, the eight domestic, and two ("*Arvicola floridanus* Ord" and "*Phoca grœnlandica?* Mull.") of doubtful reference, leaves fifty-two as the number of valid indigenous and naturalized species (the latter being the three species of *Mus*), ten of which are marine and the remaining forty terrestrial. Two bats (*Vespertilio subulatus* Say and *Scotophilus noctivagans* = *V. noctivagans* Cooper) and one shrew (*Sorex platyrhinus*) are given in

* Pacific Railroad Reports of Expl. and Surv., VIII, 1857.

† Monograph of the Bats of North America. By H. ALLEN, M. D. Smithsonian Miscellaneous Collections, June, 1864.

‡ Proc., Vol. I, p. 40, 1841; Journ., Vol. IV, p. 46, 1842.

§ Proc. Bost. Soc. N. H., Vol. IX, 164.

‖ Am. Journ. of Science and Arts, XLIII (Oct. 1842), pp. 345 – 354.

¶ History of Vermont, Natural, Civil, and Statistical, etc. By ZADOC THOMPSON. 8vo. Burlington, 1842, and Appendix, 1853.

addition to the land animals described in Professor Emmons's Massachusetts report, while two of Emmons's *Cervidæ* and the Wolverine are very properly omitted.

Dr. De Kay's Report, which appeared but a few months later than Linsley's Catalogue, gives seventy-eight species as either actual or former inhabitants of the State of New York, including, in addition to the domestic and marine species of Linsley's list, five fossil species. No new ones are added, though several are described as such, and several previously well known are separated from their supposed distinct European allies and receive new names. Two species given by Linsley for Connecticut ("*Arvicola floridanus* Ord" and "*Phoca grœnlandica?* Mull.") are rightly omitted, and others, including the Opossum (*Didelphys virginiana*), added. This is a southern species which has not yet, so far as I can learn, been detected east of the Hudson. Deducting the nominal species and those of doubtful reference, nine in number, and the eight domestic and five fossil, leaves fifty-six as the number of living valid ones, forty-six being land and ten marine. This is an excess of four only, — two bats and two very small species of shrew, — excluding the marine and the extra-limital *Didelphys virginiana*, over the number given by Dr. Emmons for Massachusetts.

Professor Thompson's Natural History of Vermont, published at about the same time, contains forty-three valid species, with descriptions of them drawn up mainly from Vermont specimens, and short general accounts of their habits. It embraces but one or two species not given in Dr. Emmons's report, one of which is the common Seal (*Phoca vitulina*). A single specimen of this is reported to have been captured on the ice in Lake Champlain, and in the Appendix, published in 1853, another similar instance is recorded.

The present catalogue embraces sixty-five species, giving for the first time a probably nearly complete list of the marine, the Seals and Cetaceans. The latter are now supposed to number eighteen species. Four land species (*Scotophilus georgianus*, *Scalops Breweri*, *Neosorex palustris*, and *Arvicola pinetorum*) are also added, that are not mentioned by either Dr. Emmons or Mr. Samuels, or by either of the extra-limital authors mentioned above.

In Massachusetts, as far as Mammals and Birds are concerned, portions of two Faunæ are represented,— the Canadian and the Alleghanian ;

the former occupying a large part of Berkshire and most of the western half of Franklin, Hampshire, and Hampden Counties, or those portions of the State having an elevation of and above fifteen hundred feet above the sea ; the latter the remaining and by far the larger portion.*

The recent or historic changes that have occurred in the Mammalian Fauna of the State consist mainly in the decrease in numbers of the larger species, amounting to a complete extirpation of a few of the large Carnivora and Cervidæ (*Felis concolor*, *Mustela Pennantii*, *Cervus canadensis*, *Alce malchis*, *Tarandus rangifer*), and the great reduction, almost to extinction, of several others (*Lynx canadensis*, *Lynx rufus*, *Canis lupus*, *Ursus arctos*, *Cervus virginianus*). None of these species are now anywhere common, though there is good reason to believe that several of them were once so, while a few are known to have been of very frequent occurrence. The smaller species, including most of the rodents, the bats, moles, and shrews, seem to be fully as numerous as they ever were, while it is not improbable that a few, especially the *Arvicolæ* and other field mice, and perhaps the woodchuck (*Arctomys monax*), are even increasing in numbers. The three species of exotic or eastern origin are the now almost cosmopolitan *Mus decumanus*, *M. rattus*, and *M. musculus*, which long since became annoying pests, and constitute the only additions to our feral Mammalia that have become fully naturalized.

Several of the species of this list are considered to be identical with species of the Old World, although most late writers have separated as specifically distinct all but one of our New England Mammals — the *Gulo luscus* — from their Old World relatives. Only two or three species of land Mammalia are now generally considered as common to any portions of both the Eastern and Western hemispheres.† Several

* The Canadian fauna, as represented in Massachusetts, may be characterized by the present or former occurrence among Mammalia of the following species: *Mustela Pennantii*, *M. martes*, *Gulo luscus*, *Alce malchis*, *Tarandus rangifer*, *Cervus canadensis*, *Arvicola Gapperi*, and *Erethizon dorsata*. The Alleghanian may be distinguished by the absence of the preceding and the presence of *Vulpes virginianus*, *Scalops aquaticus*, *S. Breweri*, *Sciurus cinereus*, *Arvicola pinetorum*, and *Lepus sylvaticus*, which do not occur in the Canadian fauna.

† The same is also true of the land birds, while a large proportion of those marine species that are probably really common to both sides of the Atlantic are regarded as distinct. It should be observed, however, that the separations in both classes have been made mainly by the same persons. On the other hand, the highest authorities in entomology admit many species to be common throughout the northern hemisphere, par-

others, particularly of the genera *Arvicola* and *Blarina*, currently received as valid, are here treated as merely nominal. While our reasons therefor are given somewhat fully in their proper connection, a few general remarks in further explanation seem called for here.

In the present greatly increased state of our knowledge of American mammals, not a few characters once very naturally considered of great importance in a specific diagnosis are to be regarded as far from decisive, they now being known to be dependent either upon age, season, or locality, or to be mere individual variations. A difference in size, for instance, is at present well known in mammals, as well as in birds, to almost universally accompany differences in the latitude and elevation of their respective habitats, the southern representatives of species widely diffused being very appreciably smaller than the northern. The difference between the extremes amounts not unfrequently to nearly one fourth, and occasionally even to one third, of the average size, so that, considered apart from the connecting stages afforded by representatives from the intervening districts, they might well be regarded as belonging to distinct species. It is also now well known that mammals vary geographically in respect to color, though not yet fully to what extent, and also in the character of the pelage. These latter facts have been long recognized practically in respect to the fur-bearing species, but it appears equally true of most of the others. Experienced trappers and fur-dealers readily distinguish the Mink and Sable skins of the north from those of the south, by the comparatively greater fineness, density, and length of the fur of the northern animal;* similar differences are equally evident in the pelage of the Wolves, Foxes, Lynxes, and Hares. This difference is similar to that observable between winter and summer specimens from the same locality, the northern corresponding in the character of the pelage to the winter and the southern to the summer ones. The resemblance is perhaps still more striking in regard to the

ticularly among the Hymenoptera, Neuroptera, and Coleoptera, and not a few are regarded as primitively almost cosmopolitan. The same is true in regard to plants, quite a large proportion of the species of the northern North American flora being considered identical with European and Asiatic. Hence we naturally inquire, Is there really this discrepancy in the distribution of species in the different classes of organized beings, or is it only apparent through the biased opinions of one or the other of these schools of observers?

* In the case of the Minks, those of the prairies are distinguished as readily from those inhabiting the adjoining wooded districts, the former having coarser and browner fur, the difference being sufficient to materially affect their price in the market.

clothing of the feet, species with the soles thickly furred in winter often having them sparsely so in summer, northern individuals differing in like manner from southern. The variation in this respect increases with the distance in latitude between the localities whence the specimens compared are taken.

Besides these geographical or climatic variations, we have found by a careful comparison of scores of specimens of the *same species, collected at the same locality*, that there is a much greater range of variation between individuals of the same species — the variation extending to every part — than is commonly conceded ; and also that differences depending upon season,* as in the color, thickness, length, and general texture of the pelage, and others depending upon age * and sex, instead of being always recognized by authors as such, have not unfrequently been taken to indicate a constant specific diversity. From this cause there has arisen, in numerous instances, an undue increase of so-called species. *Specimens* have too often been described instead of *species.* It is not surprising that these mistakes should have happened in the earlier days of our science, when the material for study was scanty and diagnoses were commonly drawn up from stuffed skins, the authors being in total ignorance of the appearance of the animal in life ; when the extent of individual variation had not been especially investigated, and it was unknown that in animals possessing a wide distribution there were marked variations accompanying wide differences in locality. But even now

* In spring, as is generally well known, mammals shed the long, thick coat worn in winter; this is replaced by a much shorter, thinner, less soft, and generally differently colored pelage. In this there is a gradual change throughout the summer, and late in fall it becomes either entirely replaced or effectually concealed by the growth of the long winter coat. The winter differs from the summer pelage not only in being longer and thicker, but generally in the different character of the hair composing it, and in the fulness of the soft under fur, as well as more or less in color. The shortness of the summer coat renders the ears of such animals as have these members very short, as the different species of *Arvicola*, *Sorex*, *Sciurus*, &c., much more conspicuous at that season than in winter, when in some of them they are nearly concealed. In young animals, too, the first pelage differs much from the succeeding, being shorter, darker, and generally more or less crisp. The general health of the animal, as no one need be told who has attentively observed domestic animals, has a marked effect upon the character of the coat, and on the time it is changed, as does also scantiness or abundance of food.

As previously stated in the text, species with the soles of the feet furred have them less densely so in summer than in winter. It is perhaps needless to advert to the fact of the existence of a temporary set of teeth in young animals, which gradually give place to a permanent one differing from the first in number and character.

but few mammalogists have come to recognize these variations as manifestations of general laws, and we are consequently scarcely surprised at the glaring inconsistencies into which even our best authorities are frequently betrayed, they at times assigning to these several variations their true character, and again, in apparently equally clear cases, considering them as indications of specific diversity. It thus happens that species are still not unfrequently based solely on differences that are but individual peculiarities, from these differences being first detected in comparing specimens from widely separated districts, whereas they are not different from variations presented by occasional specimens of the same species at any given locality. Oftener still, perhaps, species are founded on slight geographical variations, either solely or in connection with exceptional individual peculiarities, or on differences depending upon age. A remarkable instance of this latter kind seems to have occurred in our *Sorecidæ*, and especially in *Blarina*, where no less than eight at present currently received species are apparently based on one. Imperfectly understood sexual variations, associated with other differences, in some cases render the complication still greater. This occurs in the *Mustelidæ*, where the female is found to be very much smaller than the male in almost or quite all species when the sexual differences are well known. In the weasels the large amount of this difference seems to have thus far generally escaped notice, especially by American writers. As wide a range of variation, aside from the sexual, obtains in these as in their near allies, the mink and the marten. In this group, differences in size and in the relative length of the tail as compared with the body — the latter an extremely variable element — have been taken as important specific distinctions, and on these grounds alone some five species (so called) appear to have been based on two.

In respect to the differences that have been claimed to separate specifically the Old and the New World representatives of those species we in this paper consider identical, only those of very slight importance have as yet been adduced; they are only such as might be anticipated to occur when, as has repeatedly happened, the comparisons have been made between only a few specimens known to have been collected at localities widely differing in latitude, and hence in climatic conditions, and at different seasons of the year. More frequently, however, the exact origin and history of the specimens compared appears to have been wholly unknown. In no case are the differences greater, but generally less, than those presented by specimens from different localities on the same continent, where the species is admitted to be the same; sometimes not greater than is seen at the same locality. From similar unsatisfactory comparisons, and undoubtedly in part from theories of distribution, representatives from distant points in the United States of species ranging from the Atlantic to the Pacific have been described as distinct species. Not till large series of specimens from hundreds of localities have been carefully compared can all these disputed points be properly settled, through the tolerably exact determination of the influence of "locality on the individual"; and we believe that no work more important than this can at present be done.

In this connection I can hardly avoid a word or two in reference to the spirit which evidently incites many zoölogists in their researches. I refer, of course, to that eagerness for describing "new species" so patent in all their publications, — an influence highly derogatory to the advancement of scientific knowledge. It tends to divert attention from such a critical study of those species living in the naturalist's immediate vicinity as will alone acquaint him with the amount of variation a species may be expected to present.* Only by such a preparation can one be prepared to estimate properly the character and value of differences presented by specimens from remote districts, of which only a limited number of prepared examples can be examined. Almost all writers on the different classes of Vertebrata have fallen in a greater or less degree into the fault of describing species as new from either improper or insufficient material, or of founding them on characters that a critical study of numerous fresh specimens of a few well-known species would have shown were of very slight, and often of even no value as specific distinctions. The inquiry with many naturalists respecting doubtful specimens seems rarely to be whether they may not be referred to some already known species, and the points of resemblance to their nearest known ally accordingly carefully weighed against the differences, but rather are not they sufficiently different to warrant a description of them as new species? This greediness for *species nova* renders it

* In respect to Birds, I have already called attention (Memoirs Bos. Soc. Nat. Hist., Vol. I, p. 512) to the importance of collecting and comparing a very large number of specimens from the same locality, to learn the extent of the variation a species may present at the same point: it is no less essential in Mammals, where seasonal variations and those depending upon age are not always so evident.

difficult to eradicate from our systems those even but doubtfully admitted when once they have been proposed by authors high in authority, such species being ultimately accepted without having ever been scientifically established. Authors afflicted with this mania rarely reject any species of their contemporaries, but they virtually indorse the doubtful ones by adding others of their own based on similar characters. The great proportion of merely nominal species hence annually added to our lists is a detriment to science deeply to be regretted.

Perhaps the strictures contained in this article will by some be deemed too severe; they are nevertheless made, not only reluctantly and in all cases without the slightest personal feelings, but from a conviction of their necessity, and with the sole object of advancing the truth. Gladly would I have left to others the unpleasant task.

While much of the material forming the basis of this list has been, as previously stated, that of my own collecting at Springfield, I am deeply indebted to the Museum of Comparative Zoölogy for additional data, and especially for a large amount of invaluable material for the revision of the species.* It has also afforded me the opportunity of comparing American with European specimens of the species of *Mustelidæ* and *Canidæ*, and of examining specimens of most of the Mammals of North America. The very complete collection of Massachusetts mammals in the Springfield Museum of Natural History, mainly collected and prepared by Mr. C. W. Bennett, embracing as it does several unique specimens, has likewise been freely consulted, and with much profit. I have already referred to my indebtedness to Captain N. E. Atwood, of Provincetown, for notes on the Cetacea, and to Professor E. D. Cope for the identification of the species.

The names used in Dr. Emmons's Report are generally added as synonymes when different from those now adopted. A tabular comparison of the species given by Dr. Emmons from this State, by Dr. De Kay from New York, and by Mr. J. P. Linsley from Connecticut is made with those of the present list, in order to indicate their synonymy. In general only such synonymes are given, always from original examination, as are necessary to render clear the views of the writer on the

* Probably no other Natural History Museum in the world affords facilities for the investigation of the individual variation of species equal to those presented by the immense collections of New England, and especially Massachusetts, Vertebrata contained in this Institution, brought together by the Director in great part for this especial purpose.

points in question. The thorough and exhaustive manner in which this part of the subject has already been treated by Professor Baird and Dr. Allen has rendered anything further than this unnecessary.

FELIDÆ.

1. **Lynx canadensis** Raf. Canada Lynx. Rare, and generally occurring only in the more thinly settled and mountainous parts of the State. A very large one was killed in November, 1866, in the town of Ware. Reports of their capture in the towns of western Hampden, Hampshire, and Franklin Counties, as well as in Berkshire, are not very infrequent.

2. **Lynx rufus** Raf. Bay Lynx. Apparently rather more common than the preceding species, but, like this, it is generally confined to the more wooded and mountainous districts. One was taken at Ipswich a short time since, and they seem to occur at intervals in all sections of the State.

The *Felis concolor* Linn. (Panther) has probably been for some time extinct in Massachusetts, though undoubtedly once occurring here. There is a stuffed specimen in Springfield said to have been killed a year or two since in the Adirondack Mountains of New York. A few months since the writer saw another that was captured on Pine Hill, in Weathersfield, Vermont, January 31, 1867. This specimen is said to have measured seven feet from the tip of the nose to the tip of the tail, to have stood two feet nine inches high, and to have weighed one hundred twenty-two and a half pounds. It had lived for some time previously on Ascutney Mountain, a few miles from where it was captured. Very good photographs of this rare animal, taken from this specimen before it was skinned, can be obtained of Mr. J. D. Powers, of Springfield, Vermont.

Professor Thompson states, in his Natural History of Vermont (p. 37), that for some time after the settlement of that State had commenced the Panther was so common there as to be considered dangerous to travellers unless they were well armed. In his Appendix (p. 12) he states that the last one he had known to be killed in that State, and also the only one for many years, was captured in Bennington, in February, 1850.

CANIDÆ.

3. **Canis lupus** Linn. (*C. occidentalis* var. *griseo-albus* Baird.) Gray Wolf. Occasional in the sparsely populated districts of the western counties. Like the species of *Felidæ*, it has been nearly extirpated.

Authorities have differed greatly in their views respecting the identity of the American and European wolves; some, forming the majority, and among them apparently those whose opportunities for judging have been most favorable, have considered them the same, while others, and among them many who seem to have but casually examined the subject, have regarded them as distinct. Not only so, but — omitting certain varieties based on color and commonly received as merely nominal, though repeatedly raised to the rank of species — specimens from the middle and western portions of the continent have been described as specifically distinct, both from the Old World wolves and those of the eastern side of the continent.* Dr. Richardson, than whom probably no one has had better opportunities for studying American wolves, after pointing out some trivial differences in physiognomy and in the character of the pelage between the wolves of Arctic America and the Pyrenees, observes: "Notwithstanding the above enumeration of the peculiarities of the American wolf, I do not mean to assert that the differences existing between it and its European congener are sufficiently permanent to constitute them, in the eye of the naturalist, distinct species. The same kind of differences may be traced between the foxes and native races of the domestic dog of the New World and those of the Old; the former possessing finer, denser, and longer fur, and broader feet, well calculated for running on the snow.† These remarks have been elicited by a comparison of live specimens of American and Pyrenean wolves; but I have not had an opportunity of ascertaining whether the Lapland and Siberian wolves, inhabiting a similar climate with the American ones, have similar peculiarities of form, or whether they differ in physiognomy from the wolf of the south of Europe." For this reason he considered it "unadvisable to designate the northern wolf of America by a distinct specific appellation"; "the word *occidentalis*" (*Canis lupus occidentalis*), he further observes, "which I have affixed to the Linnæan name of *Canis lupus*, is to be considered as merely marking the geographical position of the peculiar race of wolf which forms the subject of this article."

Audubon and Bachman, the former having been long familiar with the American wolf in all its different varieties, unhesitatingly pronounced, after

* As *C. nubilus* Say, *C. variabilis* Maximilian, *C. gigas* Townsend, &c.

† The comparisons in this case, it should be remembered, are between specimens from localities possessing widely differing climates.

careful and extended comparisons of specimens from the two continents, the common wolves of the Old World and the New to be, in their opinion, identical. But Dr. De Kay, giving but two lines to a consideration of the subject, very summarily separates the American wolf from its Old World congener under the name of *Lupus occidentalis.* Professor Baird, after admitting the weight of authority to be in favor of the supposition of their specific identity, considers them distinct, and adopts the name of "*Canis occidentalis*" for the American species. In referring to the different varieties of the North American wolf this author says: "For the present I prefer to consider all as one species, and to assume this with good reason as distinct from some at least of the European wolves, if that continent possesses more than one." Although previously admitting the unsatisfactory character of his materials,* such a conclusion is but in accordance with his usual apparent predilection for considering American animals as distinct from their intimate affines of the Eastern continent, sometimes even where the weight of authority is by far in favor of their identity, and his own materials for an original examination of the subject are either entirely wanting or too scanty to be of much account.†

In his article on the Wolf (p. 108) Baird gives us, however, a most interesting and very valuable table of measurements of twenty-six skulls, chiefly from the Platte River, but which includes others from Sweden and Russia, as well as such remote points in North America as New York, Oregon, Texas, and Mexico. Aside from the markedly smaller size of those from the southern localities, the specimens do not appear to differ more than the same number might from either of the localities mentioned. The table shows variations in the proportion of breadth to length in the muzzle and in the whole skull, and in its relative breadth at similar points; but a careful examination of all the measurements given shows that these differences are inconstant, specimens from near the same locality differing as much or more than those from distant points. Neither are the differences greater nor different in kind from those New England specimens of the common fox (*Vulpus fulvus*), the woodchuck (*Arctomys monax*), the northern hare *Lupus Americanus*), or the gray rabbit (*L. sylvaticus*), present, and which in some of these species are sometimes exceeded.

* "In the lack of perfect specimens of the North American wolf, I find it very difficult to throw any light upon the long-vexed questions of our species, all before me being mutilated in some way, and not allowing a satisfactory comparison with each other and with descriptions." — *N. Am. Mam.*, p. 105. After stating his conclusions in regard to the matter, however, he in a later paragraph mentions the receipt of additional specimens from the Yellowstone River.

† But one species, the *Gulo luscus*, is admitted in the Report on North American Mammals, as specifically identical with any species of the Old World. In this case a strong probability, in his estimation, of distinctness is hinted at.

The variations, particularly in point of color, presented by the species under consideration do not appear restricted to its American representatives, in the north of the Old World, the wolves, according to authors, varying from the white ones of Lapland and Siberia to the gray, pied, dusky, and even black ones of the more southern States; and here also the differences in color have been considered as indicating different species. In North America, where the wolf is quite fully known, the differences between the large white, or nearly white, races of the extreme north of the continent and the smaller dusky and rufous races of the south, in size, color, in the character of the pelage, and perhaps in other points, are so great that, without the intermediate links through which these widely differing extremes almost insensibly pass into each other, through individuals inhabiting the intervening districts, these extremes might be considered as well-marked species. At the far north, and "particularly in districts nearly destitute of wood," says Dr. Richardson, "wolves totally white are not uncommon," while grayish white is the prevailing color. The gray occupy, in general, the northern and elevated parts of the continent, including the elevated and more northern sections of the United States, and pass into the white and lighter gray wolves occupying the region farther north, and into the darker colored ones existing at the south. Southwards the color increases, tending more and more towards black and red, till in Florida * and the Gulf States dusky and black wolves predominate, and in Texas red or rufous. Yet in no portion of the continent is the color of the wolves at all uniform, the same packs generally presenting a great variety in this respect, even those of the same litter often widely differing. Dr. Richardson mentions, under his "variety *sticte*," that of five young wolves, "leaping and tumbling over each other, with all the playfulness of puppies of the domestic dog," which he thought were probably of one litter, one was "pied, another entirely black, and the rest showed the common gray colors." In speaking of the black American wolf, which forms his "variety *ater*," he says the Indians do not consider them to be even a distinct race, but report that one or more black whelps are occasionally found in a litter of a gray wolf. Audubon and Bachman, in referring to the red wolf of Texas ("*Canis lupus* Linn. var. *rufus*" of these authors), state that this variety is by no means the only one found there, "where wolves black, white, and gray are to be met with from time to time. We do not think, however," say they, "that this red wolf is an inhabitant of the more northerly prairies, or even of the lower Mississippi bottoms, and have therefore called him the Red Texan

* "The varieties, with more or less of black, continue to increase as we proceed farther to the south, and in Florida the prevailing color of the wolves is black." — Aud. & Bach., *Quad. of N. Am.*, Vol. II, p. 130. These observations of Audubon my own inquiries made during a recent journey in this State tend to confirm.

Wolf." On the Missouri we find, according to Lewis and Clark, that the wolves are chiefly yellow, as also, according to Professor Baird, on the Platte and Yellowstone (N. Am. Mam., p. 110), where they appear to gradually merge into the gray and white ones of the north. These latter evidently form the so-called varying wolf (*C. variabilis*) of Prince Maximilian,* some of which, he says, are entirely white, others yellowish white, some more mixed with gray, and others still entirely gray, in the same pack. The black wolf noted by Say on the Missouri, and which he describes as *C. nubilus*, like the gray and white ones, seems to occur everywhere, but apparently much more abundantly at the south, thus corresponding in its distribution, as in general character, with the black variety of Southern Europe, described by Linnæus, and afterwards by Cuvier, as *Canis lycaon*. This name was also applied by Dr. Harlan to the American black wolf. The red, or rufous, seems likewise southern, occurring in great abundance in Texas, and thence northward through the middle region of the continent, passing gradually through paler rufous and yellowish to the prevalent gray and grayish-white wolves of the north. Though perhaps our data are at present too few to warrant positive conclusions on the subject, the facts appear to point rather strongly to a localization of these different colors; it is nevertheless true that, as already stated, the wolves present at every locality a wide range of variation, and that neither variety of color is entirely restricted to any particular region. The gray is apparently the most widely diffused, occurring in greater or less numbers almost everywhere.† We find, however, that authors have considered these color differences as indicating not only permanent varieties, worthy of distinctive names, but even species, as is shown by a glance at the subjoined table of synonymes of the American animal. Not a few, including Audubon, Bachman, Dr. Richardson, and others, have been so inconsistent as to name and characterize as "varieties" what they at the same time admit to be either positively or probably only individual variations, occurring sometimes in the same litter with the common form.‡

* Reise in das innere Nord-Amerika, Vol. II, 1841, p. 95. Ib., Archiv für Naturgeschichte, Vol. XXVII, 1861, p. 247.

† Dr. Coues observes, in a series of interesting papers on the "Quadrupeds of Arizona," in the American Naturalist (Vol. I, p. 288), that all the wolves seen by him in Arizona were of the grizzly or grayish-white variety, which in winter, at a distance, appear almost white.

‡ Dr. Richardson, after saying "these variations of color, however, not being attended with any differences of form, nor peculiarities of habit, I deem them to be no more characteristics of proper species, or *even permanent varieties*, than color would be in the domestic dog," proceeds at once to formally name and describe five "varieties," as though they were tangible, permanent forms, — so great apparently is the fascination to some minds of bestowing names, to be followed by their own as authority, in Natural History.

In some previous citations of the synonymes of this species, I find that Dr. Richardson has on several occasions been incorrectly quoted, first by De Kay and afterwards by Baird; his name, *Canis lupus, occidentalis*, having been rendered by them "*Canis* (*Lupus*) *occidentalis*," thus incorrectly conveying the impression that he regarded the wolf of North America as distinct from the European, and as also having placed it in a sub-genus (*Lupus*) of *Canis*. Dr. Richardson, however, expressly states that he did not regard them as distinct, and did not wish to further burden the science by imposing a new name to indicate what at most he thought might be but a geographical race.

Canis lupus.

Canis lupus Linnæus, Syst. Nat., I, 1767, 58.
" *mexicanus* Ib., 60.
" " Shaw, Gen. Zoöl., I, 1800, 296.
" " Desmorest, Mam , I, 1820, 199.
" " Fischer, Syn., 1829, 183.
" " Berlandier, Proc. Acad. Nat. Sc. Phil., V, 1851, 157.
" *lupus, albus* Sabine, Franklin's Journ, 652.
" *lupus, griseus* Ib., 654.
" *lupus, occidentalis* Richardson, Faun. Bor. Amer., I, 1829, 60.
" " " var. A, *griseus*, Ib., 66.
" " " " B, *albus*, Ib., 68.
" " " " C, *sticte*, Ib., 68.
" " " " D. *nubilus*, Ib., 69.
" " " " E, *ater*, Ib., 70.
" *lupus* Harlan, Faun. Amer., 1825, 84.
" *lupus*, var. *ater* Audubon and Bachman, Quad. N. Am., II, 1851, 126, pl. 67.
" " " *albus* Ib., 156, pl. 72.
" " " *rufus* Ib., 240, pl. 82.
" " Emmons, Quad. Mass., 1838, 26; Ib., 1840, 28.
" *nubilus* Say, Long's Exped. R. Mts., I, 1823, 168.
" " Harlan, Faun. Amer., 84.
" *lycaon* Ib., 126.
" *variabilis* Maximilian, Reise in das innere Nord Amer., II, 1841, 95.
" " Ib., Arch. Naturgesch., XXVII, 1861, 247.
" *gigas* Townsend, Journ. Acad. Nat. Sc. Phil. (2d series), II, 1850, 75.
" *occidentalis*, var. *griseo-albus* Baird, N. Am. Mam., 1857, 104, pl. 31.
" " " *nubilus* Ib., 111.
" " " *mexicanus* Ib., 113.
" " " *ater* Ib., 113.
" " " *rufus* Ib., 113.
Lupus occidentalis De Kay, Nat. Hist. N. Y. I, i, 1842, 42, pl. 26, fig. 2.

4. **Vulpes vulgaris.** (*V. fulvus* Rich., and of most modern authors.) Red Fox. More or less common throughout the State.

The varieties called "Silver Fox," "Black Fox," and "Cross Fox," are taken at long intervals.

These so-called varieties, to which have been given such distinctive names as *Canis decussatus*, *C. argentatus*, *C. fulvus* var. *decussatus*, etc., etc., and which some authors have regarded as species and the majority as permanent "varieties," are but different degrees of melanism of the common red fox, as they sometimes all occur in the same litter of young.* They appear exactly parallel to the dusky and black varieties of marmots, which are usually considered as only variations of this character. The dusky of the preceding species (*C. lupus* Linn.) and the black form of several species of *Sciurus* are probably but the result of the same tendency more highly developed. Foxes in other countries, and particularly the European, are well known to present corresponding dusky and black variations, which have likewise been described as permanent varieties, and even as species.

Respecting the identity of the red fox of North America with that of Europe there is a diversity of opinion. Most of the old authors considered them specifically the same, while later they were almost as generally regarded as distinct. Recently their identity has been maintained by several high authorities in Europe, among whom are Giebel, Wagner, and Maximilian, and not without a fair show of reason. Professor Baird observes, that careful comparisons of the two show "appreciable differences, although the resemblance is very close in external appearances, and scarcely to be expressed except comparatively."† The

* Audubon and Bachman, in their account of the Cross Fox ("*Vulpes fulvus* Desm., var. *decussatus* Pennant"). in Quadrupeds of North America (Vol. I, pp. 52, 53), incidentally relate the following: "In the spring we induced one of our servants to dig for the young foxes that had been seen at the burrow which was known to be frequented by the Cross Fox. With an immense deal of labor and fatigue the young were dug out from the side of a hill; there were seven. Unfortunately, we were obliged to leave home, and did not return until after they had been given away and were distributed about the neighborhood. Three were said to have been black, the rest were red. The blackest of the young whelps was retained for us, and we frequently saw, at the house of a neighbor, another of the litter that was red, and differed in no respect from the common Red Fox. The older our little pet became the less it grew like the Black, and more like the Cross Fox. It was, very much to our regret, killed by a dog when about six months old, and, as far as we can now recollect, was nearly of the same color as the specimen figured in our work."

In the following autumn the female was killed: "It was nearly jet black, with the tip of the tail white. This was the female that produced the young we have just spoken of; and as some of them, as we have already said, were Cross Foxes and others Red Foxes, this has settled the question in our minds that both the Cross Fox and Black Fox are mere varieties of the Red."

† Mamm. of N. Am., p. 126.

differences in the color and texture of the fur, to which he and others have called attention, seems the most tangible difference, though not one of high value. Several specimens from different parts of Europe, in the Museum of Comparative Zoölogy, show that some of the other differences specified by Professor Baird, particularly that of the form of the tail and the greater length of its hairs in the American animal, are far from constant, there being no such differences in this respect between them and others from the United States, as has been claimed. One of the European has the tail remarkably full, the longer hairs being fully an inch longer, instead of an inch shorter, as according to authors they should be, than average American specimens. Prince Maximilian has also observed that this distinction in regard to the form of the tail is inconstant and invalid.* While, as Professor Baird remarks, European specimens can be readily separated from American, as in the case of most species commonly admitted as identical on the two continents, it does not follow necessarily that they are specifically distinct, since in very many species of animals specimens from not very remote localities can be similarly distinguished, where naturalists never question their identity. The very exact agreement in the southward distribution of the red fox in the Old World and in the New, — their southern limitation on both continents, as nearly as can be judged, coinciding with the same isotherm, — and the occurrence of the same varieties, as "cross," "black," and "silver," and in about the same relative proportion of individuals, if indicating anything, seems to point to their identity. In considering this subject it is necessary to take into account the remarkable tendency to variation presented by other members of this family in a state of nature, and the readiness with which widely distinct breeds are developed under domestication in the common dog. The European specimens to which we have referred differ considerably among themselves, these differences being in some cases greater than between some of them and the average type of the American animal. I hence do not hesitate to consider the North American red fox as identical with the common red fox of Europe, the average amount of difference being not greater than might be anticipated in specimens from so distant localities.

5. **Vulpes virginianus** De Kay. Gray Fox. Though essentially southern, this species is said by De Kay to be rather common in the southern counties of New York, and particularly on Long Island; † Audubon and Bachman give it as not uncommon in the vicinity of Albany, N. Y., but as scarce in New England, and state

* Arch. für Naturgesch., XXVII, Theil 1, p. 259.

† Zoöl. of New York, Vol. I, p. 46.

that they had not heard of it to the north of the State of Maine.* Dr. Emmons gives it as "rare in Massachusetts." † Mr. C. W. Bennett informs me that he knew of the capture of two specimens in Leominster a few winters since. The skins of this species frequently seen in our fur stores come, so far as I have learned, altogether from Eastern Virginia and the Southern Atlantic States.

MUSTELIDÆ.

6. **Mustela Pennantii** Erxl. (*M. canadensis*, Emmons Rep.; *Martes* ‡ *Pennantii* Gray.) Fisher. Probably still of rare occurrence in the Hoosac ranges. In 1840 Dr. Emmons wrote: "It is occasionally found in the vicinity of Williamstown, particularly in that range of mountains which extends northeast through Stamford, Vermont." §

This species seems to be the only one of the old Linnæan genus *Mustela* (*Martinæ* of recent authors) peculiar to the northern parts of North America, with no very near ally in the corresponding portion of the Old World.

7. **Mustela martes** Linn. (*Martes americana* Gray; "*Mustela americana* Turton" of recent American authors; *M. zibellina* Brandt.) Pine Marten. Sable. Occasional in the mountains of Berkshire County. Thirty years since Dr. Emmons mentioned it as not infrequent there, but as most common "where pine forests abound. It is, however," he says, "often found in beech woods, where it is sure of a more ready supply of food. Its nocturnal habits, and native shyness, effectually screen it from observation, even in districts where it abounds." ‖

The variations presented by the sables and martens, at single localities as

* Quad., Vol. I, p. 172. † Rep., p. 31.

‡ Each of the three generally recognized genera of the sub-family *Martinæ* ("tribe *Mustelina*" of Gray) — *Mustela* embracing the sables and martens; *Putorius*, the minks, weasels, and ermines, and *Gulo*, the wolverine — has been recently subdivided, the sections being ranked by some as sub-genera, and by Dr. J. E. Gray as genera. In his Revision of the Genera and Species of *Mustelidæ* (Proc. London Zoöl. Soc., 1865, pp. 100–154), he restricts *Mustela* to the weasels and ermines, and *Putorius* to the polecat, while the sables and martens he places under *Martes*, and the minks under *Vison;* the distinctions, based on differences either in the dentition, form of the skull or color, are, however, very slight.

§ Rep., p. 39. ‖ Rep., p. 41.

well as in different districts, have been very perplexing, and have given rise to a considerable number of supposed species and a very great number of "varieties," the alleged distinctions between which are quite uncertain and inconstant. Some of these variations are doubtless referable to seasonal changes,* and not a few others to individual peculiarities. Dr. Gray admits six species as inhabitants of the North Old World,† several of which he divides into three to five varieties each. To a few of them only, however, does he assign separate geographical districts; in general they vary in such a way as to render the forms recognized by him as species quite intangible, the varieties forming gradations between them. Two of the three attributed to Japan (*Martes japonica* and *M. brachyura*) rest on exceedingly unsatisfactory data, while the third (*M. melanopus*) has a striking resemblance to the common form of the American species, and to varieties of both the so-called *M. abietum* and *M. zibellina* of Europe and Asia. Aside from these divisions of Dr. Gray, three principal races or forms (species of many writers) have for a long time been recognized as occurring on the Eastern continent, — the sable (*Mustela zibellina* Linn.), the pine marten (*M. martes* Linn.), and the beech marten (*M. foina* Brisson; *M. martes*, var. *fagorum* Linn.). The principal distinctions between them consist in the relative length of the tail, which varies in being sometimes longer, equal to, or shorter than the body, and in the color, which varies in general tint, and differently in the different regions of the animal, and especially on the throat, which is sometimes white, or nearly so, but more commonly yellowish or yellowish-brown; occasionally the "throat patch" is nearly obsolete. The color of the head is sometimes like that of the body, and again much lighter; the general color varies from blackish through different shades of brown to light yellowish brown and whitish. But instead of either of these differences being limited, or peculiar, to either "species," "variety," or race, or to special localities,* they are all given by Dr. Gray under the five divisions of his fifth species, — "*Mustela zibellina* Linn."; while he says of his *M. abietum*, var. *altaica*, that it is "intermediate between *M. abietum* and *M. zibellina;* but the feet are not so hairy"!* Brandt, in his Beiträge Säugtheire Russlandt, recognizes three species. The American animal (*M. americana* auct.) he considers as a yellowish or more yellowish-brown and less densely furred variety of the Asiatic sable than as a pure marten (*M. martes*), and calls it *Mustela zibellina*, var. *americana*.

Dr. Gray of course regards the American as distinct, and divides it into three varieties, — *abietinoides*, *huro*, and *leucopus*, — which seem to vary only in intensity of color, the first being "black-brown," the second

* See *postea*, pp. 165 – 167. † Proc. Lond. Zoöl. Soc., 1865, p. 104.

"yellowish-brown," and the third much lighter than the second. The habitat of the first is given as the "Rocky Mountains"; of the second, "Fort Franklin"; that of the third is not stated, and may be supposed to be general, or at least those districts not occupied by the others. It is evident, however, that these different varieties are not local, as they occur more or less frequently at the same localities, and likewise at as distant points as the two sides of the continent. Dr. Gray refers to a series of specimens of the American pine marten in the British Museum, collected by Dr. Lord during his excursion with the Boundary Commissioners, that "vary greatly in color, from pale brown to nearly black," and have "the throat variously mottled with yellow." * Mr. Bernard R. Ross says that the farther north the skins are obtained the darker the pelage, and that on the Youkon River they strongly resemble the Siberian sable.† While in general the specimens from North America are of the white-headed or sable, rather than of the marten, type, dark-headed ones also occur, not exclusively on the western side of the continent, as some have supposed, but more or less frequently at all points.

Professor Baird has described ‡ specimens from the West Coast that do not differ essentially from others from the Adirondacks, though having the head much less white. Dr. Brandt's series of American skins from the Northwest Coast, as far south as Columbia, on the contrary, had the head very light colored, and hence resembled in this respect the generality of specimens from New York, Maine, and Nova Scotia. In other general characters he also found a close agreement with the Asiatic sable, and, as already stated, he believed them specifically identical. Dr. Gray also mentions a close resemblance in the color of the head between specimens from Russia and the Northwest Coast of America. Professor Baird, after comparing American with Swedish specimens, states that "in some respects, as in certain features of the skull and teeth, the American marten approximates to the beech marten, *M. foina*, more than to the European true marten"; and that it differs from the latter (*M. martes*) in certain proportions of the skull, in the texture and paler colors of the pelage, in the relatively longer tails of the latter, and in the extent of the naked pads of the feet. He also finds resemblances in color to the Russian *M. zibellina*, but finally concludes, after quoting Dr. Brandt's reasons for considering them identical, by saying that he is "far from admitting the identity of the American marten with the Russian sable, although it occupies a position intermediate between the latter and the *M. martes* in size,

* L. c., p. 107.

† List of Mammals, Birds, and Eggs observed in the McKenzie's River District. Nat. Hist. Rev., July, 1862, p. 272.

‡ Mam. N. Am., p. 153.

length of tail and coloration, as well as in intrinsic value of the fur. The white-headed varieties of New York are most like the sable; the darker-headed ones of the Western country like the pine marten." He is "inclined to the belief," he says still later, in an interpolated note, "that we have two species, one representing the pine martin, with dark head, the other similar to the sable, with whitish head, — both probably distinct from the corresponding Old World species, the martens at least."

In Dr. Brandt's diagnosis of the martens, the relative length of the tail is dwelt upon as an important character. In *M. zibellina* the tail without the hairs is given as one third the length of the body; in *M. martes*, one half or more than one half. Professor Baird says the tail vertebræ in *M. americana* are about one half the head and body; hence not differing much from the same proportion in *M. martes*, while quite different from the same in *M. zibellina*, which Dr. Brandt considers the *M. americana* to most resemble; while Dr. Gray observes that the tail of some of Dr. Lord's specimens from Western America is almost as short as it is in the Russian sable. A marked discrepancy is evident in these statements, explainable on the ground of the inconstancy of the distinction based on the relative length of the tail. Brandt also states that the *M. foina* differs from *M. martes* somewhat in general color (but apparently not essentially, considering the much wider differences in this respect his varieties of *M. zibellina* present among themselves), and in having the tail generally longer, with more vertebræ. Since, however, the number of tail vertebræ is far from constant in most mammals with this member considerably developed (as I have myself observed in the mice, squirrels, ermines, and foxes), this latter character must lose much of its weight till repeatedly verified. Dr. Gray says, in urging the non-identity of the American and Old World martens, that "It is curious that both Brandt and Baird seem to have overlooked the small size of the last tubercular grinder, which separates the American from the Old World pine martens"; a fact he claims to have discovered. From variations I have observed in this respect in our common *Mephitis*, it would be interesting to know whether Dr. Gray has found this difference constant in a considerable series, or whether the observation rests on a single specimen, as, in the same connection, he refers to "the skull of the American specimen we have in the Museum," in speaking on another point.

I have shown in the foregoing remarks that the martens and sables of the Old World and the New are not without close points of affinity in all essential particulars; that on both continents they present almost innumerable differences, principally in respect to color, but few of which, if any, appear to be geographical, or even constant; that on both continents the variations are similar; that the points of distinction between the supposed species are slight, and rest mainly on characters which in mammals are the most likely of all others to be variable; that authors, in their statements and opinions, are widely discrepant and often contradictory; finally, that the American animal is most closely allied to the Asiatic, grading through it into the European. At present there seems to be no middle ground between considering all as forming one circumpolar species and admitting a considerable and indefinite number, since some of the so-called "varieties" seem as strongly marked forms as some of the "species." If we must consider the American as distinct from those of the Old World, we can hardly do less, on parallel grounds, than to recognize two or more in America. It seems probable that in time the greater part will be found to be not permanent or uniformly transmissible varieties, but merely irregular individual variations; — in other words, that more than one so-called variety may be represented in the same family, as has been shown is the case in the foxes and wolves, and as is well known to occur in *Mephitis*.* The comparison of a great number of specimens from many localities will be necessary before we can consider the matter as satisfactorily settled.

Since writing the foregoing, I have met with a very valuable paper on the Fur-Bearing Animals of the Mackenzie's River District,† and another on the Martens and Weasels of Nova Scotia; ‡ I have also had an opportunity of comparing a large number of skins of the Siberian sable with an extensive series of others from Hudson's Bay. Much additional information has been derived from these sources, which tends to confirm the opinion above expressed; namely, that most of the so-called varieties and species would prove to be based on seasonal and individual variations of a single circumpolar species. The writer of the first of these papers, Mr. Bernard R. Ross, is well known from his extensive Natural History explorations in the boreal regions of this continent, and his experience of thirteen years in this district as a successful trapper entitles his statements and opinions to more than ordinary weight. He seems to have been a critical observer, and in this paper adds much to our knowledge of the fur-bearing animals of North America. His remarks on the seasonal changes in the color and character of the fur in several species are particularly valuable. The following extracts from them explain to a great extent the nature of the wide variations which, in many characters, the martens and sables everywhere exhibit.

* See *postea*, p. 173 *et seq.*

† A Popular Treatise on the Fur-bearing Animals of the Mackenzie's River District. By Bernard Rogan Ross, C. T. — *Canadian Naturalist and Geologist*, Vol. VI, January, 1861, pp. 5 – 36.

‡ On the Mammals of Nova Scotia, No. III. By Dr. J. Bernard Gilpin. — *Transact. Nova Scotia Inst. of Nat. Science*, Vol. II, Part I, pp. 8 – 16.

"It is difficult to describe," he says, "the color of the marten fur accurately. In a large heap of skins (upwards of fifty) which I have just examined minutely, there exists a great variety of shades, darkening from the rarer yellowish-white and bright orange into various shades of orange-brown, some of which are very dark. However, the general tint may with propriety be termed an orange-brown, considerably clouded with black on the back and belly, and exhibiting on the flanks and throat more of the orange tint. . . . . The ears are invariably edged with a yellowish-white, and the cheeks are generally of the same hue. The forehead is of a light brownish-gray, darkening towards the nose, *but in some specimens it is nearly as dark as the body*.* The yellowish marking under the throat (considered as a specific distinction of the pine marten) is in some *well defined*, and of an *orange tint*, while in others it is *almost perfectly white*. It also varies much in extent, reaching to the forelegs on some occasions. At other times it consists merely of a *few spots*, *while in a third of the specimens under consideration it is* ENTIRELY WANTING." In respect to other characters he observes: "The tail is considerably less than half the length of the body *generally*, though it is sometimes longer; it is well covered and tolerably bushy. The feet are comparatively large, densely covered with short woolly fur, mingled with stiffer hairs, which prevent the naked balls from being visible in winter, *though they are distinctly so when the animal is in summer pelage*." † Respecting the seasonal changes he says: "When casting its hair the animal has far from a pleasing appearance, as the under fur falls off, leaving a shabby covering of the long, coarser hairs, which have then assumed a rusty tint. . . . . After the fall of these long hairs, and towards the end of summer, a fine, short fur pushes up. When in this state the pelage is very pretty, and bears a strong resemblance to a dark mink in its winter coat." He further observes: "In summer, when the long hairs have fallen off, the pelage of this animal is darker than in winter. The forehead changes greatly, *becoming as deeply colored as any other part of the body*, *which is of an exceedingly dark brown tint* on the back, belly, and legs. The yellow throat markings are much more distinct at this season, but vary much both in color and extent, though in only our summer skins are they entirely wanting." Mr. Ross also adds, that the martens of the Mackenzie's River district "bear a greater resemblance to the sable of Eastern Siberia than to the martens of Europe, holding, as it may be with propriety said, an intermediate position."

Dr. Gilpin, in his paper on the Nova Scotian Mammals already cited, has the following remarks on the variations presented by different indi-

* The italicizing in these quotations is my own.

† This may explain the differences in the hairiness of the soles pointed out by different authors, and claimed as a distinctive character of considerable importance.

viduals at the same locality: "When we begin to study this species, we soon find a very great variety in color, not only between the summer and winter specimens, but between winter skins themselves, that are all in the highest condition. Whilst they all coincide in what may be called typical marks, such as color of legs, tail, and especially ears, all of which have a very pale but conspicuous rim or border, *they vary much in color of face*, some having black, others faces so pale as to be nearly white, and the pale faces have a lighter brown color, and the orange throat much less vivid." Of seven skins described by this gentleman in detail, two "are nearly uniform mahogany brown" from the nose to the tail; the other five, though varying somewhat among themselves, are generally lighter, with much lighter faces, and the orange spot on the throat very bright, "almost fulvous." He adds that the skins from "Newfoundland and Labrador are much finer, darker in color, and more lustrous in pelage" than those from Nova Scotia.

Through the kindness of several of the fur-dealers of Boston I have had an opportunity to make a careful comparison of scores of skins of the Siberian sable from Russia with as large a series from the Territory of Hudson's Bay. The differences between them, although through the whims of fashion producing considerable difference in the mercantile value of the skins, are really quite slight. The fur of the Hudson's Bay skins is a little coarser, and the color slightly more rufous, with much fewer of the white-tipped hairs that in the Siberian skins are sometimes sufficiently numerous to give them a slight grayish cast, and which is considered to greatly increase their value. As one of the dealers practically remarked, they differ no more than the horses raised in Pennsylvania do from those bred in Massachusetts. Some of the skins of both varieties had tails much shorter than the average, showing the unreliability of this character. In a few instances this member was distinctly tipped with white, in both the Hudson's Bay and Siberian skins.

In the light of the now well-substantiated facts of a wide range of seasonal and intergrading, inconstant individual variation, it seems to me to be beyond reasonable doubt that, as I have already stated, the martens and sables, at least all thus far described, belong to a single circumpolar species, with possibly two or more well-marked and tolerably constant continental races.

8. **Putorius vulgaris** Cuv. (*Mustela vulgaris* Linn.; *Putorius pusillus* Aud. and Bach.) Least Weasel. Rather rare. Far less numerous than the next.

9. **Putorius ermineus** Cuv. (*Mustela erminea* Linn.; *Putorius noveboracensis* De Kay; *Mustela Richardsonii* and *M. Cicognanii*

Bon.; *Putorius fuscus*, *P. agilis*, and *P. ermineus* Aud. and Bach.) Common Weasel. Ermine. Comparatively common. It varies considerably in size, like other members of this family, according to sex and age.

I have obtained specimens at Springfield, identified some years since as belonging to the three species currently admitted by American authors as inhabiting Eastern North America, — "*P. Richardsonii* Bon."; "*P. Cicognanii* Bon.," and "*P. noveboracensis* De Kay." I have not access to the specimens for re-examination, but that these forms, or so-called species, occur in Massachusetts there can be little doubt, since Professor Baird, in his Report on the Mammals of North America, cites eleven examples from Middleboro', collected by Mr. J. W. P. Jenks, of his *P. Cicognanii*, two of *P. Richardsonii* and one of *P. noveboracensis*. As indicated by the synonymy already given, I consider all these as forming but a single species, which, after careful comparison of American with European specimens, I fully believe to be identical with the ermine (*P. ermineus*) of the Old World. I also feel obliged to consider the common American weasel, after similar comparisons, as identical with the common weasel (*P. vulgaris*) of the Eastern continent.

Although three species of ermines, or stoats, have been supposed to inhabit New England, in common with Eastern North America generally, no constant character has yet been indicated by which more than a single one can be positively distinguished. In size there is an almost imperceptible gradation from the smallest specimens to the largest, and similar gradations in all other characters, not excepting the relative length of the tail to the body. This latter character and that of size have formed the two distinctions most strongly urged as specifically separating them.

Previous to 1838, all the known weasels of North America were considered as belonging to two species, identical with the *Mustela vulgaris* and *M. erminea* of the Old World. At this time Bonaparte, in his Fauna Italica, added a third, which he called *Mustela Cicognanii*. He gave of it the following short and very unsatisfactory diagnosis: "*M. rufo-cinnamomea, subtus flavo-albida: cauda corporis dimidio sub-breviori, apice nigricante*"; which contains the single tangible character of "tail rather less than half the body." In the same year, in Charlesworth's Magazine of Natural History,* he added a fourth, which he called *Mustela longicauda*. This species was based on a variety mentioned in the Fauna Boreali-Americana,† by Dr. Richardson, as differing from the common ermine in being larger and in having a longer tail. Bonaparte, in the same communication, changed the name of the ermine weasel of Rich-

* Vol. II, p. 38. † Vol. I, p. 47.

ardson's work from *M. erminea* to *M. Richardsonii*, he believing them to be distinct species, and thus separated all the larger American weasels from those of the Old World. At this point begins the uncertainty and confusion that has long existed in regard to the number of species of American weasels and their distinctive characters. But no changes were currently adopted by American authors till ten or twelve years later, when, in 1841, Audubon and Bachman, in the Proceedings and Journal of the Philadelphia Academy of Natural Sciences, described a specimen taken on Long Island, New York, as a new species, under the name of *Mustela fusca*.* In the following year Dr. De Kay, in his Report on the Mammals of New York, redescribed this specimen under the name applied to it by Audubon and Bachman, and at the same time separated the larger representatives of the ermine as a species distinct from the Old World ermine and from the supposed northern *M. Richardsonii* of Bonaparte. But this author very frankly adds: "I have never seen the true ermine in its summer dress, and only know it from Pennant's description (Arct. Zool., Vol I, p. 75)." He calls the American ermine weasel *Putorius noveboracensis*, and regards it as differing generically from two other species of weasel (*M. pusilla* = *M. vulgaris* Linn, and *M. fusca* Aud. and Bach.) described by him as also inhabiting New York. In 1853, the authors of Viviparous Quadrupeds of North America, in the third volume of that work (p. 184), characterized another species as new, also from New York specimens, which they called *Putorius agilis*. In the same volume, under *P. fuscus*, they observe that whereas the number of North American weasels was believed by the older authors to be at most two, while some admitted but one, "there are now five, four of which are found in New York." If we add to the new names of Audubon and Bachman and De Kay the three bestowed on American weasels by Bonaparte, we have seven specific designations for those of Eastern North America alone; to these may be added *P. erminea* and *P. vulgaris*, Audubon and Bachman fully believing these species to be common to both continents, thus making nine.

This was the condition of the subject when Professor Baird revised the group in his Report on the Mammals of North America, in 1857. In this work eight species are admitted as inhabitants of North America. Two (*P. frenatus* and *P. xanthogenys*) are considered as exclusively southern and western in their distribution; one (*P. Kaneii*) as northwestern ("Behring's Straits and Siberia"), and three *P. Pusilla*, *P. Cicognanii*, and *P. Richardsonii*) as distributed throughout the northern parts of the continent and extending southwards into the United States. Another (*P. noveboracensis*) is regarded as ranging from Massachusetts and Northern New

* Proc., Vol. I, p. 92; Journ. Vol. VIII, 1842, p. 280.

York, west and south, to Southern Pennsylvania, Illinois, and Arkansas. The locality of still another is given as Carleton House, H. B. T., this being the variety described by Richardson as occurring at that locality, and named *Mustela longicauda* by Bonaparte. But Baird doubtfully refers to it also some long-tailed ermines from the Upper Missouri.

Concerning the Least Weasel (*P. pusillus* Aud. and Bach. of Baird's Rep.), the only queries relating to it have been principally in reference to its relationship to *P. vulgaris*, *P. pusillus* forming its principal synonyme. Bonaparte, however, doubted its occurrence in America, supposing his *P. Cicognanii* had been generally mistaken for it, as he claims he found it had been in some of the Middle States, and on his authority Dr. Godman excluded it from his American Natural History. Afterwards, however, Dr. Richardson, in the Zoölogy of Beechey's Voyage, applied to it the name of *P. Cicognanii*.

For the smaller weasels with a distinct black tip to the tail, Professor Baird retains the name of *P. Cicognanii*, referring to it the *Mustela* (afterwards *Putorius*) *fusca* of Audubon and Bachman. He gives as its distinctive character, "Length to tail, eight inches or less. Tail vertebræ, one third this length. Black of tail, two fifths its length," etc. He adds, this "species is readily distinguished from the other American weasels by the small size, and the tail, which, with the hairs, is rather less than half the body.' In a note he mentions the later reception of some hunter's skins from Nova Scotia and Labrador, among which were some that agreed very well with typical specimens from Massachusetts, while others were considerably larger, though in general preserving the same proportions. The average length of the body in the measurements of twelve specimens given by him is 8.25 inches, the largest being 10, and of tail 3.62; but between the extremes of the series there is a variation in total length of thirty-six per cent. of the average, and in the relative length of tail to the body of twelve per cent.

Putorius Richardsonii is characterized by the same author thus: "Length to tail, nine inches or less. Tail vertebræ, about half this length. Black of tail, nearly one half to one third its length," etc. "Is readily distinguished from *Putorius Cicognanii* by the longer tail, the vertebræ alone of which are fully half the length of the body, instead of requiring the entire tail to effect this proportion."* Of this "species," the measurements of two speci-

* In the account of *P. Richardsonii* in the Mammals of North America there occurs the following singular but important discrepancy, probably the result of a typographical error. In the third paragraph of page 165 it is stated, "This species, a true *Putorius* differs materially from the larger North American Weasels *in the absence of a black tip to the short tail; in this respect resembling* P. Cicognanii." But in the specific diagnosis of *P. Richardsonii* the author says: "*Black of tail nearly one half to one third its length*"; and in that of *P. Cicognanii*, "*Black of tail two fifths its length.*"

mens from Eastern Massachusetts are given, both of which, in general size, fall within the average of the twelve of *P. Cicognanii;* thus showing that "small size" fails to sufficiently distinguish the latter, and also that short tails and small size do not always go together in specimens from the same locality; the tails in these two exceed the average in the *P. Cicognanii* by about thirty per cent. of the average of the whole series. The distinction based on the relative length of the black tip seems also intangible, "two fifths" coming just between "nearly one half" and "one third." To this species he refers the *P. agilis* of Audubon and Bachman, and of course the *Mustela (Putorius) erminea* of Richardson, for which the name *Richardsonii* was substituted by Bonaparte for *erminea*. Yet the dimensions given by Richardson accord in the proportions of the tail to the body, not with Baird's diagnosis of *P. Richardsonii*, but with that of *P. Cicognanii*, the tail vertebræ being but little more than one third the body, and the hairs and vertebræ together being *less* than one half.*

Putorius noveboracensis of Baird's Report is characterized as "Length to tail about ten inches. Tail vertebræ about half this length. Black of tail about half its length," etc. It thus differs from the last only in being larger. Yet one of the three specimens of which measurements are given scarcely exceeds the size of the larger of the two specimens of *P. Richardsonii*, and falls considerably below several of the *P. Cicognanii* in length of body. One of the *P. Cicognanii* specimens even equals the average of those of *P. Richardsonii*, although *P. Cicognanii*, as previously observed, is supposed to be distinctively characterized by its small size. Some differences in the proportional length of the feet, and in the color, are mentioned as existing between this and *P. Richardsonii*, but they are evidently merely individual, and would disappear in a comparison of a large series. To this species he refers the *P. ermineus* of Audubon and Bachman and the *P. noveboracensis* of De Kay.

In comparing some of the "*noveboracensis*" specimens with a short-tailed one of the European *P. ermineus*, I am not surprised that Professor Baird found "very decided points of distinction," "notwithstanding the assurance of authors" to the contrary. The principal one mentioned, however, is the greater brevity of the tail in the European, in which the proportion of the tail to the body is about as it is in *P. Cicognanii*.

In *Putorius longicaudus* the dimensions are given as, "Length to tail about eleven inches. Tail vertebræ about half this length. Black of tail about one fourth its length," etc. The measurements given of three specimens average 10.78 inches in the length of the body, one only reaching eleven, while the tail vertebræ alone equal fully half of this length. It

* "Length of head and body, 11 inches; of tail (vertebræ), 4 inches; of tail, including fur, 5 inches." — *Faun. Bor. Am.*, Vol. I, p. 47.

differs, then, from *P. Richardsonii* only in its slightly larger size, the *proportion of length of tail to length of body being essentially the same in both.* Some smaller specimens are referred to this from the Upper Missouri, of which measurements are not given. Two of the large specimens are marked males; the sex of the other is not indicated. To this species is of course referred the long-tailed Carleton House variety mentioned by Richardson, to which, as already observed, Bonaparte gave the name *longicauda.*

From the preceding comparisons and remarks the inconstancy and the arbitrary character of the distinctions claimed as specific are fully evident. It appears that short tails by no means always accompany small size, nor long tails large size; that both occur at the same localities, as well as at points as remote from each other as the most distant localities at which the species has been found, as Hudson's Bay Territory and the Arctic Regions on the one hand and Massachusetts, Pennsylvania, and Illinois on the other; that between the "species," as characterized by Professor Baird, there is an almost insensible intergradation in all the essential characters, some of the so-called species resting on distinctions that are by no means differences (as *P. Richardsonii* and *P. longicauda; P. Cicognanii* and *P. noveboracensis*, very nearly); finally, that, contrary to the belief of this author, the short-tailed species (*P. Cicognanii* and *P. noveboracensis*) have a range to the northwards equal to that of the others, the *P. erminea* of Richardson being distinctly referable in its proportions to *P. Cicognanii.*

Although differing radically with the eminent author of the Report on the Mammals of North America in respect to the number of valid species of this group in America, — the only American zoölogist who has given it special attention, — I can but commend the candor he has exhibited in his attempt to clear up the discrepancies of former authors, and to sift the subject of its obscurities, as well as the manner in which he has presented his material.

An examination of numerous specimens from the New England and other Northern States has shown me that the variations in the relative length of the tail to the body are merely analogous to similar individual variations in the squirrels and other small mammals that have this part considerably developed, — a variation not always due merely to the lengthening or shortening of the vertebral segments, but occasionally to an increased or diminished number of the vertebræ themselves. Also, that the variation in size so noticeable in specimens from the same locality is in great part sexual, — the males in nearly all species of *Mustelidæ* being considerably larger than the females, — but in many cases to immaturity, and somewhat also to the natural individual range in this respect, which, as in their allies, the mink and marten, and in the Carnivora generally, is much greater than in some other groups. The differences in color claimed now and then as distinctive of different species are generally either such as are evidently seasonal, or such as, like those of the form and proportions of the feet, etc., would disappear in a large series. I hence feel convinced of the existence of but two species of weasels in Northeastern North America, and that these are circumpolar, identical with the *P. vulgaris* and *P. ermineus* of the Old World. These two are always distinguishable with certainty, while their representatives do not present a wider range of variation in size and other characters than is currently admitted for several of their congeners. More than this number being admitted, the whole question as to how many should be recognized, and what constitutes their distinctive characters, becomes involved in the greatest uncertainty.

Two interesting facts in respect to color in the weasels should not in this connection pass unnoticed. One is that both species generally become white in winter; apparently invariably so at the far North, and usually so as far south as Northern New England, but in Massachusetts only the larger one (*P. ermineus*) thus changes, and this not always. Still farther south such a change in *P. ermineus* occurs only occasionally, and in the extreme southern portion of its habitat not at all.* This whitening of the pelage in winter corresponds in geographical relation to the white or light gray color seen in the common wolf at the north, and the gradual darkening of its color southward. The other fact is the usual greater intensity of the yellow on the under parts in specimens from the central portions of the continent, — a variation parallel with the rufous form of the common wolf of the same region, and the comparatively more rufous tint of the pelage seen in specimens from the same district in most continentally distributed species.

Another fact in respect to size is also noteworthy, as corroborative of the general law of the larger size of the representatives of a species from the northern parts of its habitat than those from the southern. The measurements given of the length of the body by those authors who have had only southern specimens for examination is seven inches for *Putorius vulgaris*, and eight to ten inches for the corresponding measurement of *Putorius ermineus*, but Richardson, whose specimens were extremely northern, gives nine inches for the same measurement of the former, and eleven and twelve for that of the latter.†

* Respecting this seasonal change of color, compare the observations of Richardson (Fauna Boreali-Americana), Audubon and Bachman (Quadrupeds of N. Amer.), and Baird (Mam. N. Amer.).

† Professor Baird, in order to reconcile the identification of Richardson's specimens with his *P. Richardsonii*, supposes the body to have been overstretched, as he says he never saw any American ermines that would measure eleven inches before skinning;

In concluding this brief review of the American weasels I will add that, whether *P. frenatus* and *P. xanthogenys* prove ultimately distinct from each other, as they are likely to from the northern species (*P. ermineus*). I regret to feel obliged to assign the *P. Kaneii* Baird to the synonymes of *P. ermineus*, not less from my regard for its describer than for the memory of that admirable man its name is so appropriately designed to commemorate. To the same category I think must also be referred the *P. bocamelus* Bonaparte, founded on the southern race of this species in Europe (Sardinian specimens), as his *P. Cicognanii* was on a similar American race.

Since writing the above I have found that Dr. J. E. Gray, of the British Museum, has recently referred *Putorius Kaneii* Baird to *Mustela erminea* Linn., it forming his " variety 2, *Kaneii* " of this species.* To the same species he has also referred the *Putorius noveboracensis* De Kay, and the *Mustela Cicognanii* and *M. longicauda* Bonap., he calling them altogether " variety 3, *americana*," of *ermineus*. Dr. Gray adds: " Dr. Spencer Baird, in his work on the Mammals of North America, divides the stoats into six species [*P. Richardsonii, P. noveboracensis, P. longicauda, P. Cicognanii, P. ermineus*, and *P. Kaneii*], by the length of the tail and the black on the tail. . . . . When the bodies of several English stoats have been compared they show how deceptive that character is. I do not say that they may not be distinct ; but if they are, there must be other characters to separate them besides the mere length of the tail." He accordingly gives as "species 2" of the stoats, *Mustela Richardsonii*, on Professor Baird's authority, and as chiefly distinguished by the upper lips and legs being "entirely brown." He adds, " I have not seen this species." He further observes: " The specimen formerly named *M. Richardsonii* [by Bonaparte ?], in the British Museum, has the hinder part of the upper lip white, but the hair is bent back and lost off the front part." In respect to the white on the upper lip, he states that English specimens sometimes have it reduced to a very narrow margin.

The American weasel (*P. pusillus* auct.) Dr. Gray likewise considers identical with the European *P. vulgaris*. But Bonaparte's *Mustela bocamela* of Southern Europe he admits as a valid species, under the section of weasels, or of species with the " back and tail uniformly colored," and extends its habitat to include North Africa (Algiers and Cairo). The correctness of this view seems highly questionable, since New England specimens of *P. ermineus* sometimes have the tip of the tail merely

forgetting apparently for the time being this law of variation which he was one of the first to recognize, and towards establishing which no one else has done so much.

* Proc. Lond. Zoöl. Soc., 1865.

dusky, the black being almost obsolete, in which condition they seem not essentially different from the figure and original description of *P. bocamela* in the Fauna Italica.

10. **Putorius lutreolus** Cuv. (*P. vison* Gapper; *Vison lutreocephala* Gray; *Mustela lutreola* Linn.) Mink. Common.

I am not prepared to admit Audubon and Bachman's Little Black Mink (*P. nigrescens*) as distinct from the above. Specimens referable to this supposed species are not of uncommon occurrence. Mr. B. R. Ross considers that the *P. nigrescens* "is nothing more than the young of the *P. vison*," * an opinion I have also long entertained.

In this species we again have an animal of questioned identity, some authors considering it the same as the European *Mustela lutreola* Linn., while others maintain its distinctness. But the differences seem very slight, and have generally been supposed to consist in the front of the upper lip being white in the European, while there is no white on that of the American; in size, proportions, and general color, no one claims that they materially differ. This single character is one of great variability in their near allies, the ermines, some having the white margin of the upper lip very broad, while in others it is very narrow and occasionally entirely obsolete. The other white markings on the mink are notoriously variable, some specimens having this color restricted to a very narrow chin patch, or even *entirely wanting*, while in others there are spots of white on the throat and between the fore legs; in still others white spots occur also along the middle of the abdomen and between the hind legs, forming an interrupted median line of white patches. I also feel confident that I have seen specimens of the American animal with a white margin to the upper lip. Experienced trappers positively assure me that such examples are of occasional occurrence.† Dr. Gray, however, gives a second character of

* Natural History Review, July, 1862, p. 273 In a later paper in the Canadian Naturalist and Geologist (Vol. VI, p. 30), Mr. Ross says the *P. nigrescens* of Audubon and Bachman are "merely common minks under three years of age." He states in another place (l. c. p. 29), "I have remarked that the color of this animal, as well as that of the otter and beaver, grows lighter as it advances in years, and that the white blotches or spots are of greater size and more distinct in the young than in the old. The color of a young mink (under three years), when killed in season, is very handsome; its color is often an almost pure black." I have myself observed a similar variation in color with age in the common black rat, and in other mammals, as well as in many birds.

† Since writing the above I find Mr. Ross says, in referring to Professor Baird's remark that the American mink *never* has the edge of the upper lip white, "I have never seen *the whole* of that part so colored, but in one specimen now on my table there is a white spot beneath the nestril."

distinction between the American and European animals, — a difference in the size of the upper tubercular tooth, — the value or constancy of which I have at present no means of determining.

Of the American animal Dr. Gray makes three "varieties." The first is dark, with unspotted throat and chest, whose habitat he gives as "Vancouver's Island"; but it also occurs in Massachusetts, Michigan, and Illinois, as I have myself observed, and probably throughout the habitat of the species. The second is characterized simply as having the "chin entirely brown," while the third is Audubon and Bachman's *P. nigrescens*. No special habitat is given for the last two. Neither of them, however, is a permanent variety. In the general color, as well as in the white spots, there is a wide variation, different specimens varying from pale brown to quite intense black. There is also an extensive variation in size, but as very large and very small individuals occur in each stage of color it is very difficult to consider any of these variations as other than individual, or such as are evidently to be referred to season, sex, or age.

Numerous supposed species of the Old World mink have also been characterized, chiefly from the warmer regions. five of which are recognized as valid by Dr. Gray. The first of these is the common *M. lutreola* of Linnæus, the habitat of which is given as "Europe." The second is the *M. siberica* of Pallas, which Dr. Gray says is paler and smaller than *M. lutreola*, with the tail relatively longer and the end paler colored, or like the back, instead of darker than the back.* He observes that it "varies greatly in the quantity of white on the chin and throat," and adds that the "*males are much smaller*." The last statement, if true, indicates a remarkable exception to the sexual law of variation in size in this family. The habitat is given as Siberia, Himalaya, Japan, China, and Formosa. Dr. Gray's third species is the *Mustela canigula* of Hodgson, originally described from specimens from the Nepaul Hills of India. Its chief distinction seems to be an unusual amount of white on the face, chin, throat, neck. and chest, although Gray mentions as a variety a specimen with darker fur and much less white. His fourth species, *Mustela* (*Vison*) *Horsfieldii* Gray, seems not to differ particularly from the others, or from frequent American specimens, as its "variety two" is characterized as "chin brown, *edge of under lip only* white." This is likewise from India (Bootan) and Japan. The fifth, from Nepaul, the *Putorius subhemachalna* of Hodgson, differs from the preceding in being generally lighter or redder, — in other words, having less intensity of color, — with minor differences in the amount and distribution of the white. If all these species are valid, it will be seen that Southern and Eastern Asia and Japan are peculiarly rich in species of this

* The relative shade of color of the tip of the tail as compared with the back is a character too inconstant in this group to merit serious mention.

group.* But, in view of the well-known similar variations presented by our American mink, they seem to rest on very unsatisfactory distinctions, especially as the "varieties" admitted under some of them cover the differences considered as distinctive of the different species. The general paler color and somewhat smaller size of the southern forms † is paralleled by similar differences in specimens of the American animal from the southern portion of its habitat. In view of all these facts, I strongly incline to the opinion that we have here again but one circumpolar and widely dispersed species, with possibly two continental or geographical races that may be more or less easily recognized. Else, as in similar cases previously discussed, we must admit an indefinite number, subject in this respect and in their limitation to the caprice of those authors whose forte is in the description of "supposed new species." ‡

11. **Gulo luscus** Sabine. Wolverine. Dr. De Kay, in his

* It is a fact especially noteworthy that regions whose Natural History is considered as but partially explored are far richer in species (I refer more especially to mammals and birds), accepting only such as are currently allowed, than those much longer and more familiarly known. To be assured of this one needs but to compare Southern and Middle Europe with the corresponding parts of Asia, or Eastern and Northern America with Mexico and Central America, adopting as a basis for the comparison only those types or groups widely distributed. This fact is especially illustrated in the Carnivora, as the present family of *Mustelidæ* exemplifies. While distinct types appear in different regions, as some in the warmer latitudes that are not found in the colder, and *vice versa*, the martens and sables, as well as the minks, under not very different physical conditions, far outnumber in Eastern Asia alone, in reputed species, their representatives in Europe. While I would not deny the possibility of this being a fact, the intimate relationship which these several supposed species bear to each other, as well as to the European, and the unsatisfactory distinctions on which they are founded, seem to render it extremely improbable. If we extend the comparison to other groups, and to other regions, we constantly meet with cases parallel in all respects to this. This excess of species also almost always happens, in mammals, among those least known, either through their great scarcity or their nocturnal or recluse habits rendering them difficult to obtain. The explanation of this seems to be that new species are not anticipated to occur in a region that has been for a long time thoroughly explored, while specimens from imperfectly known districts, or of species in groups where the species are supposed to be difficult to distinguish, are most critically examined, and those differing slightly from others previously described — though not more, in many cases, than specimens unquestionably of the same species and obtained at the same locality frequently do — are presumed to represent undescribed species.

† See Gray's table of comparative measurements of the skulls of his several species Proc. Lond. Zoöl. Soc., 1865, p. 118.

‡ In the mink, as in the marten, it is an interesting fact that the Asiatic specimens bear a stronger resemblance to the American than the European do. According to authors, specimens not unfrequently occur in Japan and portions of Eastern Asia that are hardly distinguishable from average American ones.

Report on the Mammalia of New York, published in 1842 (p. 28), says: "Professor Emmons states that they still exist in the Hoosac Mountains, Massachusetts." But the species is not given in Emmons's Report, published two years before; it occurs, however, in Dr. Hitchcock's List, with the following note: "On Hoosac Mts.; rare.—Emmons." It is more or less common from Northern New England to the Arctic coast.

This species is remarkable for being the only one in the Mammalian Fauna of the State usually regarded as common to both the Eastern and Western Hemispheres. The existence in all together of but two or three circumpolar species of land mammals is admitted by many naturalists. It must also present an unusual constancy of character, since not only has it escaped subdivision into pseudo-species, but even no "varieties" have been generally recognized.

12. **Lutra canadensis** Sabine. (*Latax canadensis* Gray; *Lutra canadensis* and *L. destructor* Barnston.*) Otter. Not rare; still not often captured. At Springfield I have known some half-dozen specimens taken in the last ten years.

13. **Mephitis mephitica** Baird. (*M. chinga* Tiedemann; *M. varians* Gray; *M. mesomelas* and *M. chinga* Maximilian.) Skunk. Abundant. Individuals from the same locality, and even from the same litter, are very variable in color, some being almost entirely black, while others have a very large proportion of white. The amount of baldness on the soles of the feet is also very variable, independently of season or age, although this has been deemed by some naturalists, as Lichtenstein and others, as a character of great importance. Attention has been previously called to its inconstancy.†

Probably no other North American mammal is so strikingly variable in color as the common skunk; it is hence not surprising that foreign naturalists, unacquainted with the animal in life, have made of it a considerable number of supposed species. So well known is this variability to most persons at all familiar with the animal that it is all the more unexpected to find from a naturalist so justly reputed for accuracy as the author of the Report on the Mammals of North America a statement like the following: "This species varies considerably in its markings, *though individuals from the same locality are usually quite similar.*" ‡ Especially is this so after the

* Canadian Naturalist and Geologist, April, 1863, p. 147.

† See Dr. J. E. Gray's Review of the Mustelidæ, Proc. Lond. Zoöl. Soc., 1865, p. 147.

‡ Mam. N. Amer., p. 195.

detailed account given by Audubon and Bachman of very wide differences in color between individuals of the same litter.* The majority of the Massachusetts specimens I have seen accord very well with Professor Baird's diagnosis, the general color being black, with a narrow white streak down the face, a large white nuchal patch, and a broad white streak on each side of the back reaching commonly nearly to the tail, which is tipped with the same color. Sometimes the face streak is united with the nuchal patch, but oftener it is separated by a narrow space of black, and is occasionally absent. The dorsal streaks vary in breadth and posterior extent, generally enclosing a narrow band of black; but the latter is sometimes wanting, when they, uniting along the median line, form but one; they run nearly parallel or widely diverge posteriorly, where frequently each is deeply bifid; more frequently than otherwise they entirely cease near the loins. The nuchal patch also varies in form and extent; generally it is continuous with the dorsal streaks, but is often entirely separate from them, and is itself sometimes divided, forming two small lateral patches; its general outline is variable almost beyond description. The white on the tail is sometimes terminal and sometimes basal; now and then it is quite absent, but occasionally it preponderates over the black. The distinct terminal pencil of long white hairs in the tail, so often described, seems generally best defined in young specimens; in full-grown ones it is frequently absent. Individuals occasionally occur that are either entirely, or almost entirely, black; much more rarely others with nearly the whole of the dorsal surface white, as in a specimen in the Museum of Comparative Zoölogy, collected in Newton, Mass., by Mr. C. J. Maynard. This has the black restricted to a narrow dorsal line, a few scattering hairs in the tail and to the lower surface of the body, the white dorsal band being nearly two inches broad on the neck and seven at the loins. Mr. Maynard has another specimen, taken at the same locality, which has still more white, there being no black median line, and the white extends still lower on the sides of the body. In short, the variations in color in the skunks are almost endless, scarcely any two specimens being quite alike. It therefore seems preposterous to found species on particular styles of coloring, or on the relative proportion and distribution of white and black, as several authors have done.

Eight species were described by Lichtenstein in his monograph of the genus *Mephitis*† from Mexico and the United States alone, while from North and South America together he gave sixteen! Professor Baird recognized six in his Report, and mentions three others described by

* Quad. N. Amer., Vol. I, p. 319.

† Ueber die Gattung *Mephitis*, Afhand. Akad. Wiss., Berlin, for 1836, 1838, pp. 249–315, and 2 plates.

Lichtenstein from Mexico as probably valid and also likely to occur in the United States. Dr. Gray* has very judiciously reduced the number to five, including those of both North and South America, but he places them in what he considers three genera, — *Conepatus* (1837, nearly equal to *Thiosmus* Lichtenstein, of subsequent date), *Mephitis*, and *Spilogale*. He gives all as occurring in North America. To the first, *Conepatus nasutus* Gray (*M. nasuta* of Bennett†), he refers, and it appears to me very properly, the *M. leuconota* and *M. mesoleuca* of Lichtenstein and Baird, and numerous other species of other authors, thus greatly reducing the number previously received. He separates it, however, into four "varieties," which are based on the distribution of the colors, although they seem to be about as uncertain in extent and relative proportion in this species as in the more northern one. Of *Mephitis* proper Gray gives three species, two of which (*M. vittata* Licht. and *M. mexicana* Gray, = *M. macroura* Licht.) are from Mexico, and the other (*M. varians* Gray, = *M. mephitica* Baird, = *M. chinga* Tiedemann) is generally distributed over North America, from Great Slave Lake‡ southwards; of *Conepatus* and *Spilogale* one each. It is highly probable, however, that Mexico is not thus pre-eminently rich in species of these animals, and that Gray's two Mexican species may be referred to the common North American one, since they rest almost solely on distinctions of color that are far from peculiar to the Mexican examples. This being true, we have three supposed genera containing a single species each, or. what seems to me more probable, the alleged differences being slight, a single genus with three species, which agree rather closely in their general style of coloring and in possessing a remarkably large range of indefinite color variation. In distribution, one (*M. mephitica*) is northern, ranging from Mexico almost to the Arctic regions, and the others (*M. mesoleuca*, = *Conepatus nasutus* Gray, and *M. bicolor*) southern, inhabiting from Mexico and the Southern States to Patagonia.

Our common species (*M. mephitica* Baird) Dr. Gray divides into five "varieties," based on the relative extent of the white dorsal streaks, which form among themselves a graduated series. The inconstant nature of the characters assigned to these as distinctive it seems to me renders them unworthy of recognition, since they not only all occur at single localities, but, as Audubon has shown,§ several of them sometimes appear in the

* Proc. Lond. Zoöl. Soc., 1865, pp. 145 *et seq.*

† Ibid., 1833, p. 29.

‡ B. R. Ross, l. c., p. 273.

§ "In the winter of 1844 we caused a burrow to be opened in Rensselaer County, N. Y., which we knew contained a large family of this species. We found eleven; they were all full grown, but on examining their teeth and claws we concluded that the family was composed of a pair of old ones, with their large brood of young of the previous season. The male had a white stripe on the forehead; and from the occiput down the same litter. Most of these pseudo-varieties and others of a similar character have been described by authors as distinct species. Prince Maximilian in his latest work * still maintained the existence of two species, *M. mesomelas* Licht and *M. chinga* Tiedem., in the United States. The latter (*M. chinga*) he seems to have known only from imperfect skins brought by the Indians of the Upper Missouri from, as he presumed, the Red River of the North and the Saskatchewan. They were used by them as trappings for the legs, and were all very white, differing only in this respect from the common skunk. As specimens similarly colored occur more or less frequently throughout the United States, it seems more probable that the Indians may have selected skins of this color for the special use to which we are informed they applied them than that the skunks of any given region are generally so colored.

Without going into the synonymy of the subject in detail, I may add that for the common North American species Dr. Gray strangely adopts the specific name of *varians* (*M. varians* Gray, 1837), this name being superseded in priority by both *chinga* of Tiedemann (1808) and *americana* of Sabine (1823), as well by *mephitica* of Shaw (*Vivera mephitica*, 1792). This latter being the one first given, has very properly been adopted by Professor Baird.

URSIDÆ.

14. **Procyon lotor** STORR.† RACCOON. Formerly numerous,

whole of the back had another white stripe four inches in breadth; its tail was also white. The female had no white stripe on the forehead, but had a longitudinal stripe on each side of the back, and a very narrow one on the dorsal line; the tail was wholly black. The young differed very widely in color; we could not find two exactly alike; some were in part of the color of the male, others were more like the female, whilst the largest proportion were intermediate in their markings, and some seemed to resemble neither parent. We recollect one that had not a white hair except the tip of the tail and a minute dorsal line." — AUDUBON and BACHMAN, *Quadrupeds*, Vol. I, p. 319. See also the two young figured by these authors (Plate 42), one of which has white stripes on the back and a black tail, and the other no stripes and the end of the tail white, though both were of the same litter. I have myself met with similar variation in the same litter of young.

* Verzeichniss Nordamerikanischer Säugethiere, Archiv für Naturg., XVII, 2, p. 218.

† *Ursus lotor* LINNÆUS, Syst. Nat., I, 1758, 48, Ib., I, 1766, 70.

Procyon lotor STORR, Bod. Meth. Anim., 1780.

" *Hernandezii* WAGLER, Isis, XXIV, 1831, 514.

" " BAIRD, N. Am. Mam., 1857, 212.

" " IB., U. S. & Mex. Bound. Surv., II, Mam., 1859, 22.

" " var. *mexicana* BAIRD, Ib., 22.

" *lotor*, var. *mexicana* ST. HILAIRE, Voyage de la Venus, Zoöl., I, 1855, 25, pl. VI.

" *nivea* GRAY, Charlesw. Mag. Nat. Hist., I, 1837, 580.

" *psora* IB., Ann. & Mag. Nat. Hist., X, 1842, 261.

and still more or less common in the mountainous and sparsely settled parts of the State.

Quite variable in color, the variations on the one hand tending strongly towards melanism and on the other towards albinism. On specimens presenting the latter kind of variation seems to have been founded the *Procyon nivea* of Gray from Texas,* as probably also the *P. psora* of Gray † from California. ‡ With the variations in the general tint the markings usually become more or less indistinct. In even what may be considered as the normal or average type the dark rings of the tail vary from four to six in number, in intensity of color, and in relative breadth to the interspaces; sometimes the dark rings are only about half the width of the intervening lighter ones, but, as I have observed to be the case in numerous specimens killed in Massachusetts, Western New York, and Florida, they often equal, and not unfrequently exceed them. The tail varies also in its form and size, as it does in the foxes and marmots, sometimes tapering considerably towards the tip, though generally but slightly. Yet these characters have been assumed by some authors to be indicative of specific differences, the *Procyon Hernandezii* of Wagler § having been founded originally on such slight variations. Professor Baird, however, has gone quite fully into a discussion of its merits as a species, ‖ but the distinctions he particularly mentions as separating it from *P. lotor* — the more tapering form of the tail, the rings of which he deems "narrower and better defined," with "the light intervals wider," and a "*nearly constant* difference in the color of the upper surface of the hind feet," which he says is darker in *P. Hernandezii* — are so slight, and based withal on characters so exceedingly liable to variation, that they can scarcely be considered as of specific value. Though apparently of somewhat larger size the relatively larger and stouter feet claimed by him to distinguish *P. Hernandezii* his measurements seem to scarcely sustain. He admits that *P. Hernandezii* bears a very close relationship to the *P. lotor*, and says that "without close comparison the differences are perhaps intangible," and that "its characteristics are more comparative than absolute." Still "an examination of a large number of North American raccoons," he affirms, "has resulted in the appreciation of certain differences which appear quite constant." They are those above specified, and, as I have already ob-

* Charlesworth's Mag. Nat. Hist., Vol. I, 1837, p. 580.

† Ann. and Mag. Nat. Hist., Vol. X, 1842, p. 267.

‡ In his recent revision of the "Ursine Animals," Dr. Gray has referred both these to the *P. lotor*. See Proc. Lond. Zoöl. Soc., 1864, p. 684.

§ Isis, XXIV, 1831, p. 514.

‖ See N. Am. Mam., p. 213, and Mex. Bound. Survey, Vol. II, Mammals, p. 22.

served, are very slight, and pertain to the most variable parts of the animal. Some of them I feel sure are but individual differences, depending mainly, especially those in respect to the form of the tail, on age or season. In respect to the black annuli, hardly two specimens can be found that do not vary more or less. In the large series of New England specimens in the Museum of Comparative Zoölogy, the variation between the extremes in this respect covers the whole range of the differences assumed to distinguish the two supposed species. The single authentic specimen of *P. Hernandezii*, labelled apparently by Professor Baird himself, that I have seen * is not appreciably different in general color from many Massachusetts specimens. The supposed differences, it seems to me, are hence reduced to the single one of absolute size, which a large number of specimens of the so-called *P. Hernandezii*, from different localities, might very considerably modify. From a comparison of authorities, as will be seen from the remarks that follow, this seems to be indeed the fact. The example of *P. Hernandezii* above referred to (No. 67, Smithsonian Cat.), from Bodega, California, is actually smaller than the average of New England specimens.

Professor Baird remarks that some of the characters of *P. Hernandezii* given by Wagler and Wiegmann, as the prevailing color of the back and sides, differed from specimens he referred to it; in other words, they were more like his *P. lotor.* St. Hilaire, in the Zoölogy of the Voyage of the Venus, † also described and figured a specimen from Mazatlan that varied similarly from *P. Hernandezii* Baird, it being smaller and colored more like *P. lotor.* Under *Procyon Hernandezii* var. *mexicana*, Baird describes a single skin brought by the Boundary Commissioners from Espia, Sonora, that he says agrees with St. Hilaire's Mazatlan specimen (already referred to), which St. Hilaire considered to differ in nothing but in intensity of color from the common *P. lotor.* Professor Baird remarks that this Espia specimen exhibits a close relationship to *P. lotor*, though readily distinguishable from it, he claims, by its "larger and more naked feet and hands." These specimens, in resembling *P. lotor* more than some others from the same region referred to *P. Hernandezii*, show still more fully the inconstancy of some of the characters on which the latter is founded. In habits the two supposed species have not been found to differ. ‡ Hence, unless the more southern *P. cancrivorus* occurs in Cali-

* Contained in the Museum of the Boston Society of Natural History, and received from the Smithsonian Institution.

† Vol. I, 1855, p. 25, pl. VI.

‡ Professor Baird observes: "According to Dr. Berlandier, the habits of this species [*P. Hernandezii*] are precisely similar to those of the common raccoon." Dr. C. B. Kennerly's notes are also of the same purport. — *Report on the Mammals of the United States and Mexican Boundary Survey*, p. 22.

fornia, as supposed by Audubon and Bachman, I see no reason why, in view of the known variability of *P. lotor* in the Eastern States and the relatively small differences only thus far pointed out between them and their Western relatives, all the raccoons of the United States thus far known should not be referred to *P. lotor*.*

15. **Ursus arctos** LINNÆUS. (*U. americanus* Pallas.) BLACK BEAR. Extinct in the more thickly settled parts of the State; occasional among the mountains of the western counties.

In respect to the occurrence of this species in this State, Dr. Emmons remarked in 1840: "It is not many years since great numbers appeared there [on the Hoosac Mountain range] at once, and between twenty and thirty were taken in the course of one autumn, on the mountains in Adams and Williamstown. They are still to be found, and several have been taken every year since." (Rep., p. 24.) The local newspapers yet frequently chronicle their capture in Berkshire County.

Contrary to what was formerly supposed, bears everywhere appear to be among the most variable of mammiferous animals, not only in coloration, but in size, proportions, and in the conformation of the skull and other parts of the skeleton. Those familiar with them in life say it is rare to find two alike. A writer in the American Naturalist † has alluded to two females of the same litter, captured by him in Maine when young and raised as pets, that differed so essentially in their general build as to correspond respectively with what has been termed "ranger bear" and "hog bear," they differing also as much in disposition as in form. I am also informed by my friend Mr. C. W. Bennett that he has known two cubs of the same litter, taken in one of the Western States, that as they grew up differed very materially from each other in color, one being *black* and the other *brown*. They differed also widely in form and disposition, one being docile and playful while the other was ferocious and dangerous. The leading varieties in color of the American and European bears, as the brown and the

* This is also the view now taken by Dr. Gray, who remarks respecting *P. lotor* as follows: "This species varies rather in the tint of its colors in the different parts of North America It is very apt to become white, and is thus the *Procyon nivea* (Gray, Mag. Nat. Hist., 1857, p. 580) from Texas; I described a specimen from California, with the tail imperfect, as *P. psora* (Ann. and Mag. Nat. Hist., 1842); and Wiegmann described two other varieties under the names of *P. brachyurus* and *P. obscurus* (Arch. III, 369). Dr Baird, in the Mammals of North America, considers *P. Hernandezii* as a species, and calls it the Black-footed Procyon, including *P. psora*, which has feet as *pale or paler than* P. lotor." — *Proc. Lond. Zoöl. Soc.*, 1864.

† Vol. I, p. 657.

black bears are now generally deemed to be but varieties and not species, though so regarded by Cuvier and the earlier naturalists generally. Great variations in the form of the skull in individuals from the same locality not unfrequently occur, aside from the differences caused by age and sex. Professor Baird mentions a skull from Saranac Lake, New York, which differs very appreciably from the ordinary type, agreeing quite nearly in some respects with the *Ursus arctos* of Europe. Concerning this specimen he remarks: "A large number of specimens from this locality may perhaps furnish a clew to this remarkable variation, which, under other circumstances, would be readily allowed as indicating a distinct species." * I some time since began to consider many of the so-called specific characters drawn from the skull as of very doubtful value, from the wide range of variation any considerable series of specimens from the same locality, and unquestionably of the same species, usually exhibit, aside from those arising from differences of age and sex. In the foxes and wolves, the common bear, the different species of *Mustelidæ*, and the larger rodents, such differences are often very considerable. On this point I find the following concurrent testimony from an author little liable to the charge of conservatism in respect to the multiplication of species or other groups.

Dr. J. E. Gray, of the British Museum, in his recent monograph of the bears, in the Proceedings of the London Zoölogical Society, † thus calls attention to the subject. "The examination of the series of skulls of bears in the [British] Museum, like the examination of the series of bones of the *Viverridæ*, has strongly impressed me with the uncertainty that must always attend the determination of fossil bones, or indeed of bones of all animals, when we have only the skulls or other bones to compare with each other. There can be no doubt that the study and comparison of the bones of the different species is very important, — that the skull and teeth afford some of the best characters for the distinction of genera and species; but few zoölogists and palæontologists have made sufficient allowance for the variations that the bones of the same species assume. In the bears, I have observed that there is often more difference in skulls of bears of the same species from the same locality than between the skulls of two undoubted species from very different habitats and with very different habits. Thus I have the skulls of some bears the habitat of which is not certainly known, which I have doubts whether they should be referred to the Thibet Bear (*U. torquatus*), or to the North American species (*U. americanus*), but I have referred them to the latter, as they were said to have come from that country. It is the same with regard to the skull of a bear that lived in the Zoölogical Gardens for years, which has the general form of the skull and the wide palate of the European bear, but the long last grinder

* N. Am. Mam., p. 227. † 1864, p. 684.

and some other characters of the *U. ferox.* This similarity of skulls," he says, "is the more remarkable, as no two bears can be more distinct from each other than the species above named,* which have such similar skulls, showing that similar skulls do not always imply very nearly allied or doubtfully distinct species."

The bears have ever been a perplexing group, and accordingly the opinions advanced by different authors respecting the number of species vary widely. Several high authorities consider the land bears of Northern North America, Northern Asia, and Europe as forming but one, or at most two, species, among which are Blainville and Middendorff, the latter of whom, with access to a large amount of material, has especially and most minutely investigated the subject. Other authors are disposed to allow a much greater number. But, unfortunately, their statements in reference to the differences that should distinguish them are frequently contradictory. Dr. Gray recognizes eight † in his recent monograph, with numerous "varieties" and "subvarieties" of each. Of the *Ursus arctos*, or brown bear of Europe, he describes four varieties, and of the first of these eight subvarieties, to all of which he gives distinctive names. All of these are chiefly based on variations in color, the teeth, or the skull, although he states in the same paper that characters based on the latter are to a considerable extent unreliable for even the determination of species. ‡ Nilsson, in his Scandinavian Fauna, distinguishes six varieties that differ widely in color from Sweden alone. A careful study of Middendorff's tables of measurements, embracing some fifty specimens of bears from Europe and Asia, show how very extended is the range of variation in osteological and external characters, and how irregular is its nature. Schrenck has also called attention to the great variation in the size of the tuberculated grinders in the bears of Northern Asia, — a character which is unfortunately made the principal basis of Dr. Gray's specific and subspecific distinctions. Dr. Gray himself mentions that there are considerable variations in the series of skulls of American bears in the British Museum; particularly in the amount of depression in front of the orbits. His several tables of measurements of skulls that he himself refers to one

* In respect to this point I shall soon show that naturalists high in authority do not agree with Dr. Gray in regard to the great distinctness claimed by him for these species.

† It seems to me that no recent writer has been guilty of greater inconsistency than is exhibited by the author of the monograph on the *Ursidæ* above cited; for after calling attention to the variability of craniological characters, and their consequent unreliability as specific distinctions, he adopts some of those that can be readily shown to be the most trivial — even manifestly so from his own paper — as the basis of his classification of his species and varieties. So difficult is it apparently to overcome long-established habits of thought and modes of reasoning.

‡ See preceding page.

species indicate very considerable differences in the proportion of breadth to length in the entire skull, and in the relative length and slenderness of the muzzle. In consequence of such variations Dr. Gray and Professor Baird arrive at widely different conclusions in reference to the relationship of the *U. cinereus* Gray (*U. horribilis* Baird) to the *U. americanus.*

There is a strong tendency among naturalists to consider the Old World bears as all distinct from those of North America, and to recognize at least two species among the latter, — the grizzly bear (*Ursus horribilis*) of the West, and the continentally dispersed black and brown bears (*U. americanus*). Professor Baird, in his Mammals of North America, gives the probable number as five, four of which he seems to consider well founded, and thinks that there may be two others. But each of the recognized species presents so many varieties, which to a greater or less extent intergrade, that well-marked lines of distinction cannot at present be drawn. This has led a recent writer to observe, and it seems to me very justly, "If the same consolidation of species which some authors practise in plants was carried out in animals, we should have but one species [of bear] for the whole northern hemisphere." *

The present indications are that the *U. horribilis* is hardly so distinct from the common *U. americanus* as has been currently supposed; † it also presents close affinities in many respects with the *U. arctos* of Europe. Towards the north it shades into what is called the Barren Ground bear, which latter has been repeatedly referred, with more or less positiveness, by different authors to the *U. arctos* rather than to *U. americanus* or *U. horribilis.* Middendorff found the bears of Northeastern Asia equalling in size and generally resembling in other characters the *U. horribilis* (*ferox* of authors) of the Western Coast of America. The *U. americanus* also presents numerous variations in color and in other points quite parallel with similar variations in the European *U. arctos.*‡ Specimens often occur on the one continent that are strikingly like others from the other. Middendorff expressly states that the differences between *U. arctos* and *U. ferox* (*horribilis*) are not greater than occur between different specimens of *U. arctos.* Dr. Gray admits that it is only a knowledge of the locality that in some cases enables him to separate them.

* Andrew Murry, Geog. Distr. of Mammals, p. 119.

† See Professor Baird's N. Am. Mam., pp. 219 – 228.

‡ I learn from Mr. W. H. Dall, who has recently returned from a three years' exploration of Alaska, bringing with him important information relative to the natural history, geography, etc., of that country, that three kinds of bears are distinguished there; the larger and the more common being the grizzly, the second the so-called Barren Ground bear, while the third and smallest is a black bear; showing that there is found the usual variety, in point of size and color, seen on the Pacific Coast farther south.

In the Natural History Reports of the United States and Mexican Boundary Survey,* Professor Baird gives much valuable information, in addition to that contained in his Mammals of North America, respecting the bears of the Rocky Mountain and West Coast regions of the Continent. On the whole it tends to render the subject still more difficult and complex, if we recognize more than a single species in North America, as many of the different specimens described represent intermediate stages between the two commonly recognized American species. A specimen collected by Dr. Kennerly, at Los Nogales, Sonora, and others at the copper mines in New Mexico, by Mr. H. J. Clark, differ so much from the "grizzlies" of California, that Professor Baird described them as a distinct variety of the latter, — *Ursus horribilis*, var. *horriæus*. Although the leading characters are the same, this "variety" differs in being smaller, with relatively shorter ears and a longer tail, these parts being nearly equal, instead of the ears twice the length of the tail, as in California specimens; it also differs in the texture of the fur, in the arrangement of the colors, in the greater relative breadth of the skull, its narrower and slenderer muzzle and more vaulted palate, and in the shape of the teeth. While the "*horriæus*" specimens are quite distinct from either of the so-called varieties of *U. americanus*, the variation from the typical *U. horribilis* of California is towards *U. americanus; U. americanus* of the Eastern States differing from them chiefly in being smaller. In the smaller size, compared with *U. horribilis*, and the great breadth of the head, "*horriæus*" also affiliates with the *U. arctos*. The latter is usually supposed to never attain the size exhibited by many specimens of the *U. ferox* (*horribilis*); but Prince Maximilian says that this is incorrect, as he has seen Russian bears that were fully as large as the latter; and Middendorff, as already stated, remarks that the bears of Northeastern Asia are as large as those of the Pacific coast of America.†

In reference to the peculiar bears of the Sonoran region, Dr. Kennerly has observed as follows: "In regard to the bears that are found along the northern frontier of Mexico and the southern portion of New Mexico, there seems to be some confusion. In addition to the common black bear,

* Vol. II, Mammals, pp. 24–81.

† The facility with which the bears can cross in winter from one continent to the other by way of Behring's Strait, and the known fact that they do thus cross (I am assured of this fact by Mr. Dall), renders the close mutual resemblance of the bears of Northeastern Asia and Northwestern America a matter of no great surprise. The similar resemblance between the martens and the representatives of the other circumpolar species from these countries, which has been already pointed out, though some of them may be able to pass less readily than the bears from one continent to the other, would seem to be fully accounted for by a similar occasional migration, if any hypothetical explanation for so natural a phenomenon as the great similarity of the animals specifically identical in these slightly separated districts is required.

Ursus americanus, and the large Grizzly, *U. ferox*, there is found another, intermediate in size to these, generally of a brownish color, with the tips of the hairs often silvered, especially in the old individuals, and in appearance, except in size, is almost identical with the *U. ferox* found in such great numbers in California. Among the people of the country they are known as *brown bears;* but this term is variously modified by the most experienced hunters, as we have heard applied by them, to the same individual, the name grizzly bear, touch of the grizzly, cross between the grizzly and brown bear, and common brown bear; but on no occasion have we heard them assign any relationship between these animals and the common black bear, causing us to believe that there must be a considerable difference between this animal and the brown bear of Oregon, which is called by naturalists only a variety of the black; in fact, its size generally, would necessarily preclude such comparison, while even the very old individual falls far short of the weight and dimensions of the *U. ferox* of California, of which we could much more easily consider it a variety than of the *U. americanus*." * One of the three of Mr. H. J. Clark's specimens, however, referred by Professor Baird to the *U. cinnamomeus* Baird, was "glossy black," and the others brown.

Audubon remarks that the *U. horribilis* varies in color from nearly white through various shades of pale and dark brown to black, it being difficult to find two specimens alike. The young are generally much darker than the adult. Yellowish gray and grayish brown are common varieties, while some are of a rufous tint. This account is confirmed by Prince Maximilian's observations on the bears of the Upper Missouri.†

The specimens from New Mexico and the adjoining country southwards, which present the peculiar characters mentioned above, have usually been referred to the *U. horribilis*, as previously stated; but others that are equally perplexing, but commonly referred to the brown variety of *U. americanus*, also occur in the same region. Some of these latter differ so much from other brown bears from Oregon, also referred to *U. americanus*, that Professor Baird has considered the probability of their proving distinct species very great, and proposed to call the former, in that event, *U. amblyceps*. These Sonoran specimens differ from representatives of *U. americanus* from the Eastern States in nearly the manner that the Sonoran variety *horriæus* of the grizzly, *U. horribilis*, does from the true *U. horribilis* of California; namely, in the greater relative breadth of the head, the relatively smaller size of the molar teeth, and the irregular character of the

* United States and Mexican Bound. Surveys, Vol. II, Mammals, p. 28.

† Verzeichniss der auf seiner Reise in Nordamerika beobachteten Säugethiere, Vom Prinzen Maximilian zu Wied. Archiv für Naturgeschichte, XXVII, 1861, Theil 1, p. 203, Taf. VIII.

coloration. Professor Baird provisionally refers them to the *Ursus americanus*, var. *cinnamomeus*, of Audubon and Bachman, to which, he says, they bear the nearest resemblance.

Prince Maximilian, in his memoir "Über die Selbständigkeit der species des *Ursus ferox* Desm.,"* urges strongly the distinctness of *U. horribilis* (*ferox* Maxm.) from both *U. americanus* and *U. arctos*, in which he is supported by the anatomical observations of Dr. C. Mayer, which form an appendix to his paper. Several specimens of the former, of different ages, from the Upper Missouri, are described in detail, but no differences other than those previously pointed out by other authors, are mentioned. They consider that the shorter ears and longer claws of *U. horribilis*, with certain minor osteological peculiarities, sufficiently distinguish it from *U. arctos*. These authors admit that bears from northern countries present great individual differences; yet, in reviewing Middendorff's arguments, they offset their conclusions, based on an examination of a very limited number of specimens, against those of the latter, formed from probably as careful an elaboration of many times their amount of material. The differences that have been described by authors as occurring between specimens of *U. arctos* from different parts of Europe and Asiatic Russia, or between different specimens of either *U. horribilis* or *U. americanus* from different localities on this continent, are as great as those they urge as peculiar to their so-called species.

I have not space to notice in detail each point urged as distinctive by those authors who divide the bears into a large number of species. As they mainly rest on the shape and size of the molar teeth, the relative length of the claws and the ears, and the proportions of the skull, a few further remarks on these characters may not be out of place. In Professor Baird's table of measurements of skulls of American bears, the average proportion of breadth to length in the seven specimens cited is sixty per cent, with a minimum of fifty-five per cent, and a maximum of seventy-one. Only one of the series, however, exceeds sixty. Adding four other specimens referred by Baird to "*cinnamomeus?*" the average of the eleven is fifty-nine and a half per cent; the minimum is fifty-three, and two specimens range above sixty. The proportional breadth of the skull in eight specimens of *U. horribilis* is fifty-six per cent. Between the extremes of this series (Nos. 1218 and 2037) the variation amounts to ten per cent. In his comparison of *U. horribilis* with *U. arctos*, Baird cites two of Blainville's specimens in which the same proportion is sixty-six per cent; in reference to which he adds: "This width of head far exceeding that of any well-known American species, would appear to be quite conclusive as to identity," — Professor

* Verhandlungen der Kaiserlichen Leopoldinisch-Carolinischen Akademie der Naturforschung, Band. XXVI, erste Abtheil., 1857, pp. 33 – 85, Taf. III, IV, and V.

Baird not having then received the Saranac (New York) specimen, with the breadth of the head seventy-one per cent of the length. In five skulls of the *U. arctos*, of which measurements are given by Dr. Gray, the average proportion of breadth to length is sixty-seven per cent; in five of the *U.* "*torquatus*," sixty-one; in two of *U.* "*syriacus*," sixty; in four of *U.* "*Isabellinus*," sixty. The average of these sixteen European and Asiatic skulls is thus sixty-two per cent. Gray also gives measurements of five American skulls; viz., two of *U. cinereus* (= *U. horribilis* Ord) and three of *U.* "*americanus*"; the proportional breadth of the skull in the latter is sixty-one per cent, and in the former fifty-eight. This would seem to indicate a tolerable constancy in the greater narrowness of the skull in the American bears. But from Middendorff's table of measurements of fifty-five skulls, from different parts of Russia (chiefly from Northeastern Asia), the percentage of breadth to length falls to fifty-eight and a quarter, and is hence almost precisely that of the American. The maximum breadth of skull seems to be reached in Western Europe; thence eastward to Kamschatka there is a nearer and nearer approximation in this character, as in general appearance, to the American animal.

In respect to the variability of the skull in other particulars, Dr. Gray, in referring to two skulls of *U. horribilis*, remarks that they differ very considerably; the one is much broader, with the palate wider, the nose shorter, and the orbits higher and rounder.

In comparing the teeth of the American bears with those of the European, when but a single example of each is taken, the differences *may* be considerable, so great, indeed, that if constant they might be regarded as sufficient to decide the question of the distinctness of the species; but since specimens frequently occur from the same locality that differ as much, and others from the different continents that are almost or quite indistinguishable, the unreliability of such distinctions becomes sufficiently apparent.

Variation in the size and shape of the molar teeth are found in other groups than the bears, though rarely perhaps so great. According to Professor Peters of Berlin, in the *Otariæ*, or eared Seals, the variation in this respect seems to be even somewhat greater. Most authors have heretofore looked upon the teeth of the Otariæ as affording good generic characters, but Professor Peters has found them to be so exceedingly variable that he does not consider them reliable for even specific distinctions.*

The ears, in length and form, are found to vary greatly in specimens of *U. horribilis* from different localities, especially from points on different sides of the Rocky Mountains; whether variations of this sort are found in *U. arctos*, it is difficult from the few sufficiently detailed measurements given by authors to determine. That such do occur in specimens of bears referred

* Monatsber. Ak. Wiss., Berlin, 1866, pp. 261–281 and 655–672.

to the same species by authors who separate them into numerous species, lessens the importance of distinctions based on them as separating the bears of America from those of the Old World.

The claws are well known to vary in length at localities not very remote, in the Old World and in the New. Although the differences between specimens of *U. horribilis*, which seem to have them ordinarily the most developed, and others of *U. arctos* from Western Europe, is very great, they do not appear to have the importance as specific characters assigned them by Prince Maximilian and Dr. Mayer.

Finally, in weighing the evidence in reference to the number of species of North American bears and their relationship to those of the Old World, it is evident that the comparatively small number of specimens thus far examined, either from a single region or in altogether, and the vast areas from which no specimens have been received, should be carefully considered as showing how few the data are on which any opinion must be based. The inconstancy of character presented by those from the same locality, especially in the breadth and other proportions of the skull, in the shape and relative size of the molar teeth, in color, and in size, should also be duly considered, as well as the fact that however wide the differences between specimens from distant localities are, those from intermediate ones are generally of an intermediate character. In some districts bears find an abundant supply of animal food, while in others they are more or less restricted to a vegetable diet, and that these differences must give rise to modifications in the teeth and bones of the skull is to be expected. From the wide geographical range of even the different restricted so-called species, their representatives are subjected to widely different climatic and other modifying influences. In America, the coincidence of the greatest number of individuals with the maximum development in size seen in the region occupied by the typical *U. horribilis*, as in California, and the gradual transition in the easterly portions of the Rocky Mountain district to aberrant forms of this type, some of which indisputably approach quite near the common style of *U. "americanus"* of the eastern portions of the United States, and at the extreme north of the continent to the *U. arctos* of the Old World, especially to the Russian type of that animal, are facts which render the separation of the bears of these several regions into well-defined species quite improbable, if not impossible. I hence see no alternative but to consider with Blainville, Middendorff, and Murry, all the bears of the Northern Hemisphere, excepting *Ursus maritimus*, as forming but a single species. Here, as in other similar cases already considered in this paper, if the opposite view be adopted, it appears inevitable that still other species than those authors have already recognized must be allowed, with numerous "sub-species," or "varieties" and "sub-varieties" of each, in order to dispose of the constantly occurring intermediate forms.

PHOCIDÆ.

16. **Phoca vitulina** Linn. (*Callocephalus vitulinus* F. Cuv.) Common Harbor Seal. Abundant. I have observed it to be particularly numerous about Ipswich, as many as eight or ten being sometimes seen at once. In June the females are accompanied by their young, then apparently about one fourth grown. Though so common, their habits seem to be little known. They are rarely captured, as when killed they sink to the bottom and are thus difficult to obtain. A fine nearly adult male, now in the Museum of Comparative Zoölogy, was obtained at Wellfleet, in June, 1868, by Mr. C. J. Maynard and the writer. The specimen having been stranded, it had just died of exhaustion when discovered, from its frantic efforts to regain the water. It had repeatedly floundered several yards up the steep sand beach.

In reply to inquiries of mine respecting our seals, Captain N. E. Atwood, of Provincetown, has kindly written me respecting this species as follows: "At Provincetown we occasionally see a straggling specimen of what we call the Harbor Seal; in the vicinity of Cape Cod it is not very common; but there are localities on our New England coast where, in summer, they are found in great numbers. In Boston Harbor, west of Rainsford Island, there is a shoal-water bay of considerable extent, in which is a small ledge of rocks that at low water rise several feet above the surface; on these rocks many hundreds of these seals may be seen at any time during the summer. If the ledge is approached, they all dive into the water and rapidly disperse, but soon return again if they perceive no danger. These seals are small, and of little value, and are hence unmolested."

17. **Cystophora cristata** Nilsson. Hooded Seal. From accounts I have received from residents along the coast of a seal of very large size observed by them, and occasionally captured, I am led to think this species is not of very unfrequnent occurrence on the Massachusetts coast. Mr. C. W. Bennett informs me of one taken some years since in the Providence River, a few miles below Providence, which he saw shortly after. From his very particular account of it I cannot doubt that it was of this species. Mr. C. J. Maynard also in-

forms me that a number of specimens have been taken at Ipswich within the past few years, that have weighed from seven hundred to nine hundred pounds. It seems to be most frequent in winter, when it apparently migrates from the north.

CERVIDÆ.

18. **Cariacus virginianus** Gray. (*Cervus virginianus* Boddært.) Virginia Deer. A few still exist in Plymouth, Barnstable, and Berkshire Counties, where they have been for some time stringently protected by law. Mr. Samuels, in the report of the State Board of Agriculture of Massachusetts for 1861 (p. 189), observes: "This beautiful animal is now rare in this State, and will soon, probably, be extinct; it is found in the woods in Plymouth and Barnstable Counties, in the neighborhood of the Hoosac Mountains, and on several of the islands on the southeast coast." It has for a long time been extinct in most parts of the State. They were last seen in the vicinity of Springfield about fifty years ago.

Respecting individual variation in species of the *Cervidæ*, and especially in *Cervus* (*Cariacus*) *virginianus*, I find the following important observations by Hon. John D. Caton, in the Transactions of the Ottawa Academy of Natural Sciences.* Referring to our standard works on the American *Cervidæ*, he observes: "The superficial marks which assign to each of these species its appropriate classification are properly described. Yet this description is generally from a single specimen, while in fact individuals differ very widely, both in color and form; so much so that even among the few I have in my parks we might almost persuade ourselves we have distinct varieties. Among the fifty or sixty deer which I have, there are three distinct shades of color, which also seem to be characterized by a peculiarity of form. The lightest colored have long legs and slim bodies; they have the largest horns, do not fatten readily, and are more wild and restless than the others. The next are of a considerably darker shade; in some instances quite black along the top of the neck and down the back. and a black tail, as distinctly so as the California deer; they have frequently other black marks. I have one specimen with a distinct black line over each eye, of a triangular form, passing towards the ear; and several others in which this mark is quite visible, though not so conspicuous, giving them rather a ferocious appearance. This variety has short legs, rather short, heavy bodies, are very tame, and always the fattest in the park. The smallest variety, both in

* Part I, 1868, p. 43.

size and numbers, is of a distinct russet color, and has less white under the throat and belly than either of the former. In one specimen the white is nearly wanting beneath the lower jaw, and there is very little under the neck. They are not so wild as the first class mentioned, but are more timid than the second, and, in their disposition to fatten, seem also to be intermediate between the other two."

In regard to the Elk he also observes: "There seem to be distinct classes of the elk, which are as manifestly hereditary as those of the deer, especially so as to form and size. Of these I recognize in my parks two classes, varying in form and size, but not materially in color. . . . . One variety is larger, and has longer legs, and is much more graceful in form and carriage than the other. The largest variety seems to be the most hardy, and fattens the most readily; it is also less vicious."

The Elk or Wapati (*Cervus canadensis* Erxl.), judging from what is known of its former distribution, undoubtedly once inhabited Massachusetts. According to Professor Baird and others, it is still found in the Alleghanies in Pennsylvania.*

The Moose (*Alce malchis* Ogilby; *Cervus alces* Linn.) also formerly undoubtedly existed in Massachusetts, though it has now been long extinct here. It still occurs in Maine, as far south as the Umbagog Lakes, whence specimens have been received at the Museum of Comparative Zoölogy.

As to whether the individuals found in America are identical with those of the Old World, there is at present some discrepancy of opinion, though formerly regarded as the same. The distinctions between them are very slight, and to what extent constant is hardly known. While the Moose of Asia and Europe are considered identical, Sir John Richardson has pointed out some slight differences in the skeleton of those of the New and the Old World, which incline him to the opinion that they may be distinct species, and as such he bestowed on the American the specific name of *muswa*. Whether these distinctions are more than individual, or such as would disappear in a large series of specimens, it is perhaps impossible to say. Their distribution, however, is remarkably alike, reaching the Arctic coast on both continents, and extending southwards to about the same isotherm; on the whole I consider their identity as extremely probable, if not absolutely certain.

* Audubon states that fifty years ago a few still lived in Kentucky, near the Ohio River, and that they were not very uncommon at that time in Southern Illinois, — localities much more southern than Massachusetts. — *Quad. N. Am.*, Vol. II, p. 88.

The Woodland Caribou, or Reindeer (*Tarandus rangifer* Gray; *Rangifer caribou* Aud. and Bach.), like the preceding, probably once inhabited Western Massachusetts, judging from what is known of their earlier distribution, though probably rather as an occasional visitant from the north than as a numerous or permanent resident. It is still found occasionally in Northern Maine, whence specimens have been received on several occasions at the Museum of Comparative Zoölogy, from Mr. J. G. Rich. In March, 1863, according to Professor Verrill,* this gentleman brought seven to Boston, killed on the head waters of the Kennebec, out of a herd of about twenty, supposed by Mr. Rich to have come from regions farther north, as the caribou had been noticed there by him but once before during the previous five years. It is said to occur also in the Adirondacks of New York.†

In this species we are again met by the old question of identity with a closely allied Old World congener. Several high authorities still maintain its identity with the European and Asiatic reindeer, while others, whose opinions are equally entitled to consideration, believe them distinct. Unlike the moose, the reindeer, if forming but a single species, are apparently easily separated into several very distinct races, in some cases differing in size, but chiefly in the character of the horns. In America, the woodland caribou constitutes a southern form, and inhabits the northern wooded districts of the continent; in the Arctic Barren Grounds it is replaced by a much smaller race, but which, it is said, has larger horns. This smaller race seems to be a circumpolar one, inhabiting the similar woodless tracts of the extreme north of the Old World, and also Greenland, but differing somewhat in different districts, it is claimed, by peculiar modes of branching of the horns, especially in respect to the form of the brow antlers. Whether these differences that have been pointed out are to be considered as constantly characterizing the reindeer of these different regions is still questionable, as but comparatively few specimens appear to have been yet compared. From the great variability in the branching of the horns presented by all the different species of the *Cervidæ*, the right and left horns in the same individual, as well as the successive sets, being often most notably unlike, it seems to be a distinction of doubtful value.

In reference to the disputed question of whether there are one or several

* Proc. Bost. Soc. Nat. Hist., Vol. IX, p. 226.

† In reference to the much farther extension southward of the habitat of this species in earlier times than even two centuries ago, see the general remarks on the geographical distribution of the Massachusetts Mammals, at the close of the paper.

species of reindeer, Mr. Andrew Murray, in his valuable work on the Geographical Distribution of Mammals (p. 151), observes: "But there are several varieties; how far some of these deserve to be reckoned species, and if so, which of them, is a more difficult question. There is, first, the fossil variety; next, the Lapland reindeer, which is nearest to the fossil type; then the Siberian, which, although very close to the Lapland, differs in the character of the horns; moreover, there are two varieties in North America, and one in Greenland and Spitzbergen. I believe all these to be altered forms developed out of one stock, modified to an extent corresponding with the degree of deviation of their respective climates from the original condition of existence of that stock." Mr. Murray gives figures, copied from various authors, of the antlers of these different varieties, and mentions in detail their points of difference and resemblance; concerning which he adds: "The resemblance between them is too constant, and, as will be seen by the figures, is too considerable to be a matter of accident or coincidence."

Dr. Richardson seems to have first clearly distinguished the two varieties of American reindeer, or caribou, now so generally recognized, but of the woodland variety ("*Cervus tarandus*, var. β *sylvestris*") he claims to "know little, having," he says, "seen few of them alive or in an entire state. It is," he adds, "much larger than the Barren Ground caribou, has smaller horns, and when in good condition is vastly inferior as an article of food." The Barren Ground variety he seems to have studied with great care. Respecting the character of the horns, the peculiar form of which seems to be the chief character yet discovered by which to distinguish the different so-called varieties, he observes: "The old males have, in general, the largest and most palmated horns, while the young ones have them less branched, and more cylindrical and pointed; but this is not uniformly the case, and the variety of forms assumed by the horns of the caribou is, indeed, so great, that it is difficult to comprehend them all in a general description. Some have the branches and extremities *broadly palmated* [the italicizing is my own], and set round with finger-like points; others have them *cylindrical, and even tapering, without any palmated portion whatever.* The majority of adult males have a brow antler, in form of a broad vertical plate, running down betwixt the eyes, and hanging over the nose. In some, this horn springs from the *right* horn, in others from the *left;* in many there is a plate from *each side*, and in a considerable number it is *altogether wanting:* the plate is, in general, widest at its extremity, and is set with four or five points, which are sometimes recurved. The *main stem* of the horn also exhibits an *endless variety* in its *thickness, altitude*, and *curvature*." Major Smith observes, that a "probable distinction, by which some, if not all, of the varieties of caribou may be distinguished from the reindeer of the

Old Continent, is, that their horns are always shorter, less concave, more robust, the palm narrower, and with fewer processes than those of the former," — a view that has been adopted by other writers. Respecting this assumption Dr. Richardson thus observes: "I can with confidence say, after having seen *many thousands* of the Barren Ground kind, that the horns of the old males are as much, if not more, palmated than any antlers of the European reindeer to be found in the British Museum." If attention is given to the parts of the above quotation from Dr. Richardson that I have *italicized*, it will be seen how unreliable must be any distinctions based on the horns, unless the comparisons are more extended than they thus far seem to have been. That the horns of the Barren Ground form may differ from those of the wooded districts in other points than size is quite possible, but in the several pairs of horns of the latter in the Museum of Comparative Zoölogy there is a very close resemblance to those of the Barren Ground and Greenland caribous figured by Baird and Richardson, the Northern Maine specimens much more nearly agreeing with these than with Professor Baird's figures of the Lake Superior one (No. 900), which is evidently an extreme form. The horns of the northern or Barren Ground race of the American reindeer, according to the best authorities, do not differ essentially from those of the reindeer of the corresponding districts of the Old World. Mr. Murray quotes Mr. Alfred Newton as saying, in reference to the reindeer he saw in Spitzbergen: "The average type of a good Spitzbergen head is very well represented by the first figure in the Fauna-Boreali Americana (Vol. I, p. 240) of the so-called Barren Ground caribou (*Cervus tarandus*, var. *arcticus* Richardson)"; which testimony of Mr. Newton, he states, is supported by that of Mr. Lamont.* Mr. Newton, however, says the Spitzbergen reindeer are "certainly smaller than the Lapland reindeer."

Professor Baird observes, respecting the American woodland race, that its relationship to the European reindeer is not well ascertained. "The opinion," he says, "is gaining ground that the Barren Ground reindeer is distinct, and as this species cuts it off from the Arctic Circle, it would seem most probable that it cannot be the same with the animal inhabiting the circumpolar region of the Old World." But the recorded observations seem fully to prove, as is now, indeed, currently admitted, the existence of two similar races on the Old Continent, — a northern and a southern, differing from each other nearly as do the Barren Ground and woodland varieties in North America. Hence if we allow two species of reindeer for America, why not two for the Old World? But there, where the species has been longer and is better known, competent authorities seem not to doubt their identity, and from which some even regard the American as

* Geog. Distr. of Mam., p. 155.

inseparable. I have already shown that the characters used for their separation are by no means reliable. Concerning the Greenland reindeer, Mr. Robert Brown, in a recent valuable paper on the Mammals of Greenland,* says, "that after very excellent opportunities of comparison and study," he considers "the Greenland reindeer only a climatic variety of the European species. I have, moreover," he adds, "seen specimens of reindeer horns from Greenland, which could not be distinguished from European, and *vice versa*. On the whole, however, there is a slight variation."

As I have previously remarked, I see no good reason why all may not be considered as one species, within which may be distinguished several quite well-marked geographical races.

In relation to other facts, the differences in size presented by the two races of American reindeer, the woodland and the Barren Ground, becomes extremely interesting; for, supposing them to form one species, as there seems to be little reason to doubt, the variation in this respect is directly the reverse of that ordinarily presented by individuals of the same species from localities differing considerably in latitude; the general law being an increase in size at the northward. But here there is a marked decrease. It is yet not quite exceptional, as a point is reached in the habitat of the non-migratory circumpolar species, where the rigor of the climate, and the consequent altered conditions of life, seem unfavorable to a maximum development of the animal. This is exemplified by the small stature attained by the circumpolar tribes of men, as the Esquimaux of Greenland and of the north of America, and the Laplanders of the Old World. The common wolf (*Canis lupus*) has its smaller northern form, which, in America at least, occupies the Barren Grounds and the region northwards to the Arctic coast, and which differs quite positively from its more southern relatives.†

A smaller circumpolar Arctic form of the fox has long been recognized, differing in color, in size, and in the texture of its fur from the common species (*Vulpes vulgaris* and *V. fulvus* auct.). And there is a well-known corresponding race of bears, commonly referred to the *Ursus arctos*, which in America pass almost insensibly into the more southern and larger *Ursus horribilis*. Whether this decrease in size in the extreme boreal regions

* Proc. Lond. Zoöl. Soc., 1868, Part II, p. 352.

† "Of this species (*Canis griseo-albus* Rich.) I consider that there are two varieties, one of which is of a dark color and large size, inhabiting the wooded portions of the [Mackenzie's River] District as far north as the Youcon River. The other is usually of a dirty white tint, with, in general, a dark stripe down the back, and frequents the Barren Grounds northwards to the Arctic coast. It is of smaller size than the first-mentioned variety, and lives in much larger bands; indeed, it may possibly be a distinct species." — B. R. Ross, *Nat. Hist. Rev.*, July, 1862, p. 271.

extends to other species I have not at present the means of determining, though it is hardly to be expected that it will to all, since some of them are to a considerable degree migratory, going southward in winter, as the lynxes, martens, and some others. Hence extremes of climate, whether of heat or cold, seem to unfavorably influence the development of animal life generally, a mean or temperate region being as necessary for the highest development of the lower orders of mammalia as for that of man.

Besides the marked climatic modifications in size and in other features in the species cited above, certain other variations in them may be here appropriately referred to. These, though slight, so commonly appear in a number of species inhabiting the same region as to lead one at once to suspect a common cause for such differences. Dr. Richardson * long since pointed out slight differences in the color and texture of the fur, and in the breadth of the foot, in species which he considered identical in North America and Europe, between their representatives from Northern North America and Central Europe; the former having a finer and thicker coat, and broader feet, to better adapt them to a colder climate and a more snow-covered country, as well as brighter and livelier colors. These modifications appear also, he says, in the native domestic dogs.*

Naturalists have repeatedly remarked the narrower form of the head in the moose, bear, fox, and wolf in Eastern North American specimens as compared with others from Western Europe. In the former, the absolute breadth of the skull is generally less, while there is at the same time a greater development of the facial portion. In these animals a difference in size has also been claimed to distinguish their representatives from the two continents; but, owing to the variation in size on either continent with the latitude and elevation of the locality at which they were collected, observations on this point are somewhat contradictory. The general indication, however, seems to be that the American somewhat exceed the European when both are from near the same isotherm.

I have already called attention to the fact of the same species varying in color in different portions of its habitat, as in the case of the *Canis lupus*. On both continents, this species gradually changes from nearly white (yellowish or grayish white) in the Arctic regions to very dark or "black" in the southern. Individuals of the black and cross varieties of the fox (*Vulpes vulgaris*) are most numerous on both continents towards the north; † at the south, while the general fulvous color prevails on the dorsal

* Fauna Boreali-Americana, Vol. I, p. 91.

† Mr. B. R. Ross gives the proportion of the different colors in the foxes killed in the Mackenzie River District as red $\frac{6}{15}$ths, cross $\frac{7}{15}$ths, silver $\frac{2}{15}$ths; or sixty per cent of the dark variety to forty of the red; while as far south as the United States the dark varieties probably scarcely exceed one per cent. — *Nat. Hist. Rev.*, 1862, p. 272.

surface, there is apparently a greater development of dusky on the ventral; this type forming the *Vulpes* "*melanogaster*" of the south of Europe. According to Professor Baird, the black varieties in some of the American squirrels reach their greatest numerical development in the northern portions of their habitat; * where also melanic specimens of the marmot and racoon are most frequent. On the Atlantic slope there is a noticeable tendency to a predominance of gray rather than rufous tints, while in the interior, particularly in the Mississippi Valley, and on the Plains, the reverse is the case, in at least a number of species. I have in another place † called attention to the faded appearance of the plumage of many species of birds on the Plains, in those that range across the continent; in others there is a tendency to an increase of fulvous and rufous, as is noticeable in some mammals. In the Sonoran region there is a marked inclination to pied varieties, such occurring in the weasels (*P. frenatus* and *P. xanthogenys*), skunks (*Mephitis bicolor* and also in *M. mephitica*), the bears and squirrels. The changing to white in winter of many species at the north which at the south constantly retain their summer colors, as the weasels, the Arctic fox,‡ the wolf, and some of the hares,‡ it seems to me is also to be properly classed in the category of climatic and geographical peculiarities of coloration. The prevalence of neutral mouse-gray tints in so large a proportion of the mammals of Australia, and of plumbeous and black in those of Africa, in contrast with the brighter and more varied colors of those of the other continents, is but a grander exhibition of the same kind. The hibernation of certain species in the cold regions that in the warmer are constantly active, as in the *Ursidæ* and *Vespertilionidæ*, for example, is in some respects a similar phenomenon.

There are differences in size between specimens of the same species from different localities that are not apparently explainable on the ground of difference in the latitude and altitudes of their respective places of birth. On the Mississippi prairies, for example, some species of *Muridæ*,

* North Amer. Mam., p. 244.

† Mem. Bost. Soc. Nat. Hist., Vol. I, p. 513.

‡ Concerning this point Mr. Alfred Newton observes: "I have never seen it remarked, but it is unquestionably the case, that nearly all the Icelandic examples of *Canis lagopus* are 'blue' foxes; that is to say, their winter coat is nearly the same color as their summer coat. This fact, I think, must be taken in connection with the comparatively mild climate which Iceland enjoys in winter; and if so, is analogous to the circumstance that of the Alpine Hare (*Lepus timidus* Linn., *non auct.*) always becoming white in Scandinavia, generally so in Scotland, but seldom in Ireland." (*Proc. Zoöl. Society of London*, Dec. 1864, p. 497.) Dr. Richardson also states that the Arctic fox is of a purer white on the shores of Hudson's Bay than at Bhering's Straits, where, as is well known, the climate is considerably milder. (*Faun. Bor. Amer.*, I, p. 87.)

Talpidæ, and *Soricidæ* attain an appreciably larger size than under nearly the same latitude and degree of elevation at the eastward. The same fact is also observed in the mink; while the bears of the Pacific slope are larger than from most other parts of the Continent. Whether a greater abundance of their proper food may be the cause of this, it is impossible now to determine. They are facts, however, that are worthy of careful consideration, and they are cited here simply to call to them further attention.

It may be observed, in passing, that allied species, as the fox and wolf, vary differently under the same conditions; melanism being most developed in the one at the south, and in the other at the north. It is also noteworthy that circumpolar species follow the same law in their climatal variations that obtains in the differentiation in both the fauna and flora of the northern hemisphere in passing from the north southwards. As is well known, there are many species of animals and plants at the north, where their habitats approximate, that are common to the two continents. Such species become less and less numerous to the southwards, and beyond the tropics very few occur on both the Eastern and Western continents. In like manner, specimens from towards the north of the two continents of circumpolar species that range over the north temperate regions are much nearer alike than those collected from near their southern limits of distribution.

For the following notes on the Cetaceans of the Massachusetts coast, and their local names, I am indebted, as previously stated, to Captain N. E. Atwood, of Provincetown. For the scientific names I am under obligations to Professor E. D. Cope, of Philadelphia, to whom I forwarded Captain Atwood's notes for the determination of the species. Professor Cope's identifications and remarks are distinguished by being enclosed in brackets.

BALÆNIDÆ.

19. [**Balæna cisarctica** Cope.] "Right Whale. Occasional.

"This well-known species is at times taken here; in former years they were much more frequent in their visits than now. Although a straggling specimen may be seen at any time, they are generally more common during the latter part of April and the early part of May. They yield a larger amount of oil than any other species that visits our coast; besides which they have a large quantity of whalebone that finds a ready market, known as the "black whalebone" of commerce.

The skeleton of the right whale in the Museum of Comparative Zoology was taken here. The specimen yielded eighty barrels of oil, and the bone that was taken from its mouth was sold for $ 1,000."

20. [**Agaphelus gibbosus** (Erxl.) Cope.] "Scragg Whale. Rare. A species of whale known by this name, nearly allied to if not identical with the right whale, is sometimes taken here. It is the opinion of many of our whalemen that they are not a distinct species, but the young right whale that lost its mother while very young and grew up without parental care, which has caused a slight modification. The most prominent feature is that in its dorsal ridge, near the tail, there are a number of small projections or bunches, having some resemblance to the teeth of a saw. It has no dorsal fin or hump on its back."

21. [**Megaptera osphyia** Cope, or another **Megaptera**.*] "Humpback Whale. This species is common on our coast, and sometimes comes into Provincetown harbor, where it is attacked and killed by our whalemen. They yield but a small quantity of oil compared with the yield of the right whale, the usual quantity being from ten to fifteen barrels. The bone in its mouth, unlike that of the right whale, is of little value and not considered worth saving. When harpooned it will run with great swiftness, and continues to do so while it is being killed. Its affection for its young seems stronger than that of any other species, as the mother will expose her own life in defence of her offspring."

22. **Eschrichtius robustus** Lilj. Professor Cope informs me that he has found a jaw of this species on the New Jersey coast; it should in all probability be enumerated in the present list.

23. [**Sibbaldius tectirostris** Cope, and probably another species.] "Finback Whale. Frequent.

"This species is the most common large whale found along our coast, and is frequently seen at all times in the year. They are not har-

* Professor Cope believes that under the name of "Humpback," of Captain Atwood's list, more than one species may be embraced; and also more than one under the species called "Scragg Whale."

pooned by the whalemen, as they run so swiftly they cannot be killed. I have known a few to be killed by shooting them with a bomb lance. When they have been killed in this way in our bay they always sink to the bottom (they being not a fat whale), and remain there some few days, during which time much of the blubber is eaten off by sharks. I have known two of this species to run on shore in the night, in our harbor, and be left by the receding tide. When they were killed there appeared to be no indications of disease, and the cause of their running on the beach could not be learned. One of them yielded fourteen and the other twenty barrels of oil." In a subsequent communication Captain Atwood adds: "The finback is a species that yields only a small quantity of oil compared with its size; the blubber is thinner than in other species. The right whale killed here, of which the skeleton is in the Museum of Comparative Zoölogy, was forty-seven feet long, and yielded eighty barrels and fourteen gallons of oil; a finback since killed here was fifty-four feet long, and made only twenty barrels of oil, though a good fat whale of its kind."

24. **Sibbaldius tuberosus** Cope. A specimen at first doubtfully referred to the *S. laticeps* Gray,* by Professor Cope, but since regarded by him as a new species,† was captured in Mobjack Bay, Virginia, in May, 1866. It being a somewhat northern species, it should probably be included in the present list.

25. [**Sibbaldius borealis** Fisch.] "Sulphur-bottom Whale. Rare. "This species is said to occur on our coast. Like the finback, it has on its back a very small dorsal fin. Being very much elongated, it is a swift runner, and passes through the water with a velocity so great that the whalemen cannot kill them in the same way that they take the other species. I have never seen it dead, and know but little about it."

26. [? **Balænoptera rostratra**. I have not yet identified this one.] "Grampus. Occasional. When seen here alone, we know it by that name. It is the opinion of some of our whalemen, with whom I have conversed respecting this whale, that it is not a distinct species, but the young of the finback."

* Proc. Phil. Acad. Nat. Sci., 1866, p. 297. † Ibid., 1869, p. 16.

PHYSETERIDÆ.

27. **Physeter macrocephalus** Pander. Sperm Whale. Occasional off the coast; formerly much more frequent.

28. [**Mesoplodon sowerbiensis**.] To this species Professor Cope refers a specimen found stranded a short time since on Nantucket Island. I learn from Mr. S. C. Martin that it was called "Grampus" by the whalemen, and that its length was sixteen feet and three inches, and girth seven feet. The skull, presented by Mr. Martin to Professor Agassiz, is now in the Museum of Comparative Zoölogy, and is the specimen referred to by Professor Agassiz at the meeting of the Boston Society of Natural History, held November 6, 1867. He remarked that it was a species new to America, and that it belonged to the genus *Mesoplodon*, as characterized by Gervais, and ought to be separated from the fossil *Xiphius*, described by Cuvier.*

DELPHINIDÆ.

29. [**Orca gladiator** Sundeval.] "Killer. This species visits our bay occasionally in small schools. Their dorsal fin is several feet high when fully grown. They are at times in summer seen coming into our harbor. The horse-mackerel fears them, and will run in shore when they appear."

30. [**Globiocephalus melas** Traill. (*D. intermedius* Harlan and *G. intermedius* Gray.)] "Blackfish. Common. This well-known species sometimes come into our bay in large schools in summer and autumn. They are then attacked by a number of boats from the shore, and often driven into shoal water or on shore and hundreds killed."

31. **Hyperaodon bidens** Owen. A specimen referred by Professor Cope to this species came ashore at North Dennis in January, 1869; its skeleton, secured by Mr. J. H. Blake, is now in the Museum

* Proc. Bost. Soc. Nat. Hist., Vol. XI, p. 318.

of Comparative Zoölogy. A few weeks later Professor Cope obtained another that was stranded near Newport, R. I.

32. [**Beluga canadensis** ERXL. WHITE WHALE.] At the close of his list Captain Atwood thus mentions a species identified by Professor Cope as above: "Besides those already named, some few years ago a species was killed in our harbor and brought on shore which no one knew. I examined it, and found it to differ from all other species. Not long after it was announced in the papers that there was a white whale on exhibition at the Aquarial Gardens in Boston, that Mr. Cutting had brought alive from the river St. Lawrence; a species that had never been seen south of that river. Soon after I visited Boston and called to see it. I pronounced it to be identical with the unknown species taken at Provincetown." This undoubted occurrence of the white whale at Provincetown is the only instance of its having been found so far south that has come to my knowledge. The skeleton of the specimen exhibited at the Boston Aquarial Gardens, and referred to above by Captain Atwood, is in the Museum of Comparative Zoology. Is was presented by Mr. Cutting.

33. [? **Lagenorhynchus** sp.] "COW FISH. Occasional.

"This species differs from the blackfish in being much smaller, and in yielding much less oil. Its blubber is thinner, and its color is a light marble. It is sometimes called white blackfish by our whalers. It is occasionally killed here, but it does not appear in large schools, like the blackfish. It is a distinct species, intermediate in size between the blackfish and the species we call porpoise (dolphin)."

34. [**Delphinus erebennus** COPE. [" PORPOISE. This is not an abundant species here. They are at times in summer seen passing along the shore in large schools, going northward; in autumn they may be seen going back to the southward."

35. **Delphinus clymene** GRAY. According to Professor Cope this species has been taken on the coast of New Jersey,* and it is not unlikely to occasionally visit our shores.

36. [**Phocæna americana** AGASS. (or *P. brachycium* Cope; I

* Proc. Phil. Acad. Nat. Sci., 1865, p. 261.

do not know which name will stand as yet.)] "SNUFFER or PUFFING PIG (*Phocæna americana*). This is the smallest of all the species. It is very common here at all seasons, and is occasionally caught in nets set for mackerel or blue-fish." There are several skeletons in the Museum of Comparative Zoölogy.

VESPERTILIONIDÆ.

37. **Lasiurus noveboracensis** GRAY. (*Vespertilio noveboracensis* Erxl.) RED BAT. NEW YORK BAT. Common; in some sections of the State the most numerous species of the family.

This species varies greatly in color, but the difference seems to be chiefly sexual. The adult males are generally much lighter than the females. In the young the sexual variation in color seems to be often much less marked.

The only well-marked distinguishing characteristics between this species and the next, except in more highly colored specimens of the latter, is generally the black border to the ear, and the black on the lips in *L. cinereus*. In each there are the same bands of color on the hairs, distributed in the same way, — dusky, verging to black at the base, then pale yellowish brown, succeeded by darker or brighter bands of red, and tipped with whitish. In some specimens the terminal band of whitish is quite absent, particularly on the anterior part of the body, the subterminal bright red zone being thus continuous to the tips of the hairs. In other specimens the terminal band of white is developed to a great degree, so as to very much obscure the red or dark chocolate zone beneath. Such specimens often strongly approximate to what is called *L. cinereus* (*V. pruinosus* Say), where the terminal white zone reaches its maximum of development, and the subterminal russet zone its greatest intensity. I feel, in fact, far from sure that the species are distinct. In a series of about twenty Massachusetts skins, nearly all marked for sex by the collector (Mr. C. J. Maynard), all the males are of a beautiful light, bright, yellowish red, with scarcely a trace of the apical white; the females, though somewhat more variable, are universally darker, the light red of the males being replaced in these by dark russet, which is more or less obscured by the whitish tips of the fur. The alcoholic series, so far as carefully examined in reference to this point, indicates this sexual difference to be quite constant; but there are occasional exceptions.

Very little seems to be known respecting the time of copulation or the period of gestation of the bats. From Mr. J. G. Shute, of Woburn, I learn a fact in reference to this point observed by him some few years since. Soon after sunset one evening in October he observed a strange object pass him in the air, which seemed to fall to the ground not far from where he was standing. Repairing immediately to the spot he soon found it, which proved to be a pair of these bats *in coitu*. They were captured and thrown into alcohol, and thus forwarded to the Museum of Comparative Zoölogy. About the 20th of June I once found, in Northern Illinois, a number of the *Scotophilus georgianus* containing quite advanced fœtuses, usually four or five in number. Dr. C. C. Abbott says that the *V. subulatus* brings forth its litter of three to five young late in June.*

38. **Lasiurus cinereus** H. ALLEN. (*Vespertilio pruinosus* Say.) HOARY BAT. Not common. Probably the rarest species of the family found in the State. Though commonly given in New England lists, I have never seen it from Massachusetts. I have been able to find but two specimens in the Museum collection referable to it, and those are, unfortunately, without localities. I have often seen in local collections specimens labelled with this name, but they were only the more hoary form of the common *L. noveboracensis*. From Dr. Allen's list of specimens its range seems to be nearly that of the preceding, — throughout temperate North America at least, — as some of them are stated to have been received from Nova Scotia, Red River Settlement, Louisiana, Matamoras, New Mexico, California, &c. As already observed, I question the validity of this species.

39. **Scotophilus fuscus** H. ALLEN. (*Vespertilio fuscus* Pal. de Bouv.; *V. carolinensis* Geoff. St. Hil.) CAROLINA BAT. Common.

I not only consider the suspicion of Dr. Allen that *S. carolinensis* and *S. fuscus* "may prove to be the same" well founded, but to his list of synonymes of this species would add *Eptiscecus melanops* of Rafinesque. I would remove from it the *V. gryphus* of F. Cuvier, which I consider refers to the *V. subulatus* Say.

40. **Scotophilus georgianus** H. ALLEN. Less common than several of the other species, but apparently not excessively rare. There are several specimens in the Museum of Comparative Zoölogy

* Geology of New Jersey, Appendix, p. 752.

from Massachusetts, and others from Maine, the latter being at present its most northern known locality. This species is believed to be now for the first time reported from the Eastern States.

It appears to me that it would have been better to have entirely ignored the synonymes considered by Dr. Allen as doubtfully referring to this species than to have adopted any of them for its designation. The *V. georgianus* of F. Cuvier seems to me to be undoubtedly referable to *V. subulatus*. If any of F. Cuvier's names are to be considered as referring to it, it seems to me it is the *V. Saleri* of the same data, though it appears highly questionable whether this also, as well as the *V. monticola* of Bachman may not be more appropriately referred to *V. subulatus*, judging from the very imperfect descriptions alone. Dr. Allen, however, has had the types of some of these for examination, and finds them to correspond with what he calls *S. georgianus*, and it is this that appears to have guided him in determining these references.

41. **Scotophilus noctivagans** H. Allen. (*Vespertilio noctivagans* Le Conte.) Silvery-haired Bat. Rather common.

42. **Vespertilio subulatus** Say. Little Brown Bat. Common, especially in the Connecticut Valley. At Springfield it is *one* of the most common, if not *the* most common species.

Prior to the publication of Dr. Allen's monograph, but one species of the genus *Vespertilio*, as now restricted, had been recognized from Massachusetts, though others, based however on very doubtful characters, had been given by different authors from the Middle States. All who have critically studied the bats are well aware that they are quite variable in color and in many other characters. Thus Dr. Allen, under *Scotophilus fuscus*,* in alluding to certain variations in the form of the ear pointed out by Major Le Conte as distinguishing certain species of European authors, which Dr. Allen very properly deems to be merely nominal, observes: "While acknowledging that these differences may exist, I do not consider them constant. In a species so extensively distributed, and in a family so well known for its Protean tendencies as that to which *S. fuscus* belongs, slight and variable changes, confined entirely to the parts of the ear, are hardly sufficient data for these separations." Under *Vespertilio* † he remarks: "Owing to the fact that species of this genus have a widely spread distribution, minute differences in form and color in specimens brought from distant localities

* Monograph, p. 33.

† Ibid., p. 46.

have been made of more importance than they deserve. Species have thus sprung up, many of which have never been identified, and seem only to retard progress by a useless synonomy." We fear, however, that Dr. Allen, with all his care, and the almost unexceptionable character of his admirable Monograph, has fallen in this group into an error which he found it necessary to criticise in others. With original specimens of most of his species for examination, I am unable to convince myself, either from these or from his descriptions, that several of the species recognized or described as new by him — especially *V. lucifugus* and *V. evotis*, and also *V. affinis* — are not really referable to *V. subulatus*. Among the large lot of bats furnished by the Museum of Comparative Zoölogy for use in the preparation of his Monograph, including some two hundred specimens from different parts of North America (besides many from foreign countries), specimens of *Vespertilio* from various localities in Maine and Massachusetts were labelled by him, when returned, respectively *V. evotis*, *V. subulatus*, and *V. lucifugus*. Individuals of the same colony, and that I scarcely doubt in some cases belonged to the same litter, of what I call *V. subulatus*, vary considerably in color, and not a little in the form of the ear. Dr. Allen says: "The specimens of *V. subulatus* arrange themselves into two groups, one of which may be considered typical, the other tending in the shape of the ear to the *preceding* species [*V. evotis*]. Indeed, the changes from one species to the other is so gradual that it is difficult to assign a boundary to each. I have included under *V. subulatus* a number of specimens which have the ear higher than those from which the description has been taken, but agreeing with *V. subulatus* in other particulars." *

From a critical analysis and comparison of the tables of measurements given by him of the different species of this genus, they appear most decidedly to intergrade, no less in the size and form of the ear — the character on which their separation is mainly based — than in other points. The *V. lucifugus* has, perhaps, the best claims to be regarded as a species, but these seem to be highly equivocal. *V. evotis* is the form with the highest, and relatively the largest ear, grading in this particular into *V. subulatus*, the more common form, and this again into *V. affinis* (of which but one specimen had been received) and *V. lucifugus*, in which the ear exhibits the minimum of size. In the latter the snout is blunter, and in the first more produced, this character correlating with the narrowed and elongated or shortened and blunted ear. In other words, the *V. evotis* is the slender form, the *V. lucifugus* the robust form, *V. subulatus* coming in between the two.† They all appear to have the same geograph-

* Monograph, p. 51.

† Naturalists seem to overlook the fact that feral animals may vary in size, in general form, in physiognomy, in temperament and disposition, in the same way as different

ical distribution, and specimens of each generally occur in collections from the same localities, whenever the number of specimens received is at all large. They are sometimes found in cool weather clinging together in the same "festoons."

Each species ranges, according to Dr. Allen, from ocean to ocean, and from very far north nearly or quite to the tropics.

Prior to 1864 only five species of bats were currently reported from New England; Dr. Allen's Monograph nearly doubled the number, increasing it to nine. Only six, however, are recognized in the present catalogue, one only (*Scotophilus georgianus*) having been added to those previously well known.

In respect to the many species of bats imperfectly described by some of the earlier authors, I have little hesitancy in referring to *V. subulatus* of Say the following: —

V. lucifugus Le Conte, Cuv. An. King. (McMurtrie's ed.), 1831, p. 431.
V. Caroli Zimm., Man. de Mam., II, 1835, p. 236.
V. gryphus F. Cuv., Nouv. Ann. du Mus. d'Hist. Nat., I, 1832, p. 15.
V. Salari Ibid., p. 16.
V. crassus Ibid., p. 18.
V. georgianus Ibid., p. 16.
V. subflavus Ibid., p. 17.
V. brevirostris Pr. Maximilian, Verzeich. Beobach. Säugethiere in Nord Amer., p. 19.
V. monticola Aud. and Bach., Journ. Phil. Acad. Nat. Sc., Vol. VIII, 1842, p. 280.
V. virginianus Ibid., p. 282.
V. californicus Ibid., p. 285.
V. Leibii Ibid., p. 284.

SORICIDÆ.

43. **Neosorex palustris** Verrill.* (*Sorex palustris* Rich.;

individuals of any given nationality of men or breed of domesticated animals, in which such variations are patent to the most casual observer. In wild animals it needs only a critical comparison of many individuals of any species, concerning the identity of which there is no question, to satisfy careful investigators that it is equally the case here. It fails to be as well recognized only because it is impossible for us to be in sufficiently intimate relation with animals in a state of nature. In many instances where they are brought under the same conditions relatively for observation, as in the case of different species of *Cervidæ*, when kept in parks, it is soon detected. In this connection compare the observations of Judge Caton on "American Cervidæ" (see *antea*, p. 194).

* Notice of a *Neosorex* from Massachusetts, and of *Sorex Thompsoni* from Maine. By A. E. Verrill, Proc. Bost. Soc. Nat. Hist., Vol. IX (Oct. 1862), p. 164.

Neosorex albibarbis Cope.) MARSH SHREW. But three specimens of this species are as yet known from New England, two of which were captured by Professor E. D. Cope, at Franconia, N. H., and the other by Mr. F. W. Putnam, at Warwick, Mass. Professor Cope's specimens were swimming in a lake when first seen, about forty feet from the bank. As observed by Professor Verrill, the species of this genus are eminently adapted to an aquatic mode of life, they having large fringed feet and valvular ears.

44. **Sorex platyrhinus** LINSLEY. BROAD-NOSED SHREW. Comparatively common. I have taken a considerable number at Springfield, and Professor S. F. Baird, in his Mammals of North America (p. 26), cites nineteen examples in his list of specimens of this species from Massachusetts, eighteen of which were from Middleboro', and collected by Mr. J. W. P. Jenks.

45. **Sorex Cooperi** BACHMAN. COOPER'S SHREW. This rare species I have never seen myself from this State; Professor Baird mentions two specimens from Middleboro', received from Mr. Jenks. Professor Verrill, in his paper already cited, refers to a specimen from Danvers, in the collection of the Essex Institute, as being the only one he had seen from New England. Last winter I received it from Wayne Co., N. Y., from my friend, Mr. Charles Potwine. The specimen was captured in the daytime, while running on the snow in the woods.

46. **Sorex Forsteri** RICH. FORSTER'S SHREW. From its known range* this species is most likely to occur in Massachusetts. It has, in fact, been reported as often met with here, both in summer and in winter.†

Thompson's shrew (*Sorex Thompsoni* Baird) is also to be expected to occur in this State, it having been received by Professor Baird from Halifax, N. S., and Zanesville, Ohio, and by Professor Verrill from Maine.

* "Hudson's Bay to Carlisle, Pa." — BAIRD.

† "In the latter season they are found beneath a pile of wood or logs, and their tracks in the snow show their wanderings in search of food." — E. A. SAMUELS, *Agriculture of Mass.*, 1861, p. 142.

47. **Blarina brevicauda.** (*Sorex brevicaudus* Say, Emmons's Rep., p. 13; *Blarina talpoides* Gray). MOLE SHREW. Common. By far the most numerous species of the family.

A second species of *Blarina*, the *B. brevicauda* of Gray (*Sorex brevicaudus* Say) was formerly reported to exist in this State, Connecticut, New York, and throughout Eastern North America generally. But Professor Baird supposes it, if distinct from *B. talpoides*, to be exclusively Western; he has, however, failed to point out any differences of much weight between specimens he refers respectively to *S. brevicaudus* Say and *S. talpoides* Gapper (*B. talpoides* Gray). In his diagnosis of *B. brevicauda* he says: "Largest of all American shrews hitherto discovered (?)," and gives its dimensions as "Length, unstretched, over four inches to the root of the tail"; while he gives the "average length of head and body" of *B. talpoides* as "three and a half inches." Say gives the length of the head and body of *S. brevicaudus* as three inches and five eighths, or 3.62, which but slightly exceeds Professor Baird's average for *B. talpoides;* the two largest specimens of which he gives measurements (No. 2,078, from Massachusetts, and No. 2,116, from Illinois) slightly exceed this size. A Massachusetts specimen before me measures fully four inches, and two others exceed 3.75. Under *B. talpoides* he says, "With a large number of specimens before me, I have been more than usually perplexed in the attempt to determine the species of short-tailed shrews, as given by authors, and especially to distinguish between *S. brevicaudus* and *S. Dekayi*, of Bachman, De Kay, and others. I am satisfied that the latter species is identical with *S. talpoides* of Gapper (which indeed has priority of date), having found no essential differences between Canadian specimens and those from Massachusetts, Vermont, New York, Michigan, Wisconsin, and elsewhere. Gapper's specimen, it will be remembered, was taken in the district between York and Lake Simcoe, in Upper Canada.

"Thus far," he continues, "I have not been able to find any shrews from Massachusetts, New York, or adjoining States, possessing all the characters assigned by Bachman and De Kay. The hair of the same species varies with the season, being longer, softer, and fuller in winter; the precise shade of color is likewise not constant. The proportions of the shrews, unless taken from alcoholic or fresh specimens, vary exceedingly in the same species, according as the skin is under or over stuffed.

"For the present, therefore, I shall refer all the large shrews with short tails from the Atlantic States to the *S. talpoides*. I have, however, before me some specimens from the Upper Missouri and Iowa, which, as they differ in size from any in the East, and agree rather more closely with the *S. brevicaudus* of Say, I shall refer to this species." *

* North American Mammals, p. 41.

Under *B. brevicaudus* Professor Baird further observes: "I have found very great difficulty in identifying with any certainty the *S. brevicaudus* of Say, at least in the references to this species, as supposed to be found in the eastern portion of the continent. I have, however, I think, discovered it in some specimens of very large size from Nebraska and Iowa, localities nearer to that of the original specimen (Council Bluffs) than of any specimen yet discovered." In his list of the specimens referred to this species Professor Baird gives two from Nebraska, two from Iowa, and one each from Illinois and Wisconsin. The latter four are, however, referred with a mark of doubt. It is to be regretted that full measurements of all these specimens are not given for comparison with the excellent series of *B.* "*talpoides*";* as the size of two out of the three given is equalled by several of the *B. talpoides*, they being respectively but 3.50 and 3.65 inches in length. In view of the generally admitted variability of this species in size, color, length of tail, &c., at single localities, and which some seventy specimens now before me from Massachusetts fully demonstrate, and the but slightly larger size of Mr. Say's single example from Council Bluffs (which forms the original of *S. brevicaudus*) than the average of our short-tailed shrews, I refer to one species, and to this of Say, all the short-tailed shrews of the Northern and the Eastern States, Canada and the adjoining Provinces, of which the more recent name (*S. talpoides*) of Gapper becomes a synonyme. Also, in view of the already known wide distribution of this species, and the law of variation in size with respect to latitude and elevation, I must also consider the *S. carolinensis* of Bachman, which only differs from the northern specimens of *S. brevicaudus* (*B. talpoides* Gray, Baird's Report) in its slightly smaller size, as merely the more southern and hence the smaller race. Indeed, in consequence of the large size allowed it by Dr. Bachman, Professor Baird is inclined to consider this name as a synonyme of *B. talpoides*, as under this species he states: "Nor do I feel quite sure that the *Sorex carolinensis* of Bachman is really anything else than a small *S. talpoides*. The measurements given by him (length three inches) agree

* There has never been a more valuable contribution to the Natural History of the Mammals and Birds of North America, or of any country, than the lists of specimens and tables of measurements published by Professor Baird in his great and invaluable works on these two classes of the North American Vertebrata, contained in Volumes VIII and IX of the Reports of the Pacific Railroad Explorations and Surveys. They show not only, to a considerable extent, the geographical range of the different species, but their variation in size and proportion at different localities, and, when the number is large from one locality, the variation at single localities. The possession of these tables and his accompanying minute descriptions is next to having in hand the specimens themselves. It is very much to be regretted that so small a proportion of our natural history descriptions have been written with this great care and minuteness of detail.

precisely with many from Massachusetts and elsewhere, and are essentially the same in proportion with those of the largest-sized specimens of *S. talpoides*." But he adds: "There is, however, a distinct species in the Southern States, considerably smaller than *S. talpoides*, to which Bachman's name may be applied." Further on he gives a diagnosis of a "*B. carolinensis*," under which he cites Bachman's "*S. carolinensis*" as a synonyme. He describes it as "size considerably less than adults of *B. talpoides*," and gives the length of head and body as "about 2.50 inches." Comparing it with *B. brevicauda*, he says it differs from that species in its considerably smaller size, proportionally smaller feet, and in having the "third and fourth lateral teeth larger in proportion to the first and second," &c. Under this head he cites four specimens, three of which are from Missouri, and the other from South Carolina. These, he says, "agree in the main very well together, and as indicating a southern species smaller than *B. talpoides* or *brevicauda*." After finally referring *S. carolinensis* of Bachman to this species, he says: "I am by no means clear, however, that the particular measurements cited by him do not belong really to a specimen of *B. talpoides*; but," he strangely adds, Dr. Bachman having given us no such intimation, "he [Dr. Bachman] undoubtedly was acquainted with a species smaller than the latter" (*S. carolinensis* Bachman). That there is a somewhat smaller race in the South is unquestionable, but its specific rank is not to me so clear. This smaller form seems to occur generally throughout the Southern States, and along the low coast border as far north as New Jersey, and even perhaps to New York, corresponding in the limits of its distribution northward with the northern boundary of the Carolinian Fauna; the larger form occupying the Northern States generally, and the highlands of the Alleghanies south to Georgia; it thus occurring throughout the whole extent of the Alleghanian Fauna, and possibly throughout the Canadian. The range of *B brevicauda* is now carried southwards to Florida and Texas, with only such differences in size between northern and southern specimens as are admitted to occur in other unquestioned species of mammals that have the same geographical range; the difference in size being the only constant or tangible distinction yet pointed out. The difficulty experienced by Professor Baird in determining the species of the older authors, it seems to me results chiefly from two causes: first, the imperfect character of the descriptions, which are generally of single specimens only, and of skins and stuffed examples; second, the by far too great number indicated.

In this connection it is proper to notice a species of *Blarina* described as new in the Report on North American Mammals (p. 47) from a single specimen from Burlington, Vermont. This specimen, its describer says, "in external appearance perfectly resembles specimens of *B. talpoides*," but "has some remarkable peculiarities of the skull. While it has no satisfactory external characters by which to designate it," "the skull is so entirely different from all others" he had seen, he says, as "almost to make a distinct subgenus." This difference consists in its being much narrower than in other short-tailed shrews, and in the greatest interorbital constriction being placed a little in front of the middle, instead of behind it, as in the others, and in its being greater in amount. In regard to this specimen, I need only add that, in respect to its skull, and in this character alone,* whether really a distinct species or an abnormal individual variation, it still remains unique, no other like it having yet become known to naturalists.

In continuing this preliminary revision of the *Blarinæ*, we find that ten species of this strictly American genus † of the short-tailed shrews have been described, all from the United States, three of which were first characterized by Professor Baird in his North American Mammals. Seven are recognized in this work as valid; two are given as doubtful or unidentified, and one is doubtfully referred to one of the others. These are arranged in two sections, according to the number of premolars; section "A" having five, and section "B" four. Their dental formulæ are as follows: —

Section A, $\frac{2}{2} + \frac{5-5}{2-2} + \frac{4-4}{3-3} = 32$; section B, $\frac{2}{2} + \frac{4-4}{2-2} + \frac{4-4}{3-3} = 30$.

A lengthy diagnosis is given of each section, but no other essential differences are pointed out, the distinctions in respect to color, &c., being, as is evident from the descriptions of the species that follow, inconstant and invalid. In section B the first premolar is said to be slightly larger than the second, and in section A to be smaller than the second. But in the de-

* That is, judging from Professor Baird's description; but from the figures of its skull (Pl. XXX, Fig. 7), it seems to have had an imperfect or abnormal dentition, the number of visible premolars being three instead of four, in the upper jaw, and one instead of two in the lower, with a naked space between them and the incisors. It is possible, however, that the first premolar in each jaw had become accidentally lost before the skull passed into the hands of the artist.

† *Sorex brevicaudus* Say, Long's Exped., I. 1823, 164.
" *parvus* Say, Ibid., 163.
" *talpoides* Gapper, Zool. Journ., V, 1830, 208, Pl. VIII.
" *carolinensis* Bachman, Journ. Phil. Acad. Nat. Sc., VII, 1837, 366, Pl. XXIII, Fig. 1.
" *cinereus* Ibid., 373, Pl. XXIII, Fig. 3.
" *Dekayi* Ibid., 377, Pl. XXIII, Fig. 4.
" (*Brachysorex*) *Harlani*, Duvernoy, Mag. de Zool., 1842, 40, Pl. III, Fig. 6.
Blarina angusticeps Baird, N. Am. Mam., 1857, 47.
" *exilipes* Ibid., 51.
" *Berlandieri* Ibid., 53.

scriptions of *B. cinerea*, *B. Berlandieri*, and *B. exilipes*, which constitute section B, it is distinctly stated that the first premolar is *smaller* than the second. Figures of the skulls of all the species of both sections are given in Pls. XXVIII and XXX, but in no case does the first premolar *appear* to be quite equal to the second. In regard to section B, there are several circumstances suggestive of its being founded on immature examples of section A, in which the dentition is incomplete.* All the species are diminutive, and vary but little in size; the teeth are generally proportionally large compared with the size of the skull, as is always the case in young animals, and other characters seem to indicate immaturity. The missing premolar is the one we should expect the animal to acquire latest.† All the species of section B come from within the admitted geographical range of the species of section A, one only (*B. Berlandieri*) possibly excepted. Unfortunately, very young specimens of shrews are extremely rare in collections, and in the large series of *Blarinæ* in the Museum of Comparative Zoölogy there are none so small as those embraced under Baird's section B. In several of the smallest of them the fifth premolar is scarcely visible, forming a minute uncolored point on the inside of the jaw. In a single specimen from Middleboro', the smallest of the lot, it is wholly wanting. I regret that I have been unable to examine any of the original types of the species of section B. Between the three supposed species of this section (*B. cinerea*, *B. exilipes*, *B. Berlandieri*) the differences (which seem to consist chiefly in color, especially between the first two) are not greater nor different from those seen in a large series of specimens from Massachusetts or other localities. The differences between the different specimens referred to either of the species are also very appreciable, and in some cases (see under *cinerea* and *exilipes* in North American Mammals) so great that their assignment was very doubtfully made. While the evidence of the existence of so many species of *Blarina* in the Eastern United States, if really of more than one, is evidently very slight, I do not claim to have fully shown that but the one exists; my design has been mainly to call attention to the great need of a thorough revision of this

* It is well known that in *Scalops aquaticus* the number of teeth in the young is less than in the adult, and this difference has resulted in discrepant statements in respect to its dentition. (See BACHMAN on the Mole Shrews of North America, in Proc. Bost. Soc. Nat. Hist. I, 40. Also, Quad. N. Amer., Vol. I, p. 92.)

† The species of *Sorex* are divided into two sections on similar characters, where small size again accompanies the lesser number of teeth. There are other circumstances that render it not improbable that we have here again a section "B," based on immature representatives of a section "A." The number of species of *Sorex* admitted for the United States, twelve or more, is probably quite too large, though undoubtedly there may be half that number.

group. What I do claim is, that there is as yet no good evidence of the existence of more than the common and widely dispersed *B. brevicauda;* that the numerous other supposed species that have been described are mainly based, in the first section, on variations in size dependent upon locality, and that there are strong indications that those of the second section rest on variations, dependent upon immaturity, of the representatives of the first; that if other species do exist, as is not of course improbable, naturalists have thus far failed to satisfactorily establish the fact. In number of species, *Blarina* thus corresponds with *Condylura*, and in distribution with *Scalops aquaticus*.

In the following comparative analysis of the diagnoses of sections A and B of *Blarina*, given in the Report on North American Mammals, some points but casually alluded to above are more fully discussed. A table of synonymes is also added.

Genus **Blarina** Gray.

List of the Species.

Section A.	Section B.
B. talpoides.	B. cinerea.
B. brevicauda.	B. exilipes.
B. carolinensis.	B. Berlandieri.
B. angusticeps.	

Diagnoses.

Color.

"Nearly uniform plumbeous on the body and tail; scarcely lighter beneath."

Exceptions. — Specimens of *B. talpoides* are mentioned as "slightly paler beneath," "fading to the belly into a still paler tint," &c.; of *B. carolinensis* as being "a little paler beneath." Massachusetts specimens of *Blarina* are generally *nearly* uniform, but many specimens occur that are considerably lighter beneath. The general color also varies from ashy and brownish through grayish plumbeous to exceedingly dark, almost black. Occasionally the hairs are so varied with light and dark as to present a hoary appearance.

"Lower parts of the body usually lighter than the upper, with *the line of demarcation* distinctly visible."

Exceptions. — *B. cinerea:* Hoary above, "somewhat resembling pepper and salt"; below, "a lighter tint of brownish gray or light ash; the *line of demarcation* in one specimen indistinct, in another more evident." *B. Berlandieri:* "In one [specimen] the prevailing tint is a chestnut brown at the tips of the hairs, with paler next to the tips, producing a slight hoariness. The under parts are a yellowish-brownish white; *the line of demarcation on the sides quite indistinct.*"

Dental Formulæ.

$$\frac{2}{2}+\frac{5-5}{2-2}+\frac{4-4}{3-3}=32 \qquad \frac{2}{2}+\frac{4-4}{2-2}+\frac{4-4}{3-3}=30$$

Incisors.

(1)* "The upper anterior incisor with the basal portion of the cutting edge formed by a nearly rectangular lobe, (2) the entire tooth forming only a single hook."

"Lower anterior incisor (1) *stout*, (2) *much curved*, (3) *with two or three lobed dentations.*" (4) "It extends back as far as the middle of the first molar." (5) "*The first and second premolars are placed above this incisor.*"

The variation presented by different specimens renders null distinctions 1 and 2, the lobe being sometimes much produced posteriorly.

(1)* "Anterior upper incisor with the basal lobe more conical and further forward than in the other section."

"Lower anterior incisor (3) *with two or three lobed serrations*, (1) *stout*, (2) *much curved*, (4) not reaching posteriorly as far as the middle of the first molar; (5) *the two first lateral teeth entirely above it.*"

On page 9, the teeth in section A are described as "nearly uncolored," — that is, brown to the base, and in section B as "bicolored," — white at the base and tipped with brown. But in *B. brevicauda*, the second type of coloration is also quite frequent.

Upper Premolars.

(1) "The first two premolars are nearly equal, (2) the second *usually* a little larger; (3) the next two much smaller; (4) the fifth very small and usually not visible externally. (5) The first four with a basal-colored point on the inner side."

(1) "The first premolar tooth slightly larger than the second. (2) *The third decidedly smaller than either*, though larger than in the other group. (5) The small cusps on the inner side of the base of the first three lateral teeth, either wanting or very small."

Exceptions. — *B. cinerea:* "The first premolar tooth is a little *smaller* than the second."

B. exilipes: "The first lateral tooth is *rather smaller* than the second," &c.

B. Berlandieri: The first lateral tooth is "rather shorter than the second." See also the figures, which so represent them. Hence this main distinction of "first premolar tooth slightly larger than the second" by no means holds.

* The numbers prefixed to the characters in the diagnoses refer to the same character in each section. Those that seem to be nearly or quite synonymous in the two sections are italicized.

Hands.

"Hand contained about two and a third times in the hind feet."

In forty-seven specimens of *B. talpoides* the proportion is 74 to 100; in three specimens of *B. brevicauda* the proportion is 72 to 100; in three of *B. carolinensis* it is also 72 to 100. The range of variation, however, in *B. talpoides* (see Baird's table) is from .55 (specimens No. 2,076, 2,080, &c.) to .80 (specimen No. 2,083).

"Feet smaller than in section A; the anterior contained about one and a half times in the posterior."

In four specimens of *B. cinerea* the proportion is 75 to 100; in six specimens of *B. exilipes* 68 to 100; in four of *B. Berlandieri* 66 to 100.

Before closing my remarks on this subject I should call attention to the fact of the repetition of the same character, described in slightly different language, that so constantly occurs in diagnoses of the different species of the same genus, of different genera of the same sub-family, &c., and even of characters of ordinal value in specific descriptions, in the writings of even some of the best naturalists; — to the mixing up of non-essential or irrelevant characters with, and thus obscuring, those peculiar to the group in question. Sometimes, in fact, the really essential points are omitted, the diagnosis being almost as equally applicable to several species, or to any of quite a large group, as to one. All naturalists are not, of course, equally culpable in this respect. But in general, by sifting descriptions of their generalities, they could be greatly reduced and their definiteness and accuracy proportionally increased. The labor of preparing diagnoses would of course be thus increased, but the advantages arising therefrom would be immense. I am not the first, I am happy to find, to make strictures of this character, and hope that the matter will soon receive at the hands of descriptive naturalists the consideration it merits. Neither, I should say, are these strictures introduced at this time as a special criticism upon any particular author.

Blarina brevicauda.

Sorex brevicaudus SAY, Long's Exped., I, 1823, 161.
" " HARLAN, Faun. Amer, 1825, 29.
" " GODMAN, Am. Nat. Hist., I, 1831, 79. (From Say.)
" " BACHMAN, Journ. Phil. Acad. Nat. Science, VII, 1837, 381.
" " EMMONS, Quad. Mass., 1840, 13.
" " DE KAY, N. York Fauna, I, 1842, 18.

Sorex brevicaudus LINSLEY, Am. Journ. Sc., XLIII, 1842, 346.
" " THOMPSON, Hist. Vermont, 1842, 27.
" " PLUMBER, Am. Journ. Sc., XLVI, 277.
Blarina brevicauda BAIRD, Mam. N. Am., 1857, 42, Pl. XXX, Fig. 5.
" " SAMUELS, Agr. Mass., 1861, 144.
Sorex talpoides GAPPER, Zoöl. Journ., V, 1830, 208, Pl. VIII.
Corsira (Blarina) talpoides GRAY, Proc. Lond. Zool. Sc., V, 1837, 124.
Blarina talpoides BAIRD, Mam. N. Am., 37, Pl. XXX, Fig. 6.
" " SAMUELS, Agr. Mass., 1861, 145.
" " VERRILL, Proc. Bost. Soc. Nat. Hist., IX, 1863, 172.
Sorex parvus SAY, Long's Exped., I, 164.
" " HARLAN, Faun. Am., 29.
" " BACHMAN, Journ. Phil. Ac. N. Sc., VII, 394. (From Say.)
" " DE KAY, N. Y. Fauna, I, 19.
" " LINSLEY, Am. Journ. Sc., XLIII, 346.
" " AUD. & BACH., Quad. N. Am., II, 1851, 145, Pl. LXX.
" *Dekayi* BACHMAN, Journ. Phil. Acad. Nat. Sc., VII, 377, Pl. XXIII, Fig. 4.
" " DE KAY, N. Y. Fauna, I, 17, Pl. V, Fig. 2.
" " LINSLEY, Am. Journ. Sc., XXXIX, 388, Ib. XLIII, 346.
" " AUD. & BACH., Quad. N. Am., III, 1853, 246, Pl. CL, Fig. 2.
" *cinereus** BACHMAN, Journ. Phil. Acad. Nat. Sc., VII, 373, Pl. XXIII, Fig. 3.
Blarina carolinensis BAIRD, Mam. N. Amer., 45, Pl. XXX, Fig. 8, skull.
" *angusticeps* Ib., 47, Pl. XXX, Fig. 7, skull.
" *cinerea* Ib., 48, Pl. XXX, Figs. 9 & 10, skulls. (Young.)
" *exilipes* Ib., 51, Pl. XXVIII. (Young.)
" *Berlandieri* Ib., 53, Pl. XXVIII. (Young.)

TALPIDÆ.

48. **Scalops aquaticus** FISCHER. (*Scalops canadensis* Emmons, Rep., p. 15.) COMMON MOLE. Common.

49. **Scalops Breweri** BACH. HAIRY-TAILED MOLE. Apparently rare in Massachusetts, and not numerous anywhere. The original specimen described by Dr. Bachman came from Martha's Vineyard, and was collected by Dr. L. M. Yale, and presented by Dr. T. M. Brewer

* Afterwards considered by Dr. Bachman to be the young of *S. carolinensis*. See Quad. N. Am., III, p. 344. Same as *B. cinerea* Baird.

to Dr. Bachman. There is a specimen in the Museum of Comparative Zoölogy from Warwick, and others from Upton, Maine, and Hallidaysburg, Pennsylvania.

50. **Condylura cristata** DESMOREST. (*C. longicauda* Desm. and *C. macroura* Harlan of Emmons's Rep., pp. 17, 18.) STAR-NOSED MOLE. Common, but apparently more so in some parts of the State than in others. At Springfield this and *Scalops aquaticus* are about equally numerous, but in the eastern part of the State the present species seems to many times outnumber the other. From considerable variations in the length and size of the tail presented by different individuals, it was formerly incorrectly supposed that two species of *Condylura* existed in Massachusetts, and the eastern parts of the United States generally. The thickening of the tail appears to be connected with the rutting season.

SCIURIDÆ.

51. **Sciurus cinereus** LINN. (? "*S. vulpinus* Gmel.," Emmons's Rep., p. 66.) FOX SQUIRREL. Rare in most parts of the State.

52. **Sciurus carolinensis** GMELIN. ("*S. leucotis* Gapper" and "*S. niger* Linn.," Emmons's Rep., pp. 66, 67. *Macroxus** *carolinensis* (Gray.) GRAY SQUIRREL. Generally distributed, but much more common in some sections than in others, being most numerous where the forests have been least disturbed. Generally they are of the gray type, but the black variety is quite prevalent at some localities. In Wayne County, New York (on the south shore of Lake Ontario), I have found the black variety to be the most common, with every gradation between the two. All those observed that were pure glossy black seemed to be very old individuals, while the young generally presented a mixture of tawny, gray, and black, the hairs being annulated

* Dr. J. E. Gray, in his several Synopses of the Asiatic, African, and American Squirrels (Ann. and Mag. Nat. Hist., 3d Ser. Vol. XX, 1867), has recently divided the old genus *Sciurus* into several genera. *Sciurus*, as restricted by him, and *Macroxus* contain all the American species, by far the larger part of which are placed in *Macroxus*. Only the group to which *S. hudsonius* belongs, the *S. cinereus* or Northern fox squirrel, and Abert's squirrel from New Mexico (called by Gray *S.* "*Albertii*" = *S. Abertii* Woodhouse), remain in the genus *Sciurus* as restricted by Dr. Gray.

with these colors, varying in the proportion of each in almost every individual. The intensity of the black appears to increase with age.

Dr. Emmons's *S. vulpinus* seems to refer to large examples of this species rather than to the true fox squirrel (*S. cinereus* Linn.).

53. **Sciurus hudsonius** Pallas. Red Squirrel. Chickaree. Abundant.

The variations in color, in the hairiness of the soles, the presence or absence of ear-tufts, according to the season of the year, in this and other species, have already been pointed out by Professor Baird.* The lateral dusky stripe is perhaps the most variable feature in the present animal, in many specimens it being quite absent, and in the greater portion but faintly indicated, but it is not unfrequently one of the most conspicuous features of coloration. In fall specimens, particularly around Springfield, the black lateral line is generally conspicuous, being a well-defined, quite broad black band. Specimens from Northern Maine † differ from the majority of Massachusetts specimens in possessing a relatively very much shorter tail, somewhat in general color, the back being "rusty-yellow" rather than ferruginous, and in the greater fulness and softness of the fur. The black at the end of the tail is much broader and more conspicuous. In several points these specimens thus approach *S. Richardsonii.* Specimens entirely black have been received from Mr. G. A. Boardman from near Calais, Maine. In view of the wide range of variation presented by *S. hudsonius*, the descriptions of some of its near allies, especially of *S. Fremontii* and *S. Richardsonii* of Townsend and Bachman, seem scarcely to indicate more than slight local variations of one species. The specimens of the latter thus far examined have been too few to establish any very important differences between them and *S. hudsonius*, if such exist.

Professor Baird in his admirable article on the *Sciurinæ*, or typical squirrels of the United States, was able, through the very abundant material at his disposal, to eliminate a very large proportion of the invalid species that had from time to time crept into the works of preceding authors, including many described by Bachman and other Americans as well as by foreign naturalists. The variations pointed out by him as being dependent upon season and locality are important discoveries, since such variations are also of common occurrence among other groups. Two or three species only, besides those above specified, of the twelve species of *Sciurus* admitted in the work of this author seem at all questionable. These

* N. Amer. Mam., pp. 244 and 270.

† In the Mus. Comp. Zoöl., and C. J. Maynard's collection.

are the *S. castanonotus* and *S. limitis* from the little known region of Northern Mexico and the adjoining Territories northward, whose somewhat doubtful character is particularly mentioned.

Dr. Gray, in his "Synopsis of American Squirrels," * quotes Professor Baird's remarks respecting the wide variation in color presented by individuals of the same litter, the geographical variation in size, the variations in the hairiness of the soles of the feet at different seasons and between northern and southern representatives of the same species at the same season, and also in respect to the absence or presence of the ear-tufts in different individuals of the same species from the same locality; and so far as he has followed Baird's memoir his paper is to be commended. As soon, however, as extralimital species are encountered he seems to have lost sight of all these important facts quoted by him, and takes every considerable variation in color as the basis of a species. Hence the greater part of those described by previous authors receive his approval, and some *ten or twelve*, apparently, are added as new! The whole number of American *Sciuri* is thus increased to thirty-nine species. That some of the Mexican species are as variable as those of the United States is beyond question, while it is probable that some of the still more southern ones also are. According to Dr. Gray, the number of species of Asiatic *Sciuri* is forty-nine, an improbably large number, from which the excess can only be properly eliminated by a careful observer residing where these animals live, and the elaboration of a mass of material far greater than has thus far been brought together.

54. **Pteromys volucella** Desm. Flying Squirrel. Common, but, from its nocturnal habits, not often seen.

Apparently equally mature individuals from the same locality are quite variable in size, and somewhat in other characters. One, remarkably large, collected by Mr. S. Jillson at Hudson (Mass.), corresponds very well with the *P. hudsonius* Fischer (*P. sabrinus* Rich.), which supposed species is almost unquestionably but the large northern race of *P. volucella*.

Richardson described, in the "Fauna Boreali-Americana," † a variety of his *P. sabrinus* from the Rocky Mountains, to which he gave the name *alpinus* (*P. sab.*, var. *alpinus*). Wagner, in his Supplement to Schroeber's Säugethiere, ‡ and Audubon and Bachman in their North American Quadrupeds, § afterwards raised it to the rank of a species, but apparently with insufficient reason. Professor Baird also admits *P. alpinus* as a species in

* Ann. and Mag. Nat. Hist., 1867, p. 415.

† Vol. I, p. 195, pl. 18.

‡ Vol. III. p. 230.

§ Vol. III. p. 206.

his Mammals of North America (p. 289), but remarks that, from insufficient data, he was unable to arrive at a definite conclusion as to whether it was really distinct from *P. hudsonius*. The *P. oregonensis* of Bachman seems also very doubtfully distinct from *P. volucella*, as it does not differ very appreciably from the Eastern animal. The following remarks from Audubon and Bachman's North American Quadrupeds* in respect to the number of species of North American *Pteromys* are very suggestive. "As long," they observe, "as only two species of flying squirrel were known in North America, — the present species (*P. sabrinus*) and the little *P. volucella*, — there was no difficulty in deciding on the species, but since others have been described in the far West, the task of separating and defining them has become very perplexing."

Specimens in the Museum of Comparative Zoölogy from Lake Superior, Northern Maine, New Hampshire, Massachusetts, and the Middle States, form a graduated series in size, the first-mentioned, or northern, corresponding with the *P.* "*sabrinus*"; the southern, of course, with the true *P. volucella* of authors. Difference in size has been the only appreciable character that has been advanced as distinguishing them.

55. **Tamias striatus** Baird. (*T. americanus* Kuhl. *Sciurus striatus* Klein, Emmons's Rep., p. 68.) Striped Squirrel. Chipmunk. Abundant. Usually first seen abroad in spring towards the close of March, when they are readily detected by their loud clucking note.

A series of nearly fifty specimens in the Museum of Comparative Zoology, from various localities in Eastern Massachusetts, are extremely uniform in color, the variations being so slight as to be scarcely appreciable. A considerable number of others, from different localities in Maine, are generally very much lighter or paler colored. These, also, vary a good deal among themselves, chiefly, however, in the character of the stripes, which in several specimens are much less distinct than usual. In one they are quite faint and irregular, the light central one on the sides being alone well defined, and this is at one point interrupted. The difference in general tint between these Massachusetts and Maine specimens is quite marked in the rufous-colored regions of the animal, and especially on the posterior part of the back.

56. **Arctomys monax** Gmelin. Woodchuck. Abundant. At Springfield a number of specimens of the black variety have been taken within the last few years, and also three albinos. One of these is nearly white (pale grayish-white), and the other two are pale yellowish-brown

* Vol. III, p. 205.

or cream-colored. The latter are preserved in the Springfield Natural History Museum.

I have known of a few instances of the capture of this species in nearly midwinter. Once a specimen was taken running in the highway early in February, when the snow was a foot and a half deep. They generally leave their burrows very early in spring, often before the ground is fully thawed, but for some time after are irregular in going abroad, and are able to remain six or eight days inside their burrows without food, as they will often do when a trap is set for them. Till the season and vegetation are somewhat advanced they seem to take or require but little nourishment. Later, and especially after the birth of the young in June, they are forced in a much shorter time to leave their holes to obtain food. In fall they become very fat, and early in October generally permanently retire to their burrows, or at least go abroad then much less frequently than earlier, and apparently take very little food.

The Beaver (*Castor fiber* Linn.; *C. canadensis* Kuhl) is to be reckoned among those few animals that, in this State, have become fully exterminated.

The few differences pointed out by authors between the European and American beavers, including the distinction based on a comparison of the skulls, are too trivial, in the light of the extensive individual variations now so well known to be almost invariably presented by a large series of specimens of the same species from any given locality, to be taken as satisfactory evidence of their diversity. The weight of authority is also by far in favor of their identity.

57. **Jaculus hudsonius** Baird. (*Meriones* * *hudsonius* Aud. and Bach.) Jumping Mouse. Rather common, but far from numerous.

This species has distinct cheek-pouches, — a fact I have not before seen stated.

58. **Mus decumanus** Pallas. Brown Rat. Wharf Rat. Norway Rat. Abundant in the cities and larger villages generally; rare or quite unknown in the remote farming districts.

* *Meriones*, F. Cuvier, Dents des Mam., 1825, 187; type, *Dipus americanus* Barton. Not *Meriones* Illiger, Prod., 1811.

59. **Mus rattus** Linn. Black Rat. Abundant in the farming districts, but rare wherever the brown rat is numerous. In the vicinity of Boston and of the larger cities generally it seems to be quite unknown. Twenty or thirty miles from the coast, and at a little distance from the large towns along the railways, it becomes numerous, and the only species there found. The brown rat is its mortal enemy. With age this species changes from black to gray, very old individuals becoming very light colored.

60. **Mus musculus** Linn. House Mouse. Everywhere a numerous pest. Is frequent in the fields under stacks of grain as well as in houses and outbuildings.

61. **Hesperomys leucopus** LeConte. (*H. leucopus* and *H. myoides* Baird.) White-footed Mouse. Deer Mouse. A common species of the fields and woods. In winter it (sometimes at least) retires to a warm nest in a hollow stump or log, in which in severe weather I have found five or six together in a torpid state.

No species of our *Muridæ*, excepting possibly the *Jaculus hudsonius*, presents so great variations in color with season and age as the present. The young for the first two or three months, or till nearly full-grown, are dark slate or plumbeous above, somewhat lighter below. From the casting of the winter coat in spring till late in autumn the adult differs more or less in color with almost every individual, none presenting the bright yellowish or ferruginous brown seen in winter and early spring, but every stage between it and the plumbeous hue of the young; the adult being also more or less dusky for some time after moulting. Generally there is a darker band along the back, varying in width in different specimens, and in distinctness of outline ; sometimes, however, the back is uniform in color with the sides. The variation in size is also considerable between specimens apparently fully adult. The tubercles on the soles of the hind feet, on which specific distinctions are sometimes based, vary both in relative size and position. The posterior one is usually situated midway between the toes and the heel, but sometimes more posteriorly or more anteriorly. The next one is placed between this and the third, and is usually nearer to this than to the first, it being sometimes opposite to the third. The third anterior tubercle occasionally has a minute supplemental one at its outer base. But the most variable character consists in the relative length and number of the caudal vertebræ. About one fifth of the Massachusetts specimens have the tail vertebræ equal to or longer than the head and body together; occasionally a specimen is found in which the tail vertebræ alone exceed this length by one fourth to one half an inch. At least four fifths, however, have the tail shorter than the head and body, and occasionally one occurs with the tail only equal to the body alone. In these latter the proportional length of the tail vertebræ to the length of the head and body is as 68 to 100; in the other extreme, or in those with long tails, as 118 to 100. The variation between these extremes is hence about fifty per cent of the mean, — a striking example of the unreliability of this character as a specific distinction already claimed in discussing the species of *Mustelidæ*. The number of the vertebræ varies from twenty-four or twenty-five to above thirty. In regard to absolute size, the length of the head and body together, in Massachusetts specimens, rarely exceeds four inches; the average is between three and a quarter and three and a half; perhaps nearer the latter. The variation in this respect is well illustrated in Professor Baird's table of measurements of a large number of Middleboro' and other specimens of this species, given in the Mammals of North America (p. 462).

Through the seasonal and other variations in color, as well as in size and proportions, it becomes extremely difficult to distinguish the different North American species of the restricted genus *Hesperomys*, if so many species are to be recognized as have been described, similar variations apparently occurring in all the species. That several exist in the eastern part of the United States seems unquestionable, but the validity of many that have been described from this region is at the same time highly doubtful. The *H. gossypinus*, as defined by Professor Baird, would at first seem readily distinguishable by its comparatively large size, coupled with a southern habitat and its short tail; in color and proportions it closely resembles *H. leucopus*. But since in *H. cognatus* we have a form intermediate between the two and intimately allied to both, the true standing and affinities of each of the three become questionable. Some specimens of *Hesperomys* before me from Florida * differ in no essential particular from examples of *H. leucopus* in summer pelage from Massachusetts and Maine. Well-marked examples of either of the two first mentioned of these so-called species seem sufficiently distinct, but a large series of specimens is constantly presenting intermediate stages, and a large amount of variation in each of the would-be distinctive characters. A single Florida specimen of *H. Nuttallii* (*Mus aureolus* Aud. and Bach.) differs much in color from the other Florida specimens of *Hesperomys*, and from *H. leucopus*.

* In addition to the specimens collected by myself in Florida the past winter, I am indebted to Mr. C. J. Maynard for the opportunity of examining others obtained there by himself the same season.

H. michiganensis, of which I have also had fresh specimens for examination, seems as well marked as any of the group, through its small size, very short tail, and dark plumbeous color at all seasons. Other specimens collected by myself in Western Iowa, supposed from their locality to be referable to *H. sonoriensis*, differ in no way appreciably, except in being a little lighter colored, from average specimens of Massachusetts *H. leucopus*.

H. myoides, described by Baird from Canada and Vermont specimens, is positively identical with *H. leucopus*, the cheek-pouches — the only character supposed to distinctively characterize it — being probably common to all the species of the genus, as well as to *Jaculus*.* I first became aware of the existence of cheek-pouches in *H. leucopus* by capturing the animal with the pouches distended with seeds and grain; a subsequent examination of many specimens in alcohol from Berlin, Middleboro',† Springfield, and other localities in Massachusetts, and from Waterville, Norway, Bethel, Upton, and other places in Maine, has fully confirmed this discovery, as I have yet to find the first specimen without the pouches. They almost uniformly exist as described by Gapper, — that is, extending upwards to the eye and posteriorly to the ear. They are equally well marked in specimens of *H. gossypinus* and *H.* "*cognatus*," from Florida. ‡

In the large proportion of equivocal species included among the thirteen recognized in the General Report, to which one since described from In-

* See *antea*, p. 226.

† The Middleboro' specimens were collected by Mr. J. W. P. Jenks, and presented by the Smithsonian Institution to the Museum of Comparative Zoölogy, labelled "*Hesperomys leucopus*."

‡ In the Report on North American Mammals (p. 460) it is stated, "No traces of cheek-pouches can be detected" in *H. leucopus*. Under *H. myoides* the same author remarks (Ib., p. 472) that he found, much to his astonishment, decided indications of cheek-pouches in all the alcoholic specimens of that "species" he examined. "I then," he says, "investigated a considerable number of Middleboro' specimens, and in none could I detect the slightest indication of anything of the kind." "In another specimen," he says later (No. 2776), "from Watervile, New York, referable probably to the same species [*H. myoides*], I found the cheeks crammed with large seeds, and on cutting them open could see that the latter occupied a pouch of considerable size. It is possible that this specimen (immature) may not belong to *H. myoides*, if so, we must conclude that in the ability to distend the cheeks very much, even temporarily, the *H. leucopus* approaches very closely to the *H. myoides*, and this diminishes still more the propriety of placing the latter in a distinct genus. It is quite possible that others of our species may have the cheek-pouches more or less developed." It hence appears that the existence of cheek-pouches in the other species of *Hesperomys* was finally strongly suspected by the author in question. The oversight of their presence in *H. leucopus*, however, is somewhat surprising, since they are not difficult to discover in specimens preserved in alcohol, when search for them is properly made, though in specimens badly contracted by the alcohol they might quite readily escape observation.

diana by Prince Maximilian is added,* there are besides the several doubtful ones already mentioned, others equally questionable. Of those assigned to that part of the United States east of the Rocky Mountains, the *H. michiganensis*, *H. leucopus*, and *H. Nuttallii* (*aureolus* Aud. and Bach.), seem to be those best entitled to recognition, while possibly *H. gossypinus* may be also valid; but with my present knowledge of the subject, I fail to see why *H. texanus*, *H. indianus* (of Prince Maximilian), *H. sonoriensis*, *H. myoides*, and *H. cognatus*, should be thus regarded, all but the latter, and perhaps also both this and *H. gossypinus*, being apparently referable to *H. leucopus*. I do not hesitate to thus refer *H. sonoriensis*, and *H. myoides*, both of which I have examined in the fresh state, and numbers of the latter that were preserved in alcohol.

Of the Pacific Coast species, of which at least five have been described, several are intimately allied to the *H. leucopus* of the East, as well as to each other. Whether any of them are identical with *H. leucopus* is not at present, from want of sufficient material, easy to decide. Should they prove to be so, it would substantiate a more extended geographical range for *H.*

* 1. *Hesperomys leucopus* BAIRD, N. Am. Mam., 1857, 459; = *Musculus leucopus* RAFF., Amer. Monthly Mag., III, 1823, 307.

2. *Hesperomys myoides* BAIRD, N. Am. Mam., 472; = *Cricetus myoides* GAPPER, Zoöl. Journ., 1830, 204.

3. *Hesperomys indianus* MAXIMILIAN, Archiv für Naturgesch., XVIII, 1, 1862, 111.

4. *Hesperomys sonoriensis* LECONTE, Proc. Phil. Acad. Nat. Sci., VI, 1853, 413; = *H. sonoriensis* BAIRD, N. Am. Mam., 474.

5. *Hesperomys texanus* WOODHOUSE, Proc. Phil. Acad. Nat. Sci., VI, 1853, 242; = *H. texanus* BAIRD, N. Am. Mam., 464.

6. *Hesperomys Nuttallii* BAIRD, N. Am. Mam., p. 467; =? *Arvicola Nuttallii* HARLAN, Month. Amer. Journ., 1832, 446; = *Mus* (*Calomys*) *aureolus* AUD. and BACH., Jour. Phil. Acad. Nat. Sci., VIII, 1842, 302.

7. *Hesperomys cognatus* LECONTE, Proc. Phil. Acad. Nat. Sci., VII, 1855, 442; = *H. cognatus* BAIRD, N. Am. Mam., 469.

8. *Hesperomys gossypinus* LECONTE, Proc. Phil. Acad. Nat. Sci., VI, 1853, 411; = *H. gossypinus* BAIRD, N. Am. Mam., 469.

9. *Hesperomys Boylii* BAIRD, Proc. Phil. Acad., VII, 1855, 335; = Ibid., N. Am. Mam., 471.

10. *Hesperomys californicus* BAIRD, N. Am. Mam., 478; = *Mus californicus* GAMBEL, Proc. Phil. Acad. Nat. Sci., IV, 1848, 78.

11. *Hesperomys eremicus* BAIRD, N. Am. Mam., 479.

12. *Hesperomys austerus* BAIRD, Proc. Phil. Acad. Nat. Sci., VII, 1855, 336; = Ibid., N. Am. Mam., 466.

13. *Hesperomys Gambelii* BAIRD, N. Am. Mam., 464.

14. *Hesperomys michiganensis* WAGNER, Archiv fur Naturgesch., 1843, 2, 51; = *Mus michiganensis* AUD. and BACH., Journ. Phil. Acad. Nat. Sci., VIII, 304; = *H. michiganensis* BAIRD, N. Am. Mam., 476; = *Mus Bairdii* HOY & KENNICOTT, Patent-Office Rep., Agr., 1856 (1857), 92.

leucopus than many of the rodents possess, particularly the smaller species, but no greater than seems to be admitted for *Jaculus hudsonius*, its somewhat near ally. The habitat of *Jaculus hudsonius*, as now commonly defined, extends from ocean to ocean, and from the Arctic regions southward through at least the Middle States and to Missouri. This, also, is a species remarkable for its variability in color, size, proportional length of the tail to the body, etc.; but in the General Report on the Mammals of North America these differences were allowed only their proper value, and several species of authors were reduced to synonymes in consequence. Had the same course been taken in respect to the genus *Hesperomys*, undoubtedly a large proportion of the nominal species now admitted would have been referred to their proper rank. There seems to be no reason why *Hesperomys leucopus* may not range as widely as *Jaculus hudsonius*, and but little to show that such is not the case.

62. **Arvicola Gapperi** VIGORS. RED-BACKED MOUSE. Apparently not very rare in some localities in the eastern part of the State. Professor Baird mentions seven specimens sent him by Mr. J. W. P. Jenks from Middleboro'.* There are also several specimens in the Museum of Comparative Zoölogy from localities near Cambridge. It has not yet been met with, however, in the vicinity of Springfield. It is apparently less southern in its distribution than the next following species.

63. **Arvicola riparius** ORD. COMMON MEADOW MOUSE. Abundant; periodically excessively so. At such times they often do great harm by destroying fruit and other trees. Apple-trees a foot in diameter are sometimes killed by being girdled by these destructive animals. They also occasionally destroy large numbers of those of smaller size, as well as of young pitch-pines (*Pinus rigida* Linn.) and other native trees. Their excessive increase is generally coincident with a series of winters during which the ground is covered with a heavy deposit of snow, which protects them from cold, and beneath which they burrow and commit their ravages. Their decrease generally occurs during a series of "open" winters, when in searching for their food they are wholly unprotected from severe cold, and the deep freezing of the ground obstructs their shallow burrows, within which they are doubtless often frozen. They frequent every variety of situa-

* N. Am. Mam., p. 521.

tion, from half-submerged meadows to the driest sandy plains. Dr. Godman, in his American Natural History,* under *Arvicola xanthognathus*, has very minutely described the habits of this species. While in meadows it forms roadways among the roots of the grass on the surface, in grain-fields it burrows beneath the surface, its habits varying with circumstances. In the latter situation the vegetation is not generally sufficiently dense to screen it, hence its more subterranean mode of life. Their nests are found containing newly born young from early in May till November. The number of litters produced by a single female in a year is probably generally not less than three, and may be more; the young of the early litters also themselves appear to have young the same season; hence the great rapidity of increase that obtains in this species.

Specimens, even from the same locality, vary considerably in size, color, the texture of the fur, and even in the shape of the skull, independently of considerable variations that result from age and season. On these variations have been erected numerous nominal species, some of which are already currently considered as synonymes of *A. riparius* Ord, and several more, doubtless, should be added to the list. Among those described from or attributed to Massachusetts which I refer to *A. riparius* are *A. hirsutus* and *A. albo-rufescens* Emmons,† *A. nasuta* Audubon and Bachman,‡ and *A. Breweri* and *A. rufidorsum* Baird; § also, *A. rufescens* De Kay, ‖ from New York.

On Muskeget Island (a small, uninhabited, low sandy island between Nantucket and Martha's Vineyard) I recently found the so-called *A. Breweri* excessively abundant. This is the only locality from which this supposed species has been reported. They are generally much paler in color than the *A. riparius* of the interior, and though not differing from them appreciably in any other respects, they form an interesting insular race. From the peculiar character of the locality, the scattered beach-grass growing upon it affording but slight protection to these animals from the sunlight, the intensity of which is greatly heightened by the almost bare, light-colored sands, the generally bleached appearance of the Muskeget *Arvicola* might have been anticipated. Specimens occasionally occur of nearly the ordinary color, or which are undistinguishable from the lighter-colored speci-

* Vol. II, p. 66.

† Report on Quad. of Mass., p. 60.

‡ Journ. Phil. Acad. Nat. Sci., Vol. VIII, p. 296; Quad. N. Am., Vol. III, p. 211, Pl. 144, Fig. 2.

§ N. Am. Mam., pp. 525, 526.

‖ N. Y. Fauna, Vol. I, p. 85, pl. XXII, Fig. 1.

mens from the interior; but most of them seem to be quite like the ones described by Professor Baird. The mice living on the extensive sand-dunes at Ipswich, under circumstances similar to those of the Muskeget mice, often present, as I have recently ascertained, the half-white appearance of the *A.* "*Breweri.*"

The *A. albo-rufescens*, described by Dr. Emmons from two nearly white or cream-colored specimens procured at Williamstown, is, as first suggested by Audubon, undoubtedly but an albinic variety of *A. riparius*. Having obtained two specimens at Springfield that almost exactly accorded with Emmons's description of *A. albo-rufescens,* I was led at first to consider it a valid species. Subsequent experience convinced me that this is not its character. Two similarly colored specimens of the woodchuck (*Arctomys monax*), unquestionably albinic, have been since obtained at Springfield, which differ from the ordinary condition of that animal in the same way that these specimens of *Arvicola* do from the ordinary state of *A. riparius*. Aububon and Bachman mention similar examples that came under their notice; in one case different stages of albinism were observed in the different individuals of the same litter. A short time since I myself received an interesting albinic example of this species from Weathersfield, Vermont, from my friend Mr. J. P. Stoughton, of which the following is a description: Beneath, except the extreme posterior part of the body, pure white; mainly white above, with a wide, rather irregular band of dusky along the back; the anterior part of the head and the cheeks dusky; posterior part of the head white, with several dusky spots; ears, thighs, and a large spot on the left shoulder, dusky, with small axillary spots of the same color; all the feet and the terminal third of the tail, white. Irides a little lighter than the natural color, but not red. Ears conspicuous; much longer than the short, soft fur. A little smaller, and rather slenderer than ordinary specimens. Apparently a mature female, taken August 18, 1868. Albinos of this species appear to be not infrequent, the capture of a litter in which all the individuals greatly resembled the parti-colored one above described having come to my knowledge since the above was written.

The single specimen from Holmes's Hole, described as *A. rufidorsum,** which is thus far the only recognized specimen of this supposed species extant, seems to be but an unusually highly colored example of *A riparius.* At Springfield, where I have examined hundreds of specimens at different seasons of the year, the variation in color is very considerable, ranging from decidedly gray on the one extreme to as decidedly rufous chestnut-brown on the other. They are usually much grayer in March and April than they are late in the fall.

* See N. Am. Mam., p. 526, as previously cited.

The following is a partial list of the synonymes of

Arvicola riparius.

Arvicola riparius ORD, Journ. Phil. Acad. Nat. Sci., IV, 1825, 305.
" " DEKAY, N. Y. Fauna, Pt. I, 1842, 84, Pl. XXII, Fig. 2. (Young.)
" " AUD. and BACH., Quad. N. Am., III, 1854, 302.
" " KENNICOTT, Pat. Off. Rep., 1856, Agr., 1857, 304.
" " BAIRD, N. Am. Mam., 1857, 522.
" *palustris* HARLAN, Faun. Am., 1825, 126.
" *albo-rufescens* EMMONS, Quad. Mass., 1840.
" " DEKAY, N. Y. Fauna, 1842, I, 89.
" *hirsutus* EMMONS, Quad. Mass., 1840, 60.
" " DEKAY, N. Y. Fauna, I, 86.
" *oneida* Ibid., 88, Pl. XXIV, Fig. 1.
" *rufescens* Ibid., 85, Pl. XXII, Fig. 1.
" *nasuta* AUD. and BACH., Journ. Phil. Acad. Nat. Sc., VIII (2), 1842, 296.
" " Ibid., North Am. Quad., III, 1853, 211, Pl. CLXIV, Fig. 2.
" *pennsylvanica* AUD. and BACH., Quad. N. Am., I, 1849, Pl. XLV, 341.
" *rufidorsum* BAIRD, Mam. N. Am., 1857, 526.
" *Breweri* Ibid., 525.
" *xanthognathus* * GODMAN, Am. Nat. Hist., II, 1826, 65.
" " DEKAY, N. Y. Fauna, I, 1842, 90.
" " LINSLEY, Am. Jour. Sc., XLIII, 1842, 350.

64. **Arvicola pinetorum** AUD. & BACH. (*A.* [*Pitymys*] *pinetorum* Baird.) The only specimens of this species I have seen from this State are one captured at Springfield in May, 1868, by my brother, Mr. E. Allen, and one taken by myself a few weeks later. Both were taken in the same field on the "pine plains" east of the city. Audubon and Bachman, I find, speak of having received it from near Boston, from Dr. Brewer. These authors also speak of it as occurring in Connecticut, and as abundant in certain portions of Rhode Island.† Professor Baird cites it from Long Island,‡ whence Audubon and Bachman derived their first specimens of *A.* "*scalopsoides*,"§ which they afterwards very properly considered as a synonyme of *A. pinetorum*. It

* Whatever the "*A. xanthognathus*" of Leach and Richardson (Faun. Bor. Am., I, 122) may have been, the *A. xanthognathus* of Godman, DeKay, and Linsley unquestionably refers to the *A. riparius* of Ord.

† Quad. N. Am., II, p. 216.

‡ Mam. N. Am., p. 544.

§ Journ. Phil. Acad. Nat. Sci., VIII, p. 299.

being a southern species, Massachusetts is probably its northern limit Its occurrence here is comparatively rare.

65. **Fiber zibethicus** Cuv. MUSKRAT. Abundant. Individ uals nearly black are taken occasionally.

HYSTRICIDÆ.

66. **Erethizon dorsatus** F. Cuv. (*E. dorsatus* and *E. epixanthus* Auct.) PORCUPINE. "HEDGEHOG." Occasional on the Hoosac ranges.

Professor Baird, in his description of this species,* thus observes: "Fur, dark brown; the long projecting bristly hairs dusky, with white tips; spines white, the points dusky. Nasal bones not more than one third the length of the upper surface of the skull." He adds: "I regret not to have a sufficiently perfect specimen of the common Eastern porcupine before me to furnish a satisfactory description. The differences, however, from *E. epixanthus*† are not very great, *consisting chiefly in the color of the tips of the long hairs*, and one description will answer very well for both, except where the peculiarities of each are specially indicated. The range of this species is much more limited than previously supposed, as it is replaced west of the Missouri by the *E. epixanthus*."

He thus describes *E. epixanthus*, from several good specimens: "General color dark brown, nearly black; the long hairs of the body tipped with greenish-yellow. Nasal bones nearly one half or two fifths the length of the upper surface of the skull"; which he says are not more than one third in *E. dorsatus*. Nine very fine specimens of *E. dorsatus* in the Museum of Comparative Zoölogy, from Central Maine, show that the color of the projecting bristly hairs is variable. In one they are *entirely black*, except a very few about the head, which are tipped with lighter; in another those of the back are black, while on the head, sides of the shoulders, etc., they are tipped with dull yellowish-white. Several have them of the greenish-yellow supposed to characterize exclusively *E. epixanthus*; in one or two only can they be called white, while in one these bristly hairs are almost entirely absent, being quite so on the back. The quills usually project considerably beyond the fur, but are sometimes quite concealed within it. Their color varies from white to dull yellow. Professor

* Mam. N. Am., p. 569.

† "*E. epixanthus* Brandt, Mém. Acad. de St. Petersbourg, 1835, 388, 416; Plate I (animal) and Plate IX. Figs. 1-4, skull."

Baird's detailed description of the exterior characters of *E. epixanthus* is in every respect applicable to fully one half the specimens from Maine referred to above, while none differ essentially from it. The differences referred to by him in the relative length of the nasals in the two supposed species are relatively very slight, especially as compared with the large amount of variability presented in a large series of the skulls of *Arctomys monax*, or of our common squirrels or rabbits; the difference in the proportional length of the nasals to the whole length of the skull, in five specimens of *E. epixanthus* and three of *E. dorsatus*, as given by Professor Baird, being but 4 per cent; the nasals in *E. dorsatus* being 37 per cent of the whole length of the skull, and in *E. epixanthus* 41. In No. 676 (*E.* "*dorsatus*") of Baird's table, the proportional length of the nasals to the entire skull is 39 per cent; in No. 3066, 32 per cent. In No. 822 (*E.* "*epixanthus*"), 39 per cent. In other words, the specimen in the series of *E. dorsatus* in which the nasals are longest differs less than one-third of one per cent in the proportional length of the nasals to the whole skull from the specimen with relatively the shortest nasals in the seies of the *E. epixanthus* specimens.

I am not able at this time to refer to M. Brandt's paper, but Waterhouse, in his Natural History of the Mammalia,* refers to it as follows: "Five specimens of an *Erethizon* from the West Coast of North America, in the Museum of St. Petersburg, having the exposed ends of the longest hairs of the fur of a brownish-yellow color instead of white, as the same hairs are stated to be in the *E. dorsatus*, M. Brandt is inclined to suppose there are two species of *Erethizon*, but not having specimens of the Canada animal for comparison, he is not able to satisfy himself upon this point. The specimens examined by M. Brandt are from California and Unalaska, and I may add that a similar specimen is found at Sitka, as I remember to have seen a specimen in the Leyden Museum from there agreeing with M. Brandt's description; its *spines* [not *hairs*] were most of them of a delicate yellow below the dark point." The following is Mr. Waterhouse's description of *E. epixanthus*, compiled from M. Brandt's memoir: "The longer and coarser hairs brownish-yellow at the point; spines white or yellowish at the base, and most of them brownish-black or dusky at the apex."

It hence appears that the three principal writers on the subject — Brandt, Waterhouse, and Baird — have neither of them had specimens of the two species for comparison at the time of writing; Brandt having only his five West Coast specimens, Waterhouse compiling from Brandt, and Baird's specimens coming, two from the Republican Fork, one from New Mexico, and one from California, with three or four skulls from the East.

* Vol. II, p. 442.

Dr. Brandt must have been much influenced by the difference in locality whence his specimens came, in supposing there might be two species of *Erethizon*, since the only difference he points out — that of the color of the tips of the long hairs — is one of a trivial, and, as all mammalogists must be aware, most inconstant character. The differences in the skulls discovered by Professor Baird, though so appreciable, have less weight since we know that skulls of individuals of the same species from the *same locality* not unfrequently vary as much, and in the same way. Again, according to the measurements he has given, and which are discussed above, one specimen of the one series of three is not appreciably different from a specimen of the other series of five. Hence, though having only Eastern specimens for examination, I quite confidently refer, for the reasons given above, the *E. epixanthus* Brandt to the *E. dorsatus* F. Cuvier. I am quite sure, also, that, had either Professor Baird or Dr. Brandt possessed a good series of *E. dorsatus* from Eastern North America, they could hardly have admitted the latter's doubtfully proposed species, even provisionally.

Prince Maximilian, in speaking of the porcupines of the Upper Missouri,* mentions them simply under the generic name *Erethizon*, stating that he was unable to decide whether the animal he observed should be referred to *E. dorsatus* or to *E. epixanthus*.

Dr. J. E. Gray, in the proceedings of the London Zoölogical Society,† has described a small specimen of *Erethizon* from Columbia as a new species, under the name of *E.* (*Echinoprocta*) *rufescens*, although there is nothing to indicate that it is in any way different from the young of the common *E. dorsatus*. The differences on which he has raised it to a distinct section or subgenus are only such as characterize the young or half-grown animal in *E. dorsatus*, with which also his corresponds in size.

LEPORIDÆ.

67. **Lepus americanus** Erxl. (Emmons's Rep., p. 56.) White Rabbit. Common, but generally less so than the next. Rare in the immediate vicinity of Springfield, though numerous at localities less than ten miles distant, in several directions.

68. **Sylvilagus nanus** Gray.‡ (*Lepus sylvaticus* Bach. *Lepus*

* Wiegmann's Archiv, XVIII, Theil I, p. 150.

† 1865, 121, Pl. XI; also in the Annals and Magazine of Natural History of the same year.

‡ In a recent paper entitled "Notes on the Skulls of Hares (*Leporidæ*) and Picas (*Lagomyidæ*) in the British Museum," Dr. J. E. Gray has given names to the sections of the old genus *Lepus*, first indicated by Professor Baird in his well-studied essay on this group (N. Am. Mam., pp. 572 – 620), and raised them to the rank of genera, thereby, of

virginianus Harlan, Emm. Rep., p. 58.) GRAY RABBIT. Abundant in most parts of the State. Less common in the more elevated portions, and quite unknown in the higher ranges of the western counties.

GENERAL SYNOPSIS AND REMARKS ON THE GEOGRAPHICAL DISTRIBUTION OF THE SPECIES.

I. *Indigenous Species still existing in the State.*

1. Lynx canadensis *Raf.**
2. " rufus *Raf.**
3. Canis lupus *Linn.**
4. Vulpes vulgaris *Cuv.*
5. " virginianus *DeKay.**
6. Mustela Pennantii *Erxl.**
7. " martes *Linn.**
8. Putorius vulgaris *Linn.*
9. " ermineus *Linn.*
10. " lutreolus *Cuv.*
11. Gulo luscus *Sabine.**
12. Lutra canadensis *Sab.*
13. Mephitis mephitica *Baird.*
14. Procyon lotor *Storr.*
15. Ursus arctos *Linn.**
16. Phoca vitulina *Linn.*
17. Cystophora cristata *Nilsson.*
18. Cariacus virginianus *Gray.**
19. Balæna cisarctica *Cope.*
20. Agaphalus gibbosus *Cope.*
21. Megaptera osphyia *Cope.*
22. Eschrichtus robustus *Lilj.**
23. Sibbaldius tectirostris *Cope.*
24. " tuberosus *Cope.**
25. " borealis *Fisch.**
26. ? Balænoptera rostrata.
27. Physeter macrocephalus *Pander.**
28. Mesoplodon sowerbiensis.*
29. Orca gladiator *Sund.*
30. Globiocephalus melas *Traill.*
31. Hyperaodon bidens *Owen.**
32. Beluga canadensis *Erxl.**
33. Largenorhynchus sp.?
34. Delphinus erebennus *Cope.*
35. " clymene *Gray.**
36. Phocæna americana *Agass.*
37. Lasiurus noveboracensis *Tomes.*
38. " cinereus *H. Allen.**
39. Scotophilus fuscus *H. Allen.*
40. " noctivagans *H. Allen.*
41. " georgianus *H. Allen.*
42. Vespertilio subulatus *Say.*
43. Neosorex palustris *Verrill.**
44. Sorex platyrhinus *Linsley.*
45. Sorex Cooperi *Bach.**
46. " Forsteri *Rich.**
47. Blarina brevicauda *Baird.*
48. Scalops aquaticus *Fisch.*
49. " Breweri *Bach.**
50. Condylura cristata *Ill.*

course, introducing numerous changes in nomenclature. *Lepus* is restricted to the larger species, typically represented by *L. americanus* Erxl. and the European *L. timidus* Linn. Thirty species of the old genus *Lepus* are enumerated, but a considerable proportion appear to rest on highly questionable grounds. Dr. Gray enumerates in this paper thirty-nine species of *Leporidæ* alone, of which sixteen are North American and two South American. The characters of these groups, so far at least as they relate to the North American species, are those developed by Professor Baird in his excellent elaboration of this family.

* Species marked with the asterisk are very sparsely represented; among the Carnivora most of those thus distinguished have become nearly exterminated.

51. Sciurus cinereus *Linn.**
52. " carolinensis *Gmelin.*
53. " hudsonius *Pall.*
54. Pteromys volucella *Linn.*
55. Tamias striatus *Baird.*
56. Arctomys monax *Gmelin.*
57. Fiber zibethicus *F. Cuv.*
58. Jaculus hudsonius *Baird.*
59. Hesperomys leucopus *LeConte.*
60. Arvicola Gapperi *Vigors.*
61. " riparius *Ord.*
62. " pinetorum *LeConte.**
63. Erethizon dorsatus *F. Cuv.**
64. Lepus americanus *Erxl.*
65. Sylvilagus sylvaticus *Gray.*

II. *Extirpated Species.*

1. Felis concolor *Linn.*
2. Alce malchis *Ogl.*
3. Tarandus rangifer *Gray.*
4. Cervus canadensis *Linn.*
5. Castor fiber *Linn.*

III. *Adventitious Species.*

1. Mus decumanus *Linn.*
3. " rattus *Linn.*
3. " musculus *Linn.*

IV. *Northern Species.*

[Not occurring in this State south of the Canadian fauna (excepting *Lepus americanus*, which ranges through the Alleghanian), and hence represented only in portions of the western counties.]†

1. Mustela Pennantii.
2. " martes.
3. Gulo luscus.
4. Alce malchis.
5. Tarandus rangifer.
6. Arvicola Gapperi.
7. Erethizon dorsatus.
8. Lepus americanus.

V. *Southern Species.*

[Not occurring north of the Alleghanian Fauna, and hence unrepresented in the more elevated parts of the State, though more or less common in the other portions.]

† *Antea*, in a foot-note to page 147, *Cervus canadensis* is included among the species there mentioned as characteristic of the Canadian fauna, as formerly represented in Massachusetts. I have since found, from what is known of its earlier range, that it probably once extended over the greater part of the States lying east of the Mississippi, and undoubtedly extended along the Atlantic coast farther south even than Southern New England. There is unquestionable evidences of its existence within the last fifty years on both sides of the Ohio River near its mouth; a locality much more southern, faunally as well as geographically, than any part of New England. Hence it cannot be taken as a species the southern boundary of whose habitat marks the lower limit of the Canadian fauna, as there stated.

1. Vulpes virginianus.
2. Scalops aquaticus.
3. " Breweri.
4. Sciurus cinereus.
5. Sciurus carolinensis.
6. Arvicola pinetorum.
7. Sylvilagus sylvaticus.

VI. *Restricted to the Eastern Province.*

1. Cervus canadensis.
2. Cariacus virginianus.
3. ? Scotophilus georgianus.
4. Neosorex palustris.
5. Sorex Cooperi.
6. " Forsteri.
7. " platyrhinus.
8. Blarina brevicauda.
9. Scalops aquaticus.
10. " Breweri.
11. Condylura cristata.
12. Sciurus cinereus.
13. " carolinensis.
14. " hudsonius.
15. Tamias striatus.
16. ? Arctomys monax.
17. ? Hesperomys leucopus.
18. Arvicola Gapperi.
19. " riparius.
20. " pinetorum.
21. Lepus americanus.
22. Sylvilagus sylvaticus.

VII. *Species restricted to America, but which range over the greater portion of the Northern Continent.**

1. Felis concolor.
2. Lynx canadensis.
3. " rufus.
4. Vulpes virginianus.
5. Mustela Pennantii.
6. Mephitis mephitica.
7. Procyon lotor.
8. Vespertilio subulatus.
9. Scotophilus fuscus.
10. " noctivagans.
11. Lasiurus noveboracensis.
12. " cinereus.
13. Pteromys volucella.
14. Fiber zibethicus.
15. Jaculus hudsonius.
16. Erethizon dorsatus.

VIII. *Species that occur throughout the colder portion of the Northern Hemisphere.*

(Cetacea not included.)

1. Canis lupus.
2. Vulpes vulgaris.
3. Mustela martes.
4. Putorius erminea.
5. " vulgaris.
6. " lutreolus.
7. Gulo luscus.
8. Ursus arctos.
9. Phoca vitulina.
10. Cystophora cristata.
11. Alce malchis.
12. Tarandus rangifer.
13. Castor fiber.

* Probably *Sciurus hudsonius* and *Hesperomys leucopus* should be transferred from the preceding list to this.

IX. *Comparative Table.*

Showing what species of Dr. Emmons's Report on the Quadrupeds of Massachusetts, Dr. DeKay's on the Mammalia of the State of New York, and Mr. J. P. Linsley's Catalogue of the Mammals of Connecticut, are synonymous with those of the present list.

NOTE. — The numbers refer to the same species in each column. Domesticated and fossil species and the Cetacea are omitted.

Present List.	*Emmons's Report.*	*Linsley's Catalogue.*	*DeKay's Report.*
1. Felis concolor.	1. Felis concolor.	1. Felis concolor.	1. Felis concolor.
2. Lynx canadensis.	2. Lyncus borealis.	2. Lyncus borealis.	2. Lyncus borealis.
3. " rufus.	3. " rufus.	3. " rufus.	3. " rufus.
4. Canis lupus.	4. Canis lupus.	4. Canis lupus.	4. Lupus occidentalis.
5. Vulpes vulgaris.	5. Vulpes fulvus.	5. { " fulvus " decussatus. " argentatus.	5. Vulpes fulvus.
6. " virginianus.	6. Vulpes virginianus.	6. " cinero-argentatus.	6. " virginianus.
7. Mustela Pennantii.	7. Mustela canadensis.	7. Mustela canadensis.	7. Mustela canadensis.
8. " martes.	8. " martes.	8. " martes.	8. " martes.
9. Putorius vulgaris.	9. Putorius vulgaris.	9. " pusilla.	9. " pusilla.
10. " ermineus.	10. " noveboracensis.	10. { " fusca. Putorius noveboracensis.	10. { " fusca. Putorius noveboracensis.
11. " lutreolus.	11. " vison.	11. " vison.	11. " vison.
12. Gulo luscus.	12. —— ——	12. —— ——	12. Gulo luscus.
13. Lutra canadensis.	13. Lutra canadensis.	13. Lutra canadensis.	13. Lutra canadensis.
14. Mephitis mephitica.	14. Mephitis americana.	14. Mephitis americana.	14. Mephitis americana.
15. Procyon lotor.	15. Procyon lotor.	15. Procyon lotor.	15. Procyon lotor.
16. Ursus arctos.	16. Ursus americanus.	16. Ursus americanus.	16. Ursus americanus.

Present List.	*Emmons's Report.*	*Linsley's Catalogue.*	*DeKay's Report.*
17. Alce malchis.	17. Cervus alces.	17. —— ——	17. Cervus alces.
18. Tarandus rangifer.	18. " tarandus.	18. —— ——	18. Rangifer tarandus.
19. Cervus canadensis.	19. —— ——	19. —— ——	19. Elaphus canadensis.
20. Cariacus virginianus.	20. " virginianus.	20. Cervus virginianus.	20. Cervus virginianus.
21. Phoca vitulina.	21. —— ——	21. { Phoca concolor. ? " grœnlandica.	21. Phoca concolor.
22. Cystophora cristata.	22. —— ——	22. Stemmatopus cristatus.	22. Stemmatopus cristatus.
23. Lasiurus noveboracensis.	23. Vespertilio noveboracensis.	23. Vespertilio noveboracensis.	23. Vespertilio noveboracensis.
24. " cinereus.	24. " pruinosus.	24. " pruinosus.	24. " pruinosus.
25. Scotophilus fuscus.	25. " carolinensis.	25. " carolinensis.	25. " carolinensis.
26. " georgianus.	26. —— ——	26. —— ——	26. —— ——
27. " noctivagans.	27. —— ——	27. " noctivagans.	27. " noctivagans.
28. Vespertilio subulatus.	28. —— ——	28. " subulatus.	28. " subulatus.
29. Neosorex palustris.	29. —— ——	29. —— ——	29. —— ——
30. Sorex platyrhinus.	30. —— ——	30. Sorex platyrhinus.	30. Otisorex platyrhinus.
31. " Forsteri.	31. —— ——	31. —— ——	31. Sorex Forsteri.
32. " Cooperi.	32. —— ——	32. —— ——	32. —— ——
33. Blarina brevicauda.	33. —— ——	33. { Sorex brevicaudus. " parvus. " DeKayi.	33. { Sorex brevicaudus. " parvus. " DeKayi. " carolinensis.
34. Scalops aquaticus.	34. Scalops canadensis.	34. Scalops canadensis.	34. Scalops aquaticus.
35. " Breweri.	35. —— ——	35. —— ——	35. —— ——
36. Condylura cristata.	36. { Condylura longicaudata. " macroura.	36. { Condylura longicaudata. " macroura.	36. Condylura cristata.
37. Sciurus cinereus.	37. Sciurus vulpinus.	37. Sciurus vulpinus.	37. Sciurus vulpinus.

38. Sciurus carolinensis.	38. { Sciurus leucotis. " niger.	38. { Sciurus carolinensis. " niger.	38. { Sciurus leucotis. " niger.
39. " hudsonius.	39. " hudsonius.	39. " hudsonius.	39. " hudsonius.
40. Pteromys volucella.	40. Pteromys volucella.	40. { Pteromys volucella. " ——?	40. Pteromys volucella.
41. Tamias striatus.	41. Sciurus striatus.	41. Sciurus striatus.	41. Sciurus striatus.
42. Arctomys monax.	42. Arctomys monax.	42. Arctomys monax.	42. Arctomys monax.
43. Castor fiber.	43. Castor fiber.	43. Castor fiber.	43. Castor fiber.
44. Fiber zibethicus.	44. Fiber zibethicus.	44. Fiber zibethicus.	44. Fiber zibethicus.
45. Jaculus hudsonius.	45. Gerbillus canadensis.	45. •Gerbillus canadensis.	45. Meriones americanus.
46. Mus decumanus.	46. Mus decumanus.	46. Mus decumanus.	46. Mus decumanus.
47. " rattus.	47. " rattus.	47. { " rattus. Arvicola albo-rufescens.	47. { Mus rattus. " americanus.
48. " musculus.	48. " musculus.	48. Mus musculus.	48. " musculus.
49. Hesperomys leucopus.	49. Arvicola Emmonsii.	49. " agrarius.	49. " leucopus.
50. Arvicola Gapperi.	50. —— ——	50. —— ——	50. —— ——
51. " riparius.	51. { Arvicola hirsutus. " albo-rufescens.	51. { Arvicola riparius. " xanthognathus.	51. { Arvicola riparius. " rufescens. " hirsutus. " oneida. " albo-rufescens. ? " zanthognathus.
52. " pinetorum.	52. —— ——	52. —— ——	52. —— ——
53. Erethizon dorsatus.	53. Hystrix dorsata.	53. Hystrix dorsata.	53. Hystrix hudsonica.
54. Lepus americanus.	54. Lepus americanus.	54. Lepus americanus.	54. Lepus americanus.
55. Sylvilagus sylvaticu	55. " virginianus.	55. " virginianus.	55. " nanus.
— —— ——	— —— ——	— —— ——	— Didelphys virginiana.

X. *General Summary.*

Number of indigenous species still living in the State	*65
" species already extirpated	5
" adventitious species	3—
Whole number	73
Number of land species (including the seals)	52
" marine species (the cetaceans)	18
" northern species †	7
" southern species †	8
" species restricted to the region east of the great sterile plains	22
" " that range over the greater part of the continent	15
" " common to North America and the North Old World	13
" " that are numerously represented	28
" " that are sparsely represented	45
" " of Felidæ (including 1 extirpated)	3
" " Canidæ	3
" " Mustelidæ	8
" " Ursidæ	2
" " Phocidæ	2
" " Cervidæ (including 3 extirpated)	4
" " Balænidæ	8
" " Physeteridæ	2
" " Delphinidæ	8
" " Vespertilionidæ	6
" " Soricidæ	5
" " Talpidæ	3
" " Sciuridæ (including 1 extirpated)	7
" " Muridæ (including 3 adventitious)	9
" " Hystricidæ	1
" " Leporidæ	2
" " Carnivora (5 families)	18
" " Ruminantia (1 family)	4
" " Cetacea (3 families)	8
" " Insectivora (3 families)	14
" " Rodentia (4 families)	19
Number of families represented	16

Less than one half of the indigenous species existing in the State, as indicated above in Table I, are common, and more than a third are

* Emmons gave 41; Linsley, for Connecticut, 52; DeKay, for New York, 60.

† See notes to Tables IV and V, *antea*, p. 239.

rare. The common ones, with a few exceptions (*Putorius lutreolus*, *P. ermineus*, and *Mephitis mephitica* among the carnivores, *Vespertilio subulatus* and *Lasiurus noveboracensis* among the bats), belong to the three families of rodents, — the squirrels (*Sciuridæ*), the mice (*Muridæ*), and the hares (*Leporidæ*), — and to the *Balænidæ* and *Delphinidæ*, which latter are, of course, marine. In species and families, the carnivores and rodents are about equally represented, but in individuals any one of the more common rodents outnumbers all the carnivores together. Probably a single species of *Arvicola* (*A. riparius*) alone outnumbers, when it is most abundant, all the other mammals.

The list of Extirpated Species, forming Table II, five in number, is composed entirely of such animals as, from their large size and being special objects of the chase, would be expected to earliest disappear. Two of the four species of *Cervidæ* (*Alce malchis*, *Tarandus rangifer*) have not existed in the southern half of New England since the discovery of the continent by Europeans, except in the mountains of Western Massachusetts, and there probably only as occasional migrants from the contiguous region north. They may have existed in comparatively recent times in portions of the Alleghanies, but respecting such existence we have no certain record. At a remote period they must have lived much farther south than they do now, or than they have within the last three centuries, since bones of the Caribou have been found by Professor Wyman in the Kjoekkenmœddings of Southern Maine, and teeth that he believes, but does not positively assert, belong to this species in those of Cape Cod. A positive evidence of the former much greater southward extension of the habitat of this animal is indeed already at hand, a small antler and fragments of others of the Caribou being included in the very large collection of the remains of living and extinct species of mammalia recently brought by Professor N. S. Shaler to the Museum of Comparative Zoölogy from Big Bone Lick, Kentucky.* Remains of the elk and the moose having been found in the shell-mounds of the Atlantic coast as far south as New Jersey, we have evidence that these species existed thus far south in comparatively recent times.

To the list of the "extirpated species," nine † that are now ex-

* See Professor Shaler's remarks concerning these specimens in Proc. Bost. Soc. Nat. Hist., Vol. XIII, 1869.

† *Lynx canadensis*, *L. rufus*, *Canis lupus*, *Mustela Pennantii*, *M. martes*, *Gulo luscus*, *Ursus arctos*, *Cariacus virginianus*, *Erethizon dorsatus*.

tremely rare, some of them probably being but casual visitors from Vermont or New York, must soon be added. The fisher and the wolverine may be even now extinct, and the common deer exists in the wild state only by legal protection.

The three adventitious species (see Table III), which are the most noxious of our mammalia, are intruders that, like many of the common weeds, have accompanied civilized man in his voyages till they are almost cosmopolitan in their distribution.

Table IV, composed of northern species, consists, with one exception (*Arvicola Gapperi*), also of species of large size, and such as are special objects of the chase, either for their fur or for food. They hence early disappear before the advance of civilization, and it is now almost impossible to determine in respect to some of them where was formerly their natural southern limit of distribution. At present none of them (*Lepus americanus* excepted) range below the southern boundary of the Canadian fauna, though some may have formerly extended across the next fauna south. The occurrence of *Mustela martes* and *M. Pennantii* in the Alleghanies, the latter as far south as Buncomb County, North Carolina, is well established,* but they seem to be, or to have been, — they being now apparently nearly exterminated there, — confined to the mountains, and hence also to the Canadian fauna. Yet one or both of them have occurred in a few known instances at points rather more southern, faunally, than their usual range, but apparently only during casual migrations in winter.

The *Erethizon dorsatus*, however, seems to have formerly occurred at points clearly within the Alleghanian fauna, as in Western New York,† Northern Ohio,‡ Northern Indiana, Southern Michigan, and Southern Wisconsin; § but it has disappeared in all the more thickly settled parts of the United States; east of the Mississippi it does not now occur south of the Canadian fauna.

The *Lepus americanus*, also chiefly northern in its distribution, ranges, as before stated, a little farther south than the others, and finds its southern limit near the southern boundary of the Alleghanian fauna.

* Audubon and Bachman, Quad. N. Am., Vol. I, p. 314.

† Dr. J. E. DeKay, N. Y. Fauna, Vol. I, p. 79.

‡ Wm. Case, Esq., in Audubon and Bachman's Quad. N. Am., Vol. I, p. 285.

§ R. Kennicott, Pat. Off. Rep., Agr., 1857, p. 91; I. A. Lapham, Transact. Wisc. State Agr. Soc., 1852, p. 340.

Table V, comprising those species that do not occur north of the Alleghanian fauna, embraces but one of relatively large size, — *Vulpes virginianus*, — which is also the only carnivore; the others are two moles and four rodents. The presence of the species of this list, and the absence of those of the preceding, form the faunal differences that, among mammals, distinguish the Alleghanian from the Canadian fauna. The other thirty-three species of land mammals represented in the fauna of Massachusetts, and which are common to the other New England States, New York, the northern tier of the States westward to the Mississippi, and the greater portion of the Canadas, range widely both to the north and to the south, and some of them also to the westward, extending throughout the colder parts of the northern hemisphere, as is indicated by Tables VII and VIII.*

* In this connection a word in reference to the nature of faunæ may not be out of place, since naturalists of some eminence, but who cannot have thoroughly investigated the subject, appear to think that no faunal districts are recognizable unless there is an entire or almost an entire change in the species represented, while some altogether discard such distinctions. Such an extensive change more properly characterizes the larger divisions in geographical zoölogy, as the provinces and realms, rather than faunæ. It rarely happens that any species is restricted within the limits of a single fauna, and also rarely within those of two. There is not a single well-known species of mammal or bird but inhabits (taking the breeding range only of the latter) an area embracing two or more faunæ, and but few that do not range over more than two. The greater part extend over three, and a large proportion have a still wider distribution, as shown by Tables VII and VIII (see remarks respecting these beyond). But in going north or south from any point within the temperate zones, one observes at certain intervals (generally of about six or seven degrees of mean annual temperature) a marked change in the species, through the disappearance of some and the appearance of others; this change giving rise to well-marked differences in the general facies of the fauna at points not far distant. The habitats of species being in the main nearly coincident in their northern and southern boundaries with isothermal lines, and not with paralells of latitude; and since a number of species usually disappear at nearly the point at which a number of others first make their appearance, the limits of faunæ are thus readily defined, at least approximately. As isotherms necessarily vary with every inequality in the surface of the country, they rarely correspond, as is well known, with the parallels of latitude; and plants and animals sharing the same apparent irregularity in their distribution, some naturalists have been led to discredit the existence of recognizable zoölogical and botanical districts, or of any definite system in the distribution of animals and plants.

Faunæ, then (the term *fauna* in its restricted sense being usually and properly employed to designate the smallest zoologico-geographical district), it may be added, are characterized by the peculiar association of species. Generally about twenty-five per cent of those embraced in either of two adjacent faunæ are absent from the other. Rarely do adjoining faunæ differ essentially in genera, though necessarily more or less occasionally. The absence or presence of genera, sub-families, families, and even sometimes orders, more properly characterizes the higher sub-divisions, as provinces and realms.

Each of the twenty-one species mentioned in the next table (Table VI) has a comparatively restricted range, the western limit of their habitats being in most cases the eastern border of the sterile plains of the middle province. This list is composed principally of shrews, moles, and rodents; none of the first two groups and but a few of the latter ranging across the continent. The absence of carnivores from this list is its most striking feature.

Table VII embraces fifteen species that, while restricted to America, range from the Atlantic to the Pacific, and possess a correspondingly wide distribution in latitude, most of them occurring nearly throughout the northern continent. This list is composed almost exclusively of carnivores and bats, all but one of the Massachusetts species of the latter having been found in California, and at various intermediate points.

Table VIII contains thirteen species that are regarded in this paper as common to the Old Word and the New; ten of these are carnivores, and include all the New England species of that group, except those embraced in the preceding list. The geographical distribution of these species, and of the groups to which they belong, affords further evidence in favor of the supposition of the specific identity of their representatives on the two continents above assumed; each species ranging as far north on both as it seems possible for mammalian life to exist. Each has also an extended distribution southward, on each continent, some of them ranging nearly or quite to the tropics; which shows them to be fitted to exist under widely varying physical conditions. These conditions in the northern portions of their respective habitats differ much more from those of the southern portions than those of localities on the two continents ordinarily do when situated under the same isotherm. The representatives of the species in question from the eastern and western continents differ less, as has been previously stated, when the specimens compared are taken from those portions nearly contiguous, as Northwestern America and Northeastern Asia, than when they come from such widely distant points as Eastern North America and Western Europe, the nearest affinity being between those from the localities first mentioned, and the widest differences between those from the latter. The eastern and western continents, moreover, approach each other so nearly at Behring's Straits, that several of the species in question are able to pass occasionally from one to the other. It hence seems unnecessary to suppose the former existence of an Atlantic continent to explain their present distribution. It is also a noteworthy fact that no cases of close affinity among the mammals inhabiting these two continents occur in species that do not range very far to the northward, as in the *Felidæ*, for example, where the only case at all suggestive of identity, or even of close relationship, occurs between the *Lynx canadensis* of Northern North America and the *Lynx lynx* of Northern Europe; both of which species range the farthest north of any of their family, and reach the Arctic regions.

All the circumpolar species, the beaver alone excepted, pertain to the most highly organized groups found in the colder portion of the northern hemisphere, and to which belong not only all the widely ranging species of the north temperate and boreal regions, but those of this character everywhere. With three exceptions, all are carnivores. Two of the others are ruminants, and one is a rodent.

The species most highly organized in their respective families, orders, or classes are almost universally those that possess the widest geographical distribution; partial exceptions occur only in groups where the means of locomotion is specialized, or unusually developed, as in the bats among mammals. The shrews, moles, and rodents, which comprise about three fifths of the species of the North American mammals, are groups of low structural rank, and abound in species of comparatively local distribution. In this great number there are but five or six, allowing the broadest latitude in respect to the limitation of the species, that at all approach to a continental distribution, and only three as the species are usually restricted.* This is about two one-hundredths of one per cent. Only one can be regarded as identical with any Old World species. In the canivores, on the other hand, excluding sub-tropical and nominal species, the number of those that range over most of the continent reaches nearly seventy-five per cent, while fifty per cent, or one half, are identical with Old World species. In the ruminants, which rank below the carnivores, but far above the rodents and insectivores, the species having a similarly wide range on this continent, number not far from thirty per cent. Several of them are identical with Old World species. The bats, though a low group, are,

* *Castor fiber*, *Fiber zibethicus*, and *Jaculus hudsonius*. Probably the following may be added to the list of those that range across the continent: *Erethizon dorsatus*, *Sciurus hudsonius*, *Pteromys volucella*, *Hesperomys leucopus*.

from their special means of locomotion, able to range widely; but to their allies, the moles and shrews, mountain chains and arid plains prove impassable barriers.

The same laws in respect to the character of the species that among mammals have a wide distribution are equally exemplified in birds, all the wide-ranging species being of high rank, or such members of lower groups as have the power of flight unusually developed. The modification of the anterior limbs into organs of flight specially characterizing the class of birds among vertebrates, it is evident that well-developed wings are one of the elements essential to a high grade of structure; and this renders necessary the coincidence in this class of high rank with a wide geographical range. The few land-birds that embrace a large portion of the two northern continents within their respective habitats belong principally to three families, — the finches, and the hawks and owls. The first is one of the highest, if not the highest, family of the class, and the others are by no means low. The other species which have a circumpolar distribution are among the highest members of their respective families, and are rarely of a low grade. The finches thus distributed all belong to the highest genera of their family. Among the birds having a wide distribution, but which are restricted to a single continent, are the typical thrushes, another of the higher groups. The species of the short-winged genera of the Fringillidæ and Turdidæ, on the other hand, are almost invariably the most circumscribed in their habitats.* This coincidence in respect to structure and distribution is also exemplified in every sub-family, as well as family, among the water-birds; but it is not necessary to trace it further here.

Hence the view above taken in reference to the species claimed to be common to the Old World and the New is supported, not only by the

* Compare the species of *Turdus* with those of *Harporhynchus* and *Mimus;* of *Poocætes* and *Passerculus* (see observations on some of the supposed species of *Passerculus* in Mem. Bost. Soc. Nat. Hist., Vol. I, p. 515) with those of *Melospiza*, *Coturniculus*, and *Ammodromus;* or those of the sub-family *Coccothraustinæ* with those of the sub-family *Spizellinæ*. Compare, also, in the *Sylvicolidæ*, the species of *Dendrœca* with those of *Geothlypis*. Also note the very high rank of the species of *Ægiothus*, *Pinicola*, and *Plectrophanes*, and the wide extent of their habitats. Compare further, in *Falconidæ*, the species of *Falconinæ*, with their long pointed wings and compact firmly knit muscular bodies, giving unequalled powers of flight, and their extensive habitats, in several instances embracing a whole hemisphere, with the comparatively short-winged, sluggish, and clumsy species of *Buteoninæ*, of a much lower type of structure and much narrower range.

evidence already given in the special discussion of each case, but by the fact of the near approximation of their habitats, and by general principles.

The thirteen species of land mammalia common to North America and the Old World embraced in the fauna of Massachusetts comprise all thus distributed now known, except two or three very boreal ones. The faunæ of the two continents are really quite different,— not totally so, as has been claimed, — though represented largely by genera and families common to the two. These and the circumpolar species show that a close relationship exists between them, the resemblance being, in fact, far greater than between the faunæ of Southern Mexico and Canada. The difference between the faunæ of the subtropical and cold temperate zones on either continent is many times greater than between the faunæ of the temperate and boreal regions of North America and the same regions of the Old World.*

But four species have been attributed to the States adjoining Massa-

* The distribution of vegetable life in zones, differing from each other in general character and corresponding in their limitation with climatic or isothermal zones, and their similar succession at different altitudes on mountain slopes and in different latitudes at the ordinary level of the land, was partially very early recognized, but first fully demonstrated only half a century ago, by Baron Alexander von Humboldt. It was somewhat later before it was clearly shown that the same law holds in respect to the distribution of terrestrial animal life, which was done in 1845 by Professor Louis Agassiz,[1] and somewhat later still Professor Dana disclosed its presence in the distribution of marine life, in his admirable essay on the geographical distribution of the crustacea.[2] Yet most recent writers who have given attention to the geographical distribution of animals appear to have overlooked this grand fact, and hence have been led to adopt a highly artificial division of the earth's surface in respect to its primary ontological regions. While geographical botanists have so generally recognized the influence of climate, and especially of temperature, in determining the limits of distribution of plants in latitude and in altitude, zoölogists, with only a few exceptions, have very imperfectly appreciated these important influences upon the distribution of animals. While the relation of the present distribution of life to the existing means of communication between the different bodies of land and to the earlier conditions in this respect are of the highest importance in investigations of this kind, if this is the only element taken into account, as is sometimes the case, climatic influences being for the time over-

[1] "Note sur la Distribution Géographique des Animaux et de l'Homme." Bulletin de la Societé des Sciences Naturelles de Neuchatel, Tom. I, 1845. See also, by the same author, a paper on the "Geographical Distribution of Animals," in the Edinburgh New Philosophical Journal, Vol. XLVI, 1850, pp. 1–25. Also his "Sketch of the Natural Provinces of the Animal World and their Relation to the different Types of Man," in Nott and Gliddon's Types of Mankind, 1854, p. lviii.

[2] U. S. Expl. Exped. Reports, Crustacea, Vol. II, 1852, pp. 1451–1500.

chusetts that have not been detected in the latter. Two of them — *Didelphys virginiana* Shaw, and *Lepus glacialis* Leach, the former occurring in Southern New York, and the other attributed to Northern Maine, and known to occur in Newfoundland * — are not likely to occur here. The other two, *Sorex Thompsonii* Baird † and *Blarina angusticeps* Baird, ‡ — the latter described from a specimen taken at Burlington, Vermont, and the other reported from the same locality, from Halifax, N. S., and Maine, § — are of a highly questionable character. What has been called *Sorex Thompsonii* (the young probably of either *S. Forsteri* or *S. Cooperi*) doubtless occurs here.

looked, the argument is one-sided, only half the truth is reached, and the general view is a distorted one.[1]

As I have already remarked above, the mutual resemblance between the faunæ and floræ of the boreal portions of North America and those of the Europeo-Asiatic continent is exceedingly great, amounting in the arctic portion, as was long since pointed out,[2] almost to identity. In the Arctic province, which occupies the woodless tracts in the extreme north of both continents, more than four fifths of the species found on the one continent occur on the other. While a few of the small number that inhabit this region are restricted to it, the larger part range much farther to the southward, the majority even over the colder part of the north temperate zone, and several throughout this zone. Besides the mutual floral and faunal resemblance between the two northern continents imparted by this wide distribution of the circumpolar species, this resemblance is increased by the large number of genera that are circumpolar, besides those that embrace the circumpolar species, and the occurrence of other forms, both specific and generic, that are closely allied. It is also true that among the forms restricted to each continent are a few family groups; yet the number of these, as of species and genera, that occur in the tropical and not in the colder temperate regions on either continent is far greater than that of those peculiar to either of the two northern continents. Consequently to apply as ontologico-geographic designations such terms as "Palæogean Creation" to the Eastern world and "Neogean Creation" to the Western, virtually implies the ignoring of the real close affinity of the life of the whole northern hemisphere at the northward, and the vast difference between that of the tropical and the cooler north temperate regions on the same continent. But a further discussion of this point is uncalled for now, and is, moreover, the more out of place here, since I shall, I trust, soon have an opportunity to treat it in detail in a more legitimate connection.

* Quad. N. Am., Vol. I, p. 248.

† N. Am. Mam., p. 34.

‡ Ibid., p. 47.

§ Proc. Bost. Soc. Nat. Hist., Vol. IX, p. 169.

1 See Murray's Geog. Distrib. of Mammals; Wallace's Malay Archipelago, etc.

2 See Agassiz's papers, cited above.

CAMBRIDGE, October, 1869.

ERRATA.

Page 144, lines 11 and 12, for *riparia* read *riparius*.
" 147, line 9 from bottom, for *dorsata* read *dorsatus*.
" 148, " 15, *for* fourth *read* sixth ; *for* third *read* fifth.
" 152, " 27, *after* species *insert* of this group.
" 155, " 32, for *fulvus* read *vulgaris*.
" 187, " 9 from bottom, *for* Murry *read* Murray.
" 191, " 6, for *Isabellinus* read *isabellinus*.
" 192, " 37, *for* Murry *read* Murray.
" 207, " 7, *for* Gray *read* Tomes.

No. 9. — *Preliminary Report on the Echini and Star-fishes dredged in deep water between Cuba and the Florida Reef, by* L. F. de Pourtales, Assist. U. S. Coast Survey; *prepared by* Alexander Agassiz.

(Communicated by Professor B. Peirce, Sup't U. S. Coast Survey.)

I. *Catalogue of the Echini.*

Cidaris annulata Gray, Proc. Zoöl. Soc., 1855.

Syn. Cidaris metularia Lütk. (non Lam.) Bid. til Kunds. om Echin.

Lütken has adopted for the common West India species the name of C. metularia Lam., which he compares carefully with Cidaris tribuloides. It is evident from his descriptions that his C. tribuloides is the Cidaris metularia Lam.; he says himself that he may not have had the true C. tribuloides Lam. From a direct comparison with original specimens of Lamarck of both these species, kindly sent the Museum by Professor Valenciennes, there is no doubt that both C. tribuloides Lam. and Cidaris metularia Lam. inhabit the Red Sea; the latter, however, has a much more extensive range, and occurs as far as the Sandwich Islands, being quite common in the East Indian archipelago. The Cidaris metularia Lam. is also identical with the species which I named Gymnocidaris minor in the Museum Bulletin (1863). Not having at the time had the opportunity of examining series of different ages, I find that the differences which had been considered as specific are simply different stages of growth. I have adopted for our West India species the name given by Gray, satisfied that he possessed, as far as I could judge from his description, specimens of the only littoral species thus far found in the West Indies.

Littoral to 116 fathoms.

Dorocidaris abyssicola A. Ag., nov. gen. et sp.

This species has the general facies of Cidaris hystrix. We find considerable variation in specimens collected in different localities, — valuable, from the number of specimens collected, in determining the nature of individual variation in this genus, and confirming the view to which I had been brought from the study of young Cidaridæ, that the spines, much as they may apparently vary in shape, especially round the mouth, yet present excellent characters not only to distinguish species, but are also useful as a guide in separating groups of species which are generally found closely allied. From the study of young specimens I have been led to modify the views I had taken of the nature of genera among Cidaridæ, and as the group requires a complete revision, I will not attempt at present to alter the genera proposed in the Bulletin, hoping to make the changes in the general revision of the order. With reference to Orthocidaris, to which this species is temporarily referred, I would mention that, whether valid or not, the name is preoccupied, having been employed by Cotteau a few months before the publication of the Bulletin.* (The same is the case with Temnocidaris.)

Test depressed; the spines are not as distinctly fluted and crenated as in C. hystrix; they are often worn perfectly smooth, and attain their greatest diameter at about one fifth the length of the spine from the base; the milled ring is finely striated, as well as the neck of the spine, which is sharply defined. The mamelon of the primary tubercles is small, deeply cut at its base, high, the mammillary boss not prominent, the scrobicule deeply sunk; the scrobicular circle and interambulacral miliaries being prominently raised, the secondary tubercles of the scrobicular circle are but slightly larger than the miliaries, diminishing regularly in size towards the sutures of the plates, which are clearly and sharply cut; the same is the case with the sutures of the ambulacral plates; each plate carries a larger exterior tubercle with a smaller one nearer the abactinal edge, and sometimes a third and fourth miliary between the two. The poriferous zone is narrow, but slightly undulating and occupying half the ambulacral plate. The sutures of the plates of the abactinal system are marked by distinctly cut lines, instead of the wavy double line characteristic of C. hystrix; the abactinal system is large, the ocular plates heart-shaped, the genital plates irregularly octagonal; the large sides of the plate adjoining the anal system are separated by five long wedge-shaped anal plates, forming the base of the smaller plates of the anal system.

From 40 to 270 fathoms.

Salenocidaris varispina A. Ag., nov. gen. et sp.

The composition of the plates of the anal system in young Echini, explains most unexpectedly the homology of the sub-anal plate of Salenia, and proves, from a different point of view, that the position of the anal opening can in no wise form a guide by which we can determine any geometrical axis of Echini, but that the only part of the abactinal system which has a constant structural relation to the axis is the madreporic body, which

* Dujardin and Hüpé refer its Mediterranean representative to Leiocidaris *Des.* (Phyllacanthus *Br.*), with which it has nothing in common, as the pores are not joined by furrows. I would substitute for Orthocidaris Ag., non Cott. the name Dorocidaris.

at once gives us the key to the position of an anterior and posterior side among Sea-urchins. The correctness of this view is fully maintained from the analysis of the abactinal system of a living Salenia here described, which shows that the sub-anal plate is the homologue of the first anal plate of young Echini, (which in many cases remains decidedly larger in older stages, — Toreumatica, Genocidaris, Trigonocidaris,) and shows that the abactinal system of Salenia is entirely homologous with the abactinal system of the Echinoids, the original plate only retaining a greater preponderance than has thus far been noticed in other genera. The remaining part of the anal system was, in the fossil species, undoubtedly covered by small plates, as in the living species; and that this was the structure of the anal system is shown by Wright, who has figured the abactinal system of Acrocidaris, and removed the genus to Salenidæ on account of the presence of a sub-anal plate. This feature, which seemed so characteristic of a small group of Echini, is one which alone has no systematic value, so that we must, I think, hereafter consider the Salenidæ simply as a sub-family of Cidaridæ, as the description of the species dredged in Florida by Mr. Pourtales will clearly show.

The general appearance of Salenocidaris is that of a young Dorocidaris abyssicola. The primary spines are enormous, — twice the diameter of the test in length, of a brilliant white color, and of all shapes. Some of them are uniformly tapering, others swelling at about one third the distance from the base, others flattened and curved, but all finely longitudinally serrated with sharp spines, irregularly arranged along the body of the spines. The secondary spines, as well as the greater number of the spines of the ambulacra, as far as the ambitus, are short, club-shaped, sometimes curved and flattened, longitudinally striated with slight serrations. These short spines give to the median interambulacral and ambulacral zone the aspect of the corresponding zones of Cidaris; but they are not, as in Cidaris, arranged in a circle round the base of the primary spines. These small spines, as well as the whole abactinal area, are covered with prominent dark violet pigment cells, standing in striking contrast to the white primary spines. The abactinal system has the structure of that of Salenia, but the position of the anal system is that of Hyposalenia. As we know nothing of the spines of either of these genera, it is better for the present to establish a new genus founded upon this peculiarity of the abactinal system, and the imbricated buccal membrane, which is covered thickly with plates arranged somewhat as they are in Echinocidaris; the ten buccal plates are sparingly covered by pedicellariæ. The primary tubercles of the interambulacral area are large, arranged in two vertical rows in the two areas; those of the ambulacral area are smaller, and diminish rapidly towards the abactinal pole; the median interambulacral space is occupied by two vertical rows of small secondary tubercles. The primary tubercles of both areas are imperforate, but distinctly crenulated. At the actinostome the ambulacra flare slightly, somewhat as in Hemicidaris. The pores are small, placed in pairs far apart, one above the other, so that there seems to be, as far as I could see, but a single pair of pores for each ambulacral plate, though near the mouth they are somewhat closer. As in Salenia, the indentations of the actinostome are very slight. The abactinal system covers nearly the whole of the abactinal part of the test; the anal system is eccentric. There is a marked difference in the size of the genital plates, the three posterior ones being much larger than the two anterior ones; the reverse is the case of the ocular plates. In the largest genital plate there is a trace of the madreporic body, corresponding to the position assigned to it by Forbes, Müller, and Wright, and which cuts the symmetrical axis of the sub-anal plate at an angle; this is the case also with the angle made by the axis of the madreporic body and the first anal plate of young Echini; the position of the axis passing through the anal plate has no definite relation to the madreporic body. The anal opening is covered by small plates, as in other Echini. The whole abactinal system is studded with embryonic spines, which are longest along the exterior edge of the abactinal system, thus separating it most distinctly from the test. The sutures between the plates are deeply cut with deep pits at the angles of junction of the genital and sub-anal plate and of the ocular and genital plates. The three larger genital plates have also pits in the middle of their line of junction with the sub-anal plate. The genital openings are large, placed in the middle of the plates.

Off Double Head Shot Key, 315 fathoms.

Diadema antillarum Phil., Wieg. Archiv, 1845.

Syn. Diadema antillarum Lütk., Bid. til Kunds. om Echin.

Littoral to 17 fathoms.

Cænopedina cubensis A. Ag., nov. gen. et sp.

This species is a living representative of the genus Hemipedina of Wright (as emended by Desor, Wright having included in it species of other genera of Pseudodiadematidæ). It differs from its fossil representative by the peculiar arrangement of the pores, which have a tendency to arrange themselves in lateral arcs of three pairs. The general outline of the test is that of Cyphosoma. It has, like Orthopsis, Echinopsis, Hemipedina, perforate tubercles not crenulated. It reminds us of Pseudodiadema in having tubercles nearly of the same size, and has, like Phymosoma, only two rows of tubercles extending from pole to pole, while the flatness of the abactinal part of the test, and the great development of the abactinal system, remind us of some forms of Hemipedina, as, for instance, Hemipedina Guerangeri COTT. et TRIG. The actinal opening is large, with sharp cuts for the passage of long, narrow gills. The spines are long, moderately stout, as long as the diameter of the test, longitudinally striated, resembling the spines of some species of Hemipedina figured by Wright. The pores are arranged in connected vertical arcs, of three to four pairs. There are two rows of perforate primary tubercles in the ambulacral area, decreasing rapidly in size towards apex, and placed close together. They are somewhat smaller than those of the interambulacral area. There are one or two small imperforate tubercles at the base of the larger ones. The poriferous zone is broad and well defined, spreading slightly at actinostome. The perforate interambulacral tubercles are arranged in two primary rows, separated from the poriferous zone by a row of small imperforate tubercles, with two or three similar irregular rows between the larger tubercles in the median interambulacral zone. The plates of the abactinal system are large, with straight sides, the genital are heptagonal, carrying five to six small tubercles, and as many still smaller ones. The ocular plates are pentagonal, with a large ocular pore surrounded by an arc of small tubercles. The plates covering the large anal system are very numerous and minute. The anus is situated in the very centre. The teeth resemble those of Echinocidaris. The buccal membrane is strengthened round the mouth, close to the teeth, by ten large plates (perforated for buccal tentacles), occupying nearly the whole membrane, with eight to ten very much smaller ones between the large plates and test. The color of the large spines is of a dull yellowish green, while the smaller spines, as well as test and abactinal plates, have a more yellowish tint.

From 138 to 270 fathoms.

Echinocidaris punctulata DESML., Étud. Echin.

Syn. Echinocidaris punctulata A. AG., Bull. M. C. Z., No. 2.
" " Davisii A. AG. " " "
" " punctulata LÜTK., Bid. til Kunds. om Echin.
" " " " HOLMES, P. F. Pl. 2, fig. 5.
Anapesus carolinus HOLMES, P. P. F. Pl. 2, fig. 2.

The specimens collected by Mr. Pourtales seem to show conclusively that the species distinguished as E. Davisii in the second number of this Bulletin is only a local variety. All Echinocidaridæ are difficult to distinguish, as there is great variation in the same species, in the number and arrangement of the tubercles; and the characters by which E. Davisii was separated from E. punctulata are found in the large series of young specimens collected by Mr. Pourtales at Cape Fear. North Carolina, to have no permanence. Lütken considers the Echinocidaris pustulosa LAM. as a nominal species; quite a number of specimens of it were brought home by the Thayer Expedition from Brazil. It may be that a larger series than we possess will prove its identity with E. punctulata, but from the material at hand I should consider it a good species, closely allied to E. æquituberculata. I am inclined to think that the various West Coast species of this genus will be limited to two, or at the utmost three, species; namely, E. stellata and E. nigra, perhaps E. spatuligera.

Littoral to 125 fathoms.

Podocidaris sculpta A. AG., nov. gen. et sp.

This genus has the general facies of young Echinocidaris, with a depressed abactinal surface as in Astropyga, the ambulacra rising in ridges above the surface. The large spines are confined to the lower surface, the primary tubercles scarcely extending beyond the ambitus. These tubercles alone carry a large, smooth mamelon, while the rest of the test is covered with rudimentary spines, arranged, however, in regular, vertical rows, four of which form a distinct, raised band in the median interambulacral zone, flanked by three more, less well defined, while in the narrow ambulacral zone there are but two such rows, close to the poriferous zone, which is very narrow, the pores being arranged in a single vertical row. The rudimentary, knob-shaped spines, strongly serrate, are not carried upon a mamelon, but rise directly from the test, as in very young Sea-urchins, and are connected at their base by a ridge, leaving thus a more or less quadrangular pit in the space between four tubercles. This ridge is particularly prominent between the spines of the mediair interambulacral rows, while in the more irregular rows the ridges are less marked, forming simply depressions in the test, running irregularly. The pits in the ambulacral zone are very marked, and are connected into an irregular groove extending along the whole ambulacral zone, the ridges, starting from the base of the tubercles, extending only part way across the ambulacral area, like spurs and rounded knobs. The whole surface of the test is covered with long-stemmed, articulated pedicellariæ, which have a distinct mamelon for their support, surrounded by a sort of scrobicular circle, the base of the pedicellariæ forming a ball-and-socket joint with the tubercle, while there is a thin muscular membrane holding them in place, as in true spines, — an additional proof that pedicellariæ are only modified spines, as was made probable by their identical mode of development with spines, observed in the Star-fishes and Spatangoids. The abactinal system, placed in a depression of the abactinal part of the test, resembles that of Echinocidaris, having only four anal plates, with large genital and ocular plates, which, however, are not bare as in that genus, but carry small, rudimentary, knob-shaped spines. The genital openings are near the anal system. The buccal membrane carries ten large quadrangular plates, with rounded edges placed near the test, the whole space between them and the mouth being covered by small plates; the rest of the membrane is bare. The actinal opening is large, the cuts slight, and the pores are not arranged in arcs near the mouth as in Echinocidaris. The spines are sharp, flat spindle-shaped, with a prominent ridge running along the middle of the upper surface, the section is triangular, the longest side being the under side, which is convex, the shorter upper sides being concave. The spines are finely granulated longitudinally with a slightly serrate edge. The large spines, as well as the knobs of the rudimentary spines, are sometimes beautifully colored by dark violet pigment cells, following the arrangement of the granulation. The pedicellariæ have the same coloration. The tentacles, to judge from alcoholic specimens, must have been very large, though not possessed of a powerful disk; the test, when prepared to show the structure, was of a delicate cream color, upon which the brilliant coloration of the knob-shaped spines stood out in bold relief.

From 138 to 315 fathoms.

Echinometra Michelini Des., Agass. Cat. Rais.

Syn. Echinometra Michelini A. Ag. (non. Lütk.) Bull. Mus. C. Z., No. 2.
Echinometra lucunter Lütk., Bid. (non. Lam.)
" lobata Blain., Article Oursin.
Heliocidaris mexicana Auct. (non. Ag.)
Heliocidaris Castelnaudi Hupé in Casteln.

From an examination of typical specimens of Echinometra lucunter Lam. it became evident that Lamarck's species was the common Echinometra, having such an extensive range in the Pacific and Indian Oceans; extending from the Sandwich Islands to the Red Sea. It is with some doubt, however, that the above name has been adopted for our common West India species, the varieties of which have served as the type of many species; the large, somewhat oblong, swollen-sided adult, with short stout spines, has been the Echinometra lobata Blain., the flatter, more circular variety, with long slender spines, has even been referred to a different genus Heliocidaris by Hupé. Authors generally have referred the young flat stage to Heliocidaris mexicana Ag. It is somewhat remarkable that with the extensive geographical distribution of this species (the whole coast of Brazil, the Gulf of Mexico, Caribbean Sea, West India Islands, Bahamas, and Bermudas) it should be so limited in bathymetrical range.

Littoral, to 6 to 7 fathoms.

Note.—Verrill has insisted, in his notes on Radiata, on referring Heliocidaris mexicana Ag. to Anthocidaris Lütk., while he places Toxocidaris mexicana A. Ag. in Toxopneustes; I do not see upon what grounds. The specimens in the Natural History Society of Boston to which he refers are only one of the younger stages of the long-spined variety of Echinometra Michelini Des. (A. Ag.), and have nothing in common with Heliocidaris. In the second place, Anthocidaris Lütk. is synonymous with Toxocidaris A. Ag.; so that it is perfectly natural that the two species he quotes should belong to different genera, one being a young Echinometra, the other a true Toxocidaris A. Ag., Anthocidaris Lütk. I cannot see the propriety of the changes made by Verrill in the limitation of Toxopneustes, by substituting Euryechinus for a group of Echini, which are perfectly well known by all writers on Echinoderms as Toxopneustes. For the following reasons it seems to me, even granting all his premises, that the changes he proposes are not warranted. The type of a genus at the time the Monog. d. Echinides was written was never used in the restricted sense now common, but was coextensive with a group of species. When Toxopneustes was first proposed, it was applied to a so-called typical species which future investigations showed did not belong to the genus. The author took the earliest opportunity possible to point out his mistake by substituting for it another type, and giving a description which *applies not only to Toxocidaris as Mr. Verrill would have it, but also to all the species since removed as Sphærechinus by Desor.* Desor, who had edited the Catalogue Raisonné, and probably knew accurately what group of Echini was defined as Toxopneustes, was the first, in his Synopsis, to limit Toxopneustes by removing from it certain species as Sphærechinus, and restrict Toxopneustes to such forms as (T. neglectus) T. drobachiensis Ag., but still including the species which I have since, in the Bulletin of the Museum, separated as Toxocidaris. All these limitations, even were they not accepted, have the priority over a similar limitation which Verrill makes twelve years after a proper limitation of the genus has been recognized, and eighteen years after a mistake (upon which Mr. Verrill bases the whole of his proposed changes) has been corrected by the author himself; nothing, moreover, is gained in accuracy by the change proposed by Verrill, T. tuberculatus being probably only a nominal species, and one concerning which we have, at any rate, no authentic information sufficient to form the basis of a sweeping reform. At the present rate of retrospective application of the laws of priority, we are fast drifting into the most absurd anachronism by applying the present condition of our knowledge of any group to works written twenty or thirty years ago in an entirely different spirit, when the idea of type, genera, etc. had a totally distinct signification from what it has at the present day.

Echinometra viridis A. Ag., Bull. M. C. Z., No. 2.

Syn. Echinometra Michelini Lütk. (non. A. Ag., nec Des.) Bidrag.
" " plana A. Ag., Bull. M. C. Z., No. 2.

As in Echinometra Michelini Des. there is a flat long-spined variety of Echinometra viridis, distinguished formerly as Echinometra plana, but which the full series now in the Museum collection shows decidedly to hold the same relation to E. viridis which Heliocidaris mexicana Auct. holds to E. Michelini.

Same range as former species, much less common.

'chinus gracilis A. Ag., nov. sp.

This species holds an intermediate position between E. Flemingii Ball and E. melo Lam., to both of which it is allied. Like the former, it is subject to great variations in the ratio of the longitudinal and vertical diameter of the test. The primary tubercles are larger than those of E. melo, but smaller than those of E. Flemingii. The spines in the proportion they bear to test are similar to those of E. melo, as well as the general pattern of coloration, consisting of bands of green made up of irregularly shaped lozenges running in vertical rows, diminishing in intensity towards actinostome, the intermediate spaces forming brilliant white or straw-colored bands. In one of these white bands is placed the poriferous zone, and each primary row of tubercles is placed in a similar band. Thus the test is divided into twenty bands alternately green and white; the poriferous zones and two principal rows of tubercles being separated by these dark-green lozenges, giving the test a most graceful pattern of coloration. The shape of the genital plates of the abactinal system, which is compact and circular, is a pointed pentagon somewhat as in E. melo, while in Flemingii they are heptagonal. The anal system is made up of a large number of small plates. The ten large plates of the buccal membrane are quadrangular with rounded corners, carrying stout pedicellariæ similar to those of E. melo. The position and general arrangement of the tubercles is similar to E. melo; the large tubercle is placed in the centre of the interambulacral plate, which carries in addition short horizontal rows of two or three minute tubercles, the row near the horizontal suture being the most prominent. In the ambulacral zone the main tubercle has a similar position; the small tubercles are placed close to the median suture, and form irregular vertical rows. This species attains a considerable size; specimens are in our collection measuring 2.60 inches in diameter, and another 2.75 inches in height, exceeding somewhat the transverse diameter.

From 93 to 200 fathoms.

Echinus Flemingii Ball, Forbes Brit. Starf.

Among the Echini dredged by Mr. Pourtales is a single small specimen which I am unable to distinguish from specimens of the same size of E. Flemingii. It may be that, when more extensive series of the young of E. melo, E. Flemingii, and E. gracilis, described above, have been compared, that we shall find these species to be only local varieties, though I am not inclined, from the material at my command, which is quite ample, to adopt this view, but rather suppose that we have here, side by side, two allied species, one of which has an extensive range. Grube already considers E. melo and E. Flemingii as identical; I suspect he has only found the two species side by side, as they are both known to inhabit the Mediterranean.

In 195 fathoms.

Genocidaris maculata A. Ag., nov. gen. et sp.

This genus is established for a small Sea-urchin, the living representative of Opechinus, which Desor separated from Temnopleurus. The spines resemble in their structure those of Temnopleurus, but are short; the Sea-urchin with its spines resembling a Psammechinus, and having, like it, a large number of tubercles, of nearly uniform size, closely crowded together, but of a peculiar chiselled structure (so that it may be said that this genus is a Psammechinus among Temnopleuridæ), there is one principal row in the ambulacral and interambulacral area larger than the others. The poriferous zone is narrow; the pores are arranged in an unbroken vertical row separated by an arched ridge. The mamelon of the primary tubercles is smooth, imperforate. Near the base of the tubercle the test is ornamented by cuts specially marked near the suture of the plates, and the small tubercles are frequently connected by a ridge with the main tubercles, the ridge forming spokes radiating from a hub, similar to the structure of Glyphocyphus radiatus, and some species of Echinocyphus. The genera Opechinus, Temnotrema, Trigonocidaris, and Genocidaris form a transition between Psammechinus and Temnopleurus. The actinal membrane is bare, with the exception of the ten small circular buccal plates. The actinal opening is not large, with slight indentations; the test is irregularly covered with pedicellariæ, having a blunt head surmounting a long, slender stem, articulating upon a shorter, stout rod. The abactinal system is peculiar, as we find, in the largest specimens even, which appear fully developed, but a single circular plate, slightly conical, occupying nearly the whole anal system, with the exception of a small crescent-shaped slit, covered by four very small plates. The genital plates are large pentagonal, with a deep groove, in which is situated the genital opening, having on the anal edge a cluster of three or four small tubercles; the ocular plates are also pentagonal, elongated horizontally. The color of the test is greenish (in alcohol), mottled with dark violet patches; the spines are of the same greenish tinge, banded irregularly with reddish, transverse bands. In other specimens we have the same pattern of coloration, in different shades of green, with white spots irregularly scattered over the surface.

From 30 to 160 fathoms.

Trigonocidaris albida A. Ag., nov. gen. et sp.

This genus is allied to Genocidaris. The principal tubercles have the same structure; but, in addition, the whole test is covered by a reticulation of ridges, similar to those of Podocidaris, extending from the base of the different tubercles, both primary and secondary, and uniting them all in a complicated, raised system of network, with irregularly shaped cells, the ridges leaving more or less deep pits, giving the test the appearance of having been gouged out in spots. The spines are long, slender, somewhat transparent, longitudinally striated, with slight, transverse striation. The abactinal system resembles that of Cænopedina, but the anal system is covered by only four triangular plates, one of which is much larger than the others. From the fact that in the youngest specimens examined we find them already, I am tempted to suppose they never increase in number, and remain as they are, as in Echinocidaris. The actinal membrane is, as in Lytechinus, entirely covered by a number of rather large plates irregularly arranged, the ten buccal plates being but slightly larger than the others. The actinal opening is of moderate size, slightly indented; the auricles are exceedingly slender, and disconnected at the extremity. There are but two principal rows of primary tubercles, both in the ambulacral and interambulacral zone, with from five to six minute tubercles seated upon the connecting ridges in the latter zone, and two to three upon each plate in the former. The poriferous zone is narrow; the pores are placed obliquely in an unbroken vertical zone, three to each ambulacral plate, and separated by ridges running from the ambulacral tubercles to the interambulacral zone, similar to those joining the tubercles. The test, as well as the spines, are almost white, the latter having only a slight tinge of yellow when largest. The whole test is covered with pedicellariæ, having a sharp-pointed head articulated upon a long, slender thread, seeming scarcely capable of supporting the head.

From 40 to 270 fathoms.

Lytechinus variegatus A. Ag., Bull. M. C. Z., No. 2.

Syn. Lytechinus carolinus Ag., Bull. M. C. Z., No. 2.
" " atlanticus A. Ag. " " "
Echinus variegatus Rav., Cat. Echin. S. C.; P. P. Foss. Pl. 2, fig. 1.
" " variegatus Lam., An. s. V.
Psilechinus variegatus Lütk., Bidrag.
Psammechinus exoletus McCr., Pl. Foss. S. C., Pl. 2, fig. 6.

Soon after the publication of the second number of the Museum Bulletin, Dr. Lütken called my attention to the identity of L. carolinus and L. atlanticus with E. variegatus. The extensive series of this species collected by Professor Agassiz in Brazil, the West India Islands, and dredged by Mr. Pourtales, have satisfied me of the correctness of his view, the variations due to age or locality being astonishing. It has, like the common Echinometra, a great geographical range identical with it, but at the same time has a somewhat more extensive bathymetrical distribution.

Littoral, to 34 fathoms.

Tripneustes ventricosus Ag., Agas. Cat. Rais.

Young specimens of Tripneustes show the correctness of the analysis of the arrangement of the pores made by Dr. Lütken. Each ambulacral plate has only three pairs. The original Heliechinus Gouldii Gir., Proc. Bost. Soc. N. H. 1850, is nothing but a young Tripneustes.

Littoral, to 10 fathoms.

Clypeaster rosaceus Lam., An. s. Vert.

It is quite remarkable that of a species so common as this no young small enough to show any very striking difference from the adult should have been collected, while of nearly all the more common species complete series of all sizes were obtained.

Littoral, to 5 fathoms.

Stolonoclypus prostratus Ag., Bull. M. C. Z., No. 2.

Syn. Clypeaster prostratus Lütk., Bidrag.

This genus is distinguished from the true Clypeaster by the character of the internal pillars connecting the actinal and abactinal part of the test, which is totally different, in all the flat Clypeastroids allied to Clypeaster placunarius Lam., from that of Clypeaster rosaceus Lam., being slender, often needle-shaped points, instead of heavy, solid columns, as in true Clypeaster. Rhaphidoclypus cannot be maintained as an independent genus; it is only the young type of Stolonoclypus which presents some striking peculiarities, and the species upon which the genus was based will probably turn out to be young specimens of a species of true Stolonoclypus, to judge by analogy with the young of this Florida species, which undergo very great changes during their growth, resembling to such an extent Echinocyamus pusillus Leske of Europe, that for some time I considered the young as identical with that species.

Littoral to 325 fathoms.

Stolonoclypus Ravenelii A. Ag., nov. sp.

The presence of a true Laganum in the West Indies has been often mentioned by various writers on Echinoderms, but it has invariably been presumed to be founded upon mistaken localities (Rumphia Lesueuri) or a confusion with young specimens of Stolonoclypus prostratus. Mr. Pourtales has dredged, from a depth of thirty-four fathoms, a small Clypeastroid of about two inches in length, which has the facies of a Laganum to such an extent that it would pass for one without an examination of the internal structure. The outline is pentagonal, with rounded corners; the pentagon is equilateral, and more regular than in any species of Laganum, the central part of the test rising abruptly from the extremity of the ambulacral rosette. The test has a thick, rounded edge, and it may be that specimens of this species have been collected by those who have referred to the presence of a Laganum in the West India Islands. Hupé speaks of Laganum latissimum as found on the coast of Brazil; it certainly cannot be the Clypeaster latissimus Lam., which Agassiz distinctly says is allied to C. scutiformis, although by mistake it was subsequently referred to Laganum in the Catalogue Raisonné, and which is found in the East Indies. The specimen collected by Mr. Pourtales is evidently the young of a large Stolonoclypus collected by Mr. Ravenel off Charleston Harbor, which, from want of additional material, remained undescribed in the Museum collection. It does not differ in outline (although measuring five and a half inches in length) from the smaller specimen; has the same thick, rounded edge, with abruptly rising test near the extremity of the ambulacral rosette. The rosette is not raised as in other species of Stolonoclypus, but is flush with the rest of the test; the whole lower part of the test is flat, as in Laganum. In the smaller specimen the rosette is harp-shaped, well opened at the extremity, as in Echinarachnius, while in the adult this is the case only in the anterior ambulacrum; the others are brought close together at the extremity. The ambulacral rosette extends to within one third the distance of the apex from the edge. The poriferous zone is much broader than in S. prostratus. The furrows are more numerous and more closely crowded together than in any other species of Stolonoclypus. In the younger specimen the lower surface is covered with spines only upon the interambulacral area. This is narrow, leaving the broad, bare bands of the ambulacral areas colored light yellow, giving this species a striking appearance. The tubercles of the upper part of the test are quite small, closely crowded together; they increase in size in the interambulacral spaces of the lower surface. The color of the spines is greenish yellow in the smaller, and in the larger specimen the color was duller.

Off Charleston bar; Florida in 34 fathoms.

Mellita testudinata Klein, Nat Disp. Echin.

Syn. Mellita pentapora Lütk., Bid.
Mellita quinquefora Ag., Agass. Cat. Rais.
" ampla Holmes, Rav. Cat.

The large series collected by the Thayer Expedition along the whole coast of Brazil show that this species has a wide geographical range, and is liable to great variations, indicating that the characters which are described as separating M. quinquefora and M. testudinata have no permanent value.

Littoral, to 7 fathoms.

Mellita hexapora Ag., Agass. Cat. Rais.

Syn. Mellita hexapora Lütken, Bid.
" caroliniana Rav., Cat.; Pl. Foss. S. C., Pl. 1, fig. 4.

Littoral, to 270 fathoms.

Encope Michelini Ag., Agass. Cat. Rais.

Syn. Encope Michelini Ag., Bull. M. C. Z., No. 2.
" aberrans Martens, Wieg. Archiv. XXXIII. I. p. 112.

The extensive suite of Encopidæ brought home by the Thayer Expedition from different points of Brazil, and more particularly the series of all sizes of Encope emarginata which the Museum owes to the kindness of Dr. Fritz Müller, of Desterro, has satisfied me that Lütken is correct in uniting under one name, that of E. emarginata, most of the nominal species he mentions (E. Valenciennesii, subclausa, oblonga, E. quinqueloba Esh. and Grube), to which we would add the name given by Béval. E. Griesbachii. E. tetrapora Gmel. must remain doubtful, as the original cannot be found in any Museum. Yet I cannot agree with him in referring to the same species Encope Michelini Ag., in which the position of the apex is totally different from that of any of the other species referred to E. emarginata, as is readily seen by the excellent profile given in Agassiz Mon. d. Scut., Pl. 6^a, fig. 10. Nor can I agree with him in referring to Encope emarginata E. grandis Ag., a species found in the Gulf of California, and Encope

Agassizii MICH., identical with it. There is a second species also found on the West Coast, which Verrill has described as E. occidentalis, and which is identical with Encope tetrapora AG. non GMEL. From a careful comparison of specimens of E. cyclopora, micropora, and perspectiva, there is no doubt that these are only nominal species, all identical with Verrill's E. occidentalis ; and as the name micropora seems to be the most appropriate, it would be the best name to retain.

Littoral to 11 fathoms.

Encope emarginata AG., Agass. Cat Rais.

Syn. Encope Valenciennesii AG., Agass. Cat. Rais.
" subclausa " " "
" oblonga " " "
" quinqueloba " " "
" Griesbachii BÉVAL., Acad. de Brux.
" emarginata LÜTK., p. p. Bidrag.
Moulinsia cassidulina AG., Agass. Cat. Rais. (young!)
" " LÜTK., Bidrag.

Dr. Lütken, in his discussion of Encope emarginata, has given figures of young Encope after the appearance of the posterior interambulacral lunule. Younger specimens in our collection, before the appearance of this posterior lunule, show that Moulinsia is only a young Encope emarginata. As in my account of young Echini I have given a full description of the changes Encope undergoes during its growth, I will only recall them here to justify the synonymy adopted.

Littoral to 7 fathoms.

Echinoneus semilunaris LAM., An. s. v.

Syn. Echinoneus semilunaris LÜTK., Bid.
" elegans A. AG., Bull. M. C. Z., No 2.

Lütken, like myself, has only been able to recognize one species in the We• India Islands. As is well known, the difficulty of distinguishing the species in this genus is very great ; the more so, as thus far only tests without spines have been used in the determination of species. Mr. Pourtales has collected one specimen at Carysfort Reef with its spines and tentacles, which gives us the first opportunity of making a direct comparison with specimens from the Sandwich Islands (the true E. cyclostomus) still retaining the anal and buccal membranes. As far as I am able to discriminate between the test of these two species, the Pacific species is remarkable for the narrowness of its poriferous zone, the pores being placed in close contact, separated by a ridge carrying small tubercles, while in the specimens of E. semilunaris the poriferous zone is much broader. It has also (taking the same point of the test in specimens of the same size) larger tubercles, and a greater number of large, glassy tubercles, while the miliaries are closely crowded together. In E. cyclostomus, on the contrary, the primary tubercles, as well as the glassy tubercles, are, proportionally, much smaller and farther apart, the miliaries being more numerous. From the examination of the alcoholic specimen from Florida, I could not come to any satisfactory conclusion concerning the function of the glassy tubercles; they are not primary tubercles in the course of growth, as they are fully as large, and the primary tubercles, when young, always appear at first as opaque tubercles. They carry no special spines. On living specimens their function will probably be ascertained. Similar glassy tubercles often appear on the edge of very young Clypeastroids (Stolonoclypus prostratus), which disappear in older stages. Desor has given figures of the spines; but in addition to these, the test is thickly covered with stout pedicellariæ carried upon moderate peduncles. The tentacles do not differ (as far as could be judged from this alcoholic specimen, where they still were tolerably expanded) from the tentacles of our ordinary Echini, having prominent suckers. The tentacles retain the same structure from the mouth to the apical system. On the lower surface, especially round the mouth and anal system, the spines are longer and more slender than on the remaining portions of test. The anal system will, I think, furnish good characters for the determination of species, if we can judge from the striking differences the arrangement of the plates of the anal system presents in the two thus far examined. In the Pacific species the anal opening is more pear-shaped; the anus is placed near the blunt end, surrounded by a number of small plates arranged concentrically round it, and extending as a narrow band of small, slender, elongated plates between the single rows of large plates, extending on each side along the other extremity of the anal system. This row of large plates consists of five large plates, diminishing in size from the centre of the row towards either extremity, and carry a few large tubercles bearing spines. In the West India species, on the contrary, the anal system is more elliptical, the anus being placed almost in the centre, surrounded by a smaller number of small plates radiating from it irregularly. The single rows are made up of four plates, leaving a triangular space covered by small plates between them and the anus. The rest of the anal system is covered by much larger polygonal plates than in the Pacific species. The buccal membrane is covered by small quadrangular plates, arranged in rows radiating from the mouth, diminishing in size towards the opening of the mouth placed in the centre of the membrane. The absence of teeth is fully confirmed by an examination of this specimen. The close structural resemblance between the young of Echinolampadæ and Echinoneus shows that Echinoneus has no affinity whatever with the Galeritidæ, with which the genus has always been associated, but that it is a true embryonic Cassidulus allied to Echinolampadæ and Caratomus, already suggested by Desor to be a true Cassidulus, and not a Galerites. This affinity the examination of young Echinolampadæ proves undoubtedly. The removal of Echinoneus, Caratomus, and all the allied edentate forms of Galerites now reduces the family to one of great homogeneity, and suggests again the question of their affinity to true, regular Echinoids in a more forcible manner than before. We must, however, wait till we find a living representative of Galerites, to have the question fully decided. I am inclined, in the mean while, to associate the Galeritidæ having teeth with the true Echinoids, and consider them as forming among Echinoids a prophetic type of the Clypeastroids, with which they have many points of resemblance.

Littoral.

Echinolampas caratomoides A. AG., nov. sp.

Fragments of an Echinolampas were dredged in the first expedition, indicating the presence of a species which must attain a length of at least two inches. In the second expedition an entire specimen, measuring a little over an inch, was dredged from a depth of thirty-five fathoms. It resembles in outline E. Richardii DESML. found in Senegal, but differs from it by the peculiar structure of the ambulacral rosette, which is not strictly petaloid (the large fragments have the same structure), the two lines of pores of each ambulacrum having a different development. In the posterior pair, the anterior zone is fully developed, forming one side of the petal, while the other zone is not quite half as long. It is the same with the anterior pair of ambulacra, but the anterior zone is the shorter. In the odd ambulacrum the left poriferous zone is the shortest. In the continuation of the ambulacra from the rosette to the mouth it is always the exterior pore which is continued from each zone, and not pairs of pores, as is uniformly represented in all drawings of fossil Echinolampadæ. The floscelle round the mouth is most distinct, but in this specimen the bourrelets were not yet developed, formed as yet only by simple accumulations of small tubercles closely crowded together. In still younger specimens the resemblance of the opening of the actinal system to that of Clypeastroids is much greater, showing plainly that the distinction of a suborder, founded upon the presence of the bourrelets and phyllodes, as separating the Echinolampadæ from the Spatangoids cannot be maintained, and is simply an embryonic feature which may be more or less developed. The peculiar bare space of the actinal part of the test, so characteristic of Pygorhynchus, and upon which Desor lays so much stress, is well developed, though in older specimens of

Echinolampadæ it can be traced only as a faint, indistinct narrow band. The young of this Echinolampas resemble Caratomus to such an extent (see the description of the young stages) that the larger specimens were considered as living representatives of Caratomus. The series collected by Mr. Pourtales in his second expedition shows conclusively that Echinolampas passes at first through a stage strikingly similar to Echinoneus and subsequently most closely allied to Caratomus.

NOTE. — Desmoulins has called attention to the fact that the Senegal species should be named E. Laurillardi DESML., the name Richardii having been applied by him to a fossil species from the tertiaries of Bordeaux, from which it is different.

From 35 to 160 fathoms.

Rhyncholampas caribbæarum A. AG., nov. gen.

Syn. Cassidulus caribbæarum LAM., An. s. Vert.
Cassidulus caribbæarum LÜTK., Bid.
Nucleolites Richardii DUCH., Antill. (non DESML.)

Lamarck's genus Cassidulus, as established in 1801, contains in it two distinct types: Cassidulus lapis cancri and the species from the West Indies; Cassidulus Marmimi has very justly been separated as a distinct genus, Rhynchopygus by Desor, but this still leaves Cassidulus of Lamarck composed of two types, for either of which the name Cassidulus might properly be retained, but as Cassidulus is preoccupied among Mollusca, I would propose to retain temporarily Cassidulus for the fossil species allied to C. lapis cancri, and leave to some palæontologist the task of properly limiting that genus, and separate from Cassidulus under the name of Rhyncholampas a genus including Cassidulus caribbæarum and its West Coast representative, which was originally named Pygorhynchus pacificus in the Museum Bull. No. 2. This view is the one Lütken adopted at first, but afterwards he has referred these two species to Rhynchopygus, a change which does not seem judicious, and which his own excellent analysis and comparison of Cassidulus and Rhynchopygus does not justify. Mr. Pourtales brought home fragments of this species, showing that it must equal in size its pacific representative. As it has been figured frequently, and described so well by Lütken, I will only call attention to a few points of difference between the East and West Coast species. The bare actinal band of the West India species is deeply pitted with longitudinal round and elliptical pores, the edges surmounted by minute tubercles, carrying extremely delicate spines, resembling in every respect the structure of the microscopic spines of the fascioles of the true Spatangoids. The spines in fascioles cannot be called pedicellariæ, although it is the universal practice: they are true spines, having all the structure of embryonic spines, — in fact, true pedunculated pedicellariæ among Spatangoids are not found in fascioles at all; they are found round the mouth principally, and also on the surface of the test. The plates of the anal system, arranged in three rows, are broader and longer than in the Pacific species, where they are arranged in two rows only, the outer row being the largest. In the pacific species the pits of the smooth band are reduced to a few indistinct impressions, the whole band being thickly covered by minute silk-like spines. The floscelle is most distinct also, while, owing to the sculpture of the bare band round the mouth in the West India species, its outline cannot be traced.

Fragments in 106 fathoms.

Neolampas rostellatus A. Ag., nov. gen. et sp.

Outline from above resembling Echinolampas more elongated, three large genital openings; the left anterior one atrophied, placed closely together, madreporic body restricted to a narrow ridge separating them. Seen in profile, the test rises gradually from the anterior extremity towards the apical system, attaining its greatest height between it and the posterior extremity; this is sharply truncated anteriorly, as in some species of Catopygus. The lower extremity is concave, undulating; the anal system is large, elliptical, occupying the whole of the posterior truncated end, somewhat as in Botriopygus, the test being turned in like the finger of a glove, while the anus opens at the end of a long slender tube, extending well beyond the outline of the test, starting from the upper part of the anal membrane, which is covered by small plates, gradually diminishing in size and eventually firmly soldered together to form the base of the anal tube. Test thin, mouth placed near anterior extremity, having a well-developed floscelle and prominent bourrelets. The test is covered by minute tubercles of different sizes, not separated into primaries and miliaries, as in Echinolampas. The tubercles are not sunk, but stand out prominently from the test. The spines are straight, very fine, resembling those of the Scutellidæ. There is no ambulacral rosette so prominent in all Echinolampadæ. From an external examination alone it would be difficult to trace the course of the ambulacra, but from the interior we easily see one pore for each ambulacral plate extending from the floscelle to the apical system, and appearing as most minute pores when seen from outside. In fact, the structure of all the ambulacra is here identical with the structure of the ambulacra between the rosette and the mouth in other Echinolampadæ. The color of this Sea-urchin is a yellowish green, and I am convinced it is not the young of any other Echinolamp, in spite of its size ($\frac{7}{12}$ of an in.), owing to the great development of the bourrelets, which in other Echinolampadæ appear only after the specific characters are fully formed and the main features of the adult attained.

From 100 to 125 fathoms.

Pourtalesia miranda A. Ag., nov. gen. et sp.

A single specimen of this interesting genus was dredged at a depth of 349 fathoms. It is a living representative of Infulaster of the cretaceous period, holding the same relation to it which Rhynchopygus, with its projection covering the anus, holds to Echinolampas, if the posterior part of the test of the former were drawn out into a long spout. The outline of this genus, and of Infulaster, is very peculiar, and at first sight no one would take for a Sea-urchin the elongated, bottle-shaped body with its thin and transparent test. It is more like a Holothurian; the anus is nearly at one extremity, while the mouth is placed at the other. The short, vertical diameter, as compared to its length; the absence of any feature which would indicate the presence of a petaloid ambulacral rosette; the long, slender, curved spines, far apart, supported upon peculiar tubercles, mark this genus as one of the most interesting which have been brought to light by Mr. Pourtales. It forms a valuable link in our appreciation of the affinities of Spatangoids proper with Spatangoids in which the mouth is not labiate. Seen from above, the outline is bottle-shaped, the neck being the posterior extremity. At the base of the neck the test carries a deep pit, surmounted at its anterior extremity by a rostrum projecting from the test, and under this, at the bottom of the pit, is placed the anus. Seen in profile, the anterior extremity is almost vertically cut off, the test arching regularly from the apical system to the rostrum, where it is abruptly cut off, forming a regular curve to the posterior extremity, which extends beyond the anal system like a snout thickened at the end, surmounted at its extremity by an accumulation of minute deep violet-colored tubercles, which carry no spines. The lower surface is convex, regularly arched from the posterior to the anterior extremity. The posterior pair of ambulacra extend on both sides of an elongated plastron to the base of the snout-like prolongation, where they curve sharply upwards, and follow close to the abactinal part of the test, along a marked wedge-shaped ridge, extending from the apical system into the rostrum, protecting the anus, to the apical system, situated almost at the summit of the nearly vertical anterior extremity. The pair of anterior ambulacra take a similar course, but curve more regularly, and do not extend beyond the median line towards the posterior end. The odd ambulacrum is made up of two lines of pores far apart, situated in the deep anterior groove. The abactinal system consisting of four large genital openings, placed close together, with the madreporic body tolerably well defined in the centre, is situated at the origin of the anterior groove, this is flanked by prominent ridges extending from the apical system, gradually disappearing towards the mouth, placed at the other extremity of the anterior groove, which increases in depth on the lower surface, resembling, in fact, the anal groove of Echinobrissus, and allied genera with inverted position. The actinal system is elliptical in the trend of the groove, very large, with sharply defined edges covered by very minute plates. There are no indications of a floscelle. The odd ambulacrum carries large, thick tentacles, with a slightly lobed disk, while the tentacles of the other ambulacra are peculiar. They are placed, one for each plate, far apart, branching at the extremity, strengthened by a rod separating in the three branches, each terminating by a well-marked disk. There is no petaloid portion in the ambulacra; they are all simple pores from the mouth to the apical system. The spines are long, curved at the base, as in Spatangoids, but the tubercles to which they are attached have not a sunken, scrobicular area. The mamelon is small, crenulated, perforate, surrounded by a large granulated, scrobicular area, and raised above the surface of the test, to which the milled ring is attached by a very flexible muscular membrane. There are smaller spines of a similar structure scattered irregularly over the test, but quite distant. The whole appearance of the test is bare, and it is only on the ridges along the anterior groove, round the mouth and anus, that the small spines are closely packed together. Radiating from the apex towards the mouth, and extending along the abactinal plastron, there are masses of pigment cells forming lines of dark violet spots, also a similar series of spots round the extremity of the anal prolongation of the test, particularly marked on the edge of the pit leading to the anal opening. From the above description it is evident that Infulaster and the Ananchytidæ must have had a structure allied to that of Pourtalesia, and are embryonic Spatangoids, still retaining some features of Clypeastroids, while the features characteristic of young Spatangoids are prominently developed.

Off the Tortugas in 349 fathoms.

Lissonotus fragilis A. Ag., nov. gen. et sp.

This genus has the general outline of Maretia, but is somewhat more elongate. It must, from the description of Grube, be closely allied to Platybrissus, but the presence of a subanal fasciole, as well as a slight anterior groove, readily distinguish the two genera, in addition to the presence of a rudimentary rosette in Platybrissus, wanting in this genus. The mouth is not labiate, but pentagonal, with a well-developed floscelle, while the remaining portion of the ambulacra, extending to the apical system, are simple pores, one for each ambulacral plate, so that the ambulacral areas, seen from above, are scarcely perceptible, marked only by the somewhat more closely packed minute tubercles covering the ambulacral plates. Seen in profile, the test is regularly arched anteriorly, from the lower side to the apex, running then almost horizontally, and abruptly bevelled at the posterior extremity. The central plastron is small, triangular, surmounted by an elliptical subanal fasciole. The spines of the lower surface are large and few in number, confined entirely to the edge of the test, leaving broad, bare bands in the ambulacral areas and adjoining parts, while on the rest of the test the tubercles are minute, carrying small, fine spines, with the exception of three large, curved spines (Lovenia-like) near the circumference, placed in the anterior extremity of the test. The tubercles are also somewhat larger on the edge of the anterior groove, and more closely packed in the posterior interambulacral space, from the apex to the anal system, than in remaining parts of the test. The plates of the two posterior ambulacra are broad, while all the other ambulacra are made up of smaller plates. There are three large genital openings; the right anterior one is obliterated. The anal system is transversely elliptical, its membrane covered by minute granulation; an indistinct branch of the subanal fasciole extends along the lower side of the opening; the anus itself opens in a short, delicate tube, similar to that of Neolampas, but shorter. The whole test is mottled with dark spots; the ground color is grayish, with a purplish tinge.

From 320 to 368 fathoms.

Brissus columbaris Ag., Cat. Rais.

Littoral.

Meoma ventricosa Lütk., Bidrag.

Syn. Brissus ventricosus Ag., Cat. Rais.
" panis Grube, Neue Echin.
" spatiosus McCr., P. Pl. Foss. S. C., Pl. 3, fig. 1.

Lütken first referred this species to the genus Meoma of Gray, established for a presumed Australian species, M. grandis. Lütken also, in 1863, called my attention to the generic identity of Kleinia nigra A. Ag., with Meoma, which I had with doubt referred to Kleinia. This mistake I was led into by the fact that Gray himself did not refer Brissus ventricosus to Meoma, but still retained it in a section of Brissus. This shows how little reliance can be placed upon the subdivisions which Gray so frequently introduces in his genera (often copied without any attempt at a more accurate discrimination of the species from similar headings in the Catalogue Raisonné), when two species as closely allied as Meoma ventricosa and Meoma grandis are placed in two genera, or when in the subdivisions of Echinocardium, as another instance, Echinocardium ovatum is placed in the subdivision of the genus with "*deep, odd, ambulacral groove*," instead of being placed in the same subdivision as E. gibbosum. The genus Kleinia I am unable from Gray's figures and descriptions to distinguish from Brissopsis. Meoma grandis

GRAY, I am also inclined, from a careful comparison of the figures of Gray, to consider as identical with Meoma nigra (Kleinia nigra A. AG.), as the locality quoted by Gray is undoubtedly erroneous, Captain Belcher, as Lütken mentions in his "Bidrag," having visited Central America; and the fact that we have in the British Museum, brought back by Belcher, an Agassizia subrotunda GRAY, and a Meoma grandis GRAY, marked "Australia," neither of which can be distinguished from Agassizia ovulum and Meoma nigra, found upon the West Coast of Central America, seem to indicate without much doubt an error in the localities of the specimens of Gray's Catalogue.

Littoral, to 85 fathoms.

Plagionotus pectoralis AG., Agass. Cat. Rais.

Syn. Plagionotus pectoralis LÜTK., Bidrag.
" " GRAY, Cat.
" Desorii GRAY "
" Holmesii, Ravenellianus McCR., Pl. Foss. S. C., Pl. 3, figs. 2, 3.

I am unable to appreciate the grounds upon which Gray distinguishes P. Desorii GR. from P. pectoralis AG. The figure he quotes as basis for his species is taken from the original Spatangus pectoralis LAM., which came from Bahia.

The identity of the pliocene and post-pliocene species here cited, as well as in the synonymes of the preceding and following species, is of course problematical; yet the differences indicated by McCrady do not indicate as great a range of variation as we find in living species. I have quoted the figures for the sake of calling attention to them. There are, in addition, other tertiary species described by Michelin and by Guppy, coming from the Gulf and the West India Islands; but as those represented in our collections are not accompanied by figures, I have not attempted to point out their affinities.

Littoral and fragments from 115 fathoms.

Brissopsis lyrifera AG., Agass. Cat. Rais.

The only difference to be traced, after a careful comparison, between Florida and European specimens is the existence of a distinct branch of the subanal fasciole extending round the anal system to the peripetalous fasciole. In European specimens there are traces of this branch, but it is not distinctly and sharply defined as in the Florida specimens. The subanal fasciole seems, from all I can gather after an examination of Spatangoids in various stages of growth, the only one subject to changes, and it is not remarkable that we should have in Brissopsis similar variations, in the sub-anal fasciole, to these upon which Troschel has founded his genera Abatus Hamaxitus and Atrapus, — changes which, in Brissopsis at least, are due to different stages of growth. The character of continuity of the adjoining pairs of ambulacra, which Desor assigns to Toxobrissus as a distinguishing feature, does not constitute a sufficient basis for its separation from Brissopsis. This character is more and more apparent according to the size of the specimens; so much so, that we should place Brissopsis lyrifera, when young, in Brissopsis, but when full grown it would most decidedly pass for a Toxobrissus. If the subanal fasciole is really absent in Toxobrissus, it cannot, as Lütken considers it, be identical with Kleinia. It may be that other characters will yet be traced to separate it from Brissopsis; if not, then Kleinia and Toxobrissus will both become synonymous with Brissopsis.

From 55 to 156 fathoms.

Agassizia excentrica A. Ag., nov. sp.

Syn. Agassizia porifera McCr., Pl. Foss. S. C., Pl. 1, fig. 5.

I am somewhat inclined to consider this species as the Agassizia porifera; but not having any original specimens for comparison, and the drawings of Ravenel and McCrady showing rather striking differences, I will not take their identity for granted, and compare it only with the West Coast representative, from which it can at once be recognized by the position of the apical system, which is much more eccentric posteriorly; on this account the disparity between the odd anterior pair of ambulacra and the posterior pair is greater than in that species. The interambulacral plastron is elliptical, and with this exception the arrangement and proportion of the tubercles is that of A. ovulum Lütk. The peripetalous fasciole does not pass below the ambitus, and the posterior fasciole makes a sharp angle under the anal opening.

I am unable to distinguish Agassizia scrobiculata, of which authentic specimens are in the Museum collection, from A. ovulum. I must say, however, that Valenciennes's drawings in the Venus are not very faithful, and, from an identification based upon his figures alone, specific differences would readily become apparent.

From 36 to 115 fathoms.

Echinocardium ovatum Gray, Cat. Brit. M.

Syn. Amphidetus ovatus Ag., Agass. Cat. Rais.
E. orthonotus McCr., P. Foss. S. C., Pl. 2, fig. 1.

An examination of young specimens of Echinocardium cordatum shows that the generic distinction which I attempted to make between Amphidetus and Echinocardium, based upon the isolation of the anal from the subanal fasciole, and thus separating the group with a deep anterior groove from these with a slight anterior groove is untenable. The presence of three species of Echinocardium on both sides of the Atlantic is certainly remarkable, but I am unable to distinguish the fragments of specimens unmistakably identical with a fine specimen of Echinocardium ovatum collected at Charleston, S. C., in the Museum collection, from European specimens of this species.

Off Charleston bar; Florida in 128 fathoms.

Echinocardium lævigaster A. Ag., nov. sp.

The existence of several species of Echinocardium having the outline of Echinocardium cordatum, but the slight odd ambulacral groove of Echinocardium ovatum, is an additional proof of the identity of Echinocardium and Amphidetus, as they had been limited in the Museum Bulletin, No. 2. The present species, of which but a single specimen was collected, is closely allied to the Mediterranean E. gibbosum. Not having sufficient material to make a thorough comparison, which may prove their identity, I give the points of difference observed in the specimens compared. The abactinal ridge between the posterior ambulacra is quite prominent, extending as a well-marked rostrum over the anal opening; this is pear-shaped. The arrangement of the anal plates is similar to that of E. ovatum; the apical portion of the odd ambulacrum is narrow, the fasciole being elongated, elliptical; the sides of the test slope up very gradually from the ambitus; the apex is anterior to the centre; the whole upper surface of the test is covered by minute tubercles, with the exception of a few large ones along the edge of the ambulacral groove. The bare spaces of the ambulacra on the lower surface are very broad, the subanal plastron projects beak-like from the posterior extremity. which is nearly vertically truncated, but the beak is not as prominent as in E. gibbosum, where it becomes a striking feature.

From 79 to 121 fathoms.

Echinocardium Kurtzii Gir., Proc. Bost. Soc., 1852.

Syn. Echinocardium ampliflorum McCr., P. Foss. S. C., Pl. 2, fig. 2.
" " gothicum McCr. " " " Pl. 2, fig. 3.
" ? " cordatum Gray, Cat. B. M.

Girard has described as Echinocardium Kurtzii a species from Charleston (it occurs also in N. C.) closely allied to the European E. cordatum. Fragments of it were collected by Mr. Pourtales, and it may be interesting to compare our American species, of which the Museum possesses excellent series, with E. cordatum, with which future investigations may yet prove it identical, as the differences are confined almost entirely to a portion of the test, subject to the greatest variation in Spatangoids. These consist in the greater prominence of the posterior abactinal interambulacral ridge; the anal opening is almost circular, and covered by a larger number of plates than in the European species, where they are larger and few in number. The extremity of the subanal plastron also projects beak-like, and is more prominent, though not as much as in E. lævigaster.

Littoral, to 85 fathoms.

Schizaster cubensis D'Orb., Agass. Cat. Rais.

Fragments of a true Schizaster, allied to S. gibberulus, were collected. These are referred with some doubt to the above species; especially if the determination of Dujardin is correct, who refers it to Periaster, and must have had access to the original specimen. The fragments have, however, the distinctive mark, given in the Catalogue Raisonné, of having the anterior ambulacrum much less sunken than in S. canaliferus, — a character which has nothing to do with Periaster.

Fragments from 80 fathoms.

Mœra atropos Mich., Rev. Mag. de Zool.

Syn. Schizaster atropos Ag., Agass. Cat. Rais.
Schizaster lachesis Gir., Proc. B. S., 1850.
Mœra lachesis Des., Synops.
Mœra atropos Lütk., Bidrag.

Fragments of this species were dredged from a depth of 80 fathoms. Girard has attempted to separate specimens from Texas, of slightly more elongated outline, as a distinct species. The color of M. atropos when alive is yellowish. The spines, where more thickly clustered, are brownish; they are short except where they cover the sunken ambulacra, which are entirely hidden by the spines meeting from both sides. On the lower surface, the interambulacral plastron is covered by long spines, which as they wear out at the extremity become spatula-shaped. On the side of the ambitus, and the upper lateral part of the posterior ambulacra, the spines attain a great length, especially towards the mouth, where they are most closely crowded together. Gray is particularly unfortunate in his subdivision of this genus; he has, like Michelin, divided Schizaster, but into three genera (following exactly the three types of the Cat. Rais.). "Nina" having for its type S. canaliferus, while S. gibberulus, which is most closely allied to it and cannot be separated generically, figures as Brisaster, and the most abnormal of the Schizasteridæ is retained as Schizaster. Michelin's subdivisions, made at the same time, have been adopted here.

The attempts made thus far to restore old generic names, in vogue before

Lamarck, and limit them to genera, as we understand them now, have been most confusing. Not that I would ignore writers who, like Breynius, Leske, Klein, Linck, were often far in advance of many modern publications, but when the so-called restoration amounts to sweeping out of existence genera which are well understood, and properly defined, and have been current in literature for more than half a century, and replacing them by generic names of doubtful limitation, I can consider such radical changes as anything but progress and justice. It seems to me that unless these changes are made with as much discretion and judgment as they have been made by Desor in his Synopsis, applying the old name to a subdivision, and retaining at the same time the current name for a portion of the genus thus subdivided, they are not calculated to advance our knowledge of Echinoderms. For instance, the attempt to substitute Echinanthus (which includes genera as widely different as Echinolampas, Conoclypus and Clypeaster) for Clypeaster, while D'Orbigny considered Echinolampas as identical with Echinanthus; the adoption of either view involves endless confusion, and Desor's solution is so natural that we must, as a general rule, take his definitions, in spite of the priority of this and many other restorations proposed by Gray, which are liable to similar objections.

Littoral, to 80 fathoms.

II. *On the Young Stages of Echini.*

From the large number of small-sized Echini collected by Mr. Pourtales it became necessary, in order to study them intelligently, to examine the young of as many species as possible, and obtain some criterion by which to determine this collection accurately. As the results to which this examination has led me form the basis of the preceding descriptions, it is not out of place to give the proofs, as far as they can be given by a short *résumé* and without figures, of the conclusions to which I have been led by the study of these young, leaving for a more elaborate paper a detailed description, as well as figures, of the changes here mentioned, which these young undergo. Some of the specimens collected by Mr. Pourtales are so small that they must have absorbed their Pluteus very recently before their capture. This collection, taken in connection with the Museum materials, gave the means of studying the changes due to growth of the following species: —

Cidaris annulata Gray.

Dorocidaris abyssicola A. Ag.

Diadema antillarum PHIL.
Garelia cincta A. AG.
Echinocidaris punctulata DESML.
" æquituberculata AG.
Echinometra VanBrunti A. AG.
Toxopneustes drobachiensis AG.
Echinus Flemingii BALL.
" melo LAM.
" gracilis A. AG.
Sphærechinus brevispinosus DES
Temnotrema sculptum A. AG.
Toreumatica concava GRAY.
Genocidaris maculata A. AG.
Trigonocidaris albida A. AG.
Lytechinus variegatus A. AG.
Tripneustes ventricosus AG.
Boletia granulata A. AG.
Echinocyamus angulosus LESKE.
Clypeaster rosaceus LAM.
Stolonoclypus prostratus A. AG.
Echinarachnius parma GRAY.
Encope emarginata AG.
Mellita testudinata KL.
" hexapora AG.
" longifissa MICH.
Fibularia volva AG.
Echinolampas caratomoides A. AG.
Echinocardium cordatum GRAY.
Brissopsis lyrifera AG.
Agassizia excentrica A. AG.

I doubt if without the aid of the information gained by the study of these young Echini a satisfactory report of this collection could have been made. The changes some species undergo are so great that nothing would have been more natural than to place the two extremes of the series not only in different species, but often in different genera, and even in different families. As a necessary consequence, the study of these young, showing what we may consider differences due only to growth, will lead to the elimination of numerous species and genera, and give us hereafter a much more accurate basis in our limitation of genera, species, and the higher subdivisions. But it would be out of place here to do more than hint at this reform, especially as I trust soon to publish, in our Illustrated Catalogue, a Revision of the Echini, which has been undertaken, with the collections in the Museum and of the Smithsonian as a basis. I shall always consider myself fortunate to have had the opportunity — thanks to the liberality of the Superintendent of the Coast Survey — of examining this collection, forming the most valuable addition to our knowledge of recent Echinoids since the collections of the same order made by Stimpson in the Pacific.

In Toxopneustes drobachiensis Ag. soon after resorption of the Pluteus the young Sea-urchin has few large tubercles with mamelon, limited to the ambitus (Podocidaris and Podophora-like). The next stage has two principal rows of large tubercles occupying the whole test (Cidaris-like, no miliaries), increasing in number as they grow older, the spines gradually passing from a condition similar to those of Rhabdocidaris, Cidaris, Echinocidaris, and finally to Toxopneustes-like spines, as fast as the primary tubercles are formed, retaining their embryonic features most strongly while the spines are directly connected to the test, as in Podocidaris. In the earlier stages the actinal opening is large (Echinocidaris-like), without indentations (Cidaris-like), occupying nearly the whole of the actinal surface. As the test increases this opening becomes proportionally smaller, and slight cuts are formed (Psammechinus-like). The anal system is at first closed by a single subanal plate, appearing before the formation of the genital and ocular plates; it remains for a considerable period more prominent than the other plates, which are added to cover the enlarged anal system. The symmetrical axis of the subanal plate does not hold a fixed relation to the madreporic body, being opposite different genital plates in various stages of growth. This corresponds to the oblique position of the subanal plate in Salenidæ, when we take as starting-point the madreporic body. The abactinal system subsequently passes through a stage reminding us of Echinocidaris and Trigonocidaris, only there are five instead of four anal plates. The poriferous zone is at first narrow, the pores arranged in vertical rows; subsequently they are slightly arched vertically; they next separate into horizontal arcs of a smaller number of pores, increasing rapidly in number with age, and in small specimens we can trace their mode of formation, as the arcs near the ambitus are similar to those of the adult, while those next the abactinal system are similar to the younger stages. The plates of the poriferous zone increase independently of the inter-ambulacral plates. The different stages of growth represent in the younger stages Cidaris, next Hemicidaris, then Pseudodiadema, Echinocidaris, Heliocidaris. The same general changes take place in Toxopneustes lividus, but the turban shape (Cidaris state) of the young test is more striking than in T. drobachiensis.

In Cidaris the difference between old and young stages is almost entirely limited to the proportionally larger size of the spines, and the more prominent serrations (recalling Salenocidaris). The abactinal system early assumes the character of the adult; in fact, with the exception of the smaller number of coronal plates, the above differences in the spines are the only important changes undergone in this genus. The same holds good for Diadema and Garelia, in both of which the spines are proportionally larger, and being so much less numerous gives to young Diadematidæ a peculiar facies (D. calamaria-like). We find also in young Diadema characters in the actinal membrane differing from the adult; the peculiar grouping, in five separate clusters, of the buccal ambulacral plates which appear first, is soon lost by the encroachment of the smaller interambulacral plates, and in older specimens the plates become deeply imbedded in the buccal membrane. The pores at first are placed in a vertical row in very young specimens; they then become arranged in arcs of three or four pairs; with increasing age the median rows of interambulacral tubercles assume the arrangement found in the adult. Owing to the rapid growth of the spines in the young, the extremity, and frequently the greater part of the spine almost to the base, is hollow; but as the young increase in age they become more solid at the base, and further up in proportion to their age.* Garelia is a good genus, as has been acknowledged by

* The genus Echinodiadema of Verrill is founded upon structural peculiarities of young Diadema mexicanum. Complete series of the young Diadema antillarum, from one tenth of an inch in diameter upwards, show that: the slight cuts, the shape of the abactinal system, the presence of small scales covering the anal system (few in number in very small specimens), the trigeminate arrangement of the pores, the hollowness (generally upper extremity only) of the spines, due to the mode of growth and subsequent solidification from the base upwards in Diadematidæ, the arrangement of the tubercles, the peculiar grouping of the plates of the buccal membrane, — features upon which the genus has been characterized, — are found in young Diadematidæ. I have carefully examined the type of Mr. Verrill's species, as well as young of Diadema mexicanum,

Bölsche, in letters subsequently to the "Nachtrag" to his Diadematidæ, in Wiegman's Archiv. The spines are solid, already longitudinally striated in the youngest specimens examined, differing totally in their structure from those of Echinothrix or Diadema. This shows plainly that in these embryonic Echini (Cidaridæ, Diadematidæ) the structure of the spines forms a good basis for the discrimination of groups notwithstanding their apparent great changes of form. These do not extend to the nature of the ornamentation, which remains very constant, and will prove of great value in fossil Echini.

Nowhere among the young regular Echini have I found such great changes in the shape and proportions of the test and spines as in Echinometra. We frequently find specimens of the same size, where in one case the outline is almost circular, the test flattened, covered with long slender spines, while in the other the test is lobed, swollen, high, surmounted by numerous short stout spines. These and all intermediate stages, complicated by the greater or smaller number of primary tubercles, the arrangement of the arcs of the poriferous zone undergoing changes exactly similar to those described in Toxopneustes, are found retained in specimens of very different size. This has given rise in a great measure to the confused synonymy attached to our most common species, and renders their identification, if based upon meagre material, almost hopeless.

In young Echinocidaridæ we have already in the youngest stages four anal plates. The abactinal system of very young specimens is remarkably prominent, occupying more than one half the abactinal part of the test. The whole test is deeply pitted (Trigonocidaris-like); the rudimentary tubercles, covering the greater part of the abactinal part of the test, are connected by ridges, which are gradually resorbed and reduced to the granulation found upon the coronal plates of the genus. The primary tubercles are at first limited to the ambitus, surmounted by short stout spines (Podophora-like), gradually becoming more slender and proportionally longer with increasing age (the opposite of what takes place in Toxopneustes, Cidaris, and most young Echini). The rudimentary spines are not seated upon tubercles; they are club-shaped (identical

of D. antillarum, and additional specimens of the so-called Echinodiadema coronatum, which has convinced me that Verrill's species is only a young Diadema mexicanum, the structural differences noticed being found in all young Diadematidæ I have had occasion to examine (D. antillarum, D. paucispinum, and D. mexicanum).

in structure to those of Podocidaris). The poriferous zone has in the earliest stages the structure found in the adult, only it does not widen at the actinostome. The ratio of the actinostome to test does not vary greatly in different stages of youth; the edge of the actinal system forming the groove of the gills is turned back but slightly in young, the lips taking the place of cuts becoming more prominent (Boletia-like) with increasing age. The separation of Echinocidaris and Arbaçia to represent the groups with bare or crowded interambulacra is not natural, depending upon the greater or less resorption of the rudimentary tubercles formed in the earlier stages. It is very common to find young of Echinocidaris punctulata which would pass for young of Arbacia, and young Arbacia æquituberculata which would pass for young Echinocidaris. Owing to the independent growth of the plates of the poriferous zone, we have either three or four pairs of pores for each ambulacral plate; the same is the case with other Oligoporidæ, as limited by Desor, showing that the division he has made, convenient though it is as a key for the easier grouping of genera, is yet not strictly reliable, the mode of growth of many Polyporidæ showing in their young stages that they have but a small number of pores (Tripneustes, Mespilia) for each ambulacral plate which places them among the Oligoporidæ; but, owing to the independent growth of the plates of the poriferous zone in older stages, they seem to belong to the Polyporidæ.

In Echinus, Sphærechinus, Lytechinus, we find in the younger stages the same unbroken vertical arrangement of the pores, taking next a vertically arched form, still connected, and then assuming the arrangement of the adult. In these genera the anal system is at first covered by one plate, and undergoes changes similar to those of Toxopneustes, by the addition of four smaller plates, and so on, the original subanal plate retaining long a greater prominence. The miliaries are formed in these genera as well as Toxopneustes by radiating ridges arising from the base of the primary tubercles, forming a sort of star, then they swell at the distal extremity, forming a set of club-shaped spokes round the main tubercle; these are little by little separated from it, and become independent elliptical tubercles at first, and then miliaries or secondary tubercles. The ten large buccal plates of the actinal membrane are the first to appear. Small plates (in genera in which they are found in the adult) are next formed between them and the teeth (Echinus-like), while afterwards they cover the whole membrane, as in Lytechinus, Psammechinus, Trigonocidaris, appearing between the ten plates and the test. This mode of growth is totally unlike the growth of the buccal plates of the Cidaridæ, where these plates perform the part of ambulacral and interambulacral plates, and appear near the test at first, forming in full-grown specimens rows made up of more than two plates, as in the Palæchinidæ, suggesting that the test of Palæchinidæ must have been made up of plates homologous to the buccal plates of Cidaris. The test of course would then have been capable of considerable compression and change of outline, as is the case in Astropyga and Asterosoma. This similarity is very striking in young Cidaridæ, where the number of coronal plates is small, and the young Sea-urchin seems to consist almost entirely of an abactinal and an actinal system, separated by a narrow band of coronal plates. Let this narrow band of coronal plates disappear entirely, and the buccal plates take a correspondingly great development, and we have a Palæchinus made up of small ambulacral and interambulacral plates consisting of several rows, and continuous from the teeth to the abactinal system, similar to that discovered by Meek and Worthen, the whole test surmounted by short spines, articulating upon a more or less distinct mamelon. The structural features of the buccal membrane of Cidaridæ entitle them to a higher rank than that of a family, in the suborder of Echinoids, intermediate between the Palæchinidæ and Echinidæ proper.

In the Temnopleuridæ (Toreumatica) the subanal plate remains very prominent in adult specimens; the anal system in the young is covered by one large elliptical plate; as the anal system enlarges, numerous minute plates surround the larger plate, which always retains its peculiar ornamentation, and is readily distinguished from the other by its size and shape. In Temnotrema, on the contrary, the anal system undergoes changes identical with those of Toxopneustes, Echinus, and the like. In Toreumatica, the pits at the angles of the plates appear at first like rectangular openings, which, as the specimens grow older, become little by little connected by grooves, growing deeper and more prominent with advancing age. The same is the case in Temnotrema; the pits, however, are never so marked in the adult, becoming simply comma-shaped. The miliaries in both these genera are formed as in other genera by ridges appearing at first connected with the base of the primary tubercles. In Trigonocidaris the young differ from the old in having larger pits, less numerous and lower ridges, and but few secondary tubercles, the principal rows of ambulacral and interambulacral tubercles being very prominent. The buccal membrane and abactinal system present no striking differences, the anal plates being only four in number in all the specimens collected. In Genocidaris, of which an extensive series was collected, we find in the smallest specimens a few large spines, resembling the spines of young Dorocidaris abyssicola, equalling in length the diameter of the test. As the specimens increase, the spines lose their spindle-shaped form and their serrate edge; they become more pointed and elongate, diminishing rapidly in proportion to the size of the test, and soon take the proportions they have in the adult. The actinal opening is very large at first, the test in young specimens being a narrow ring when seen from the actinal side. The primary tubercles are few in number, with remarkably prominent ridges radiating from them, leaving deep pits between the ridges. With increasing size these ridges become miliaries and secondary tubercles, the pits, however, remaining round the boss of the primary tubercles in both the areas; so that the test passes through stages in which it resembles at first young Psammechinus, then a Psammechinus with deep grooves radiating from the tubercles, and finally with deep pits round their base. The subanal plate retains always its preponderance, and the embryonic character of the anal system (retained in the generic name) is a marked feature of this interesting Sea-urchin. The actinal opening rapidly becomes smaller, and resembles that of Psammechinus. In fact, Genocidaris might be called a Psammechinus among Temnopleuridæ, while Toreumatica is the Lytechinus of the family.

The changes taking place in the arrangement of the pores in Tripneustes and Boletia are similar to those observed in Echinus; at first a simple vertical row, then arcs laterally curved, then three pairs of pores for each ambulacral plate, in oblique open curves, and finally almost horizontal curves, the pores appearing to be placed in independent vertical rows. Hipponöe of Gray cannot be retained, the name being preoccupied by Audouin, and as Hipponöe and Tripneustes are identical, the name Tripneustes can be retained to include the species of both these genera.

Among the Clypeastroids we find in the young during their growth great changes of form and structure taking place. In young Echinarachnius the outline is elliptical, the test is arched, high, the anus is placed in a slight depression of the test, and, seen in profile, we are reminded of the general aspect of Pygorhynchus. There are but two principal rows of large tubercles in each area, extending from apex to mouth, so that, seen from above, the young Echinarachnius has much the facies of an Echinometra. The mouth is large, pentagonal, its radius being half the radius of the test. The ambulacral rosette is reduced to two pairs of pores, — simple perforations of the test, one in each poriferous zone for each ambulacrum. This extraordinary shape and structure the young do not retain long; they soon become pyriform; the blunt extremity being the posterior, the test becomes greatly flattened and the anus approaches the edge. The rosette is now composed of three and two pairs of simple pores in each poriferous zone for each ambulacrum, the anterior ambulacrum having only two pairs in each zone. The tubercles are proportionally smaller, though there are still but two rows in each area, but further apart. In the next stage we find the rudimentary rosette composed of four and five pairs of pores close together and two or three distant pairs of pores, in the following ambulacral plates, one pair in each plate, which in subsequent stages increase in number and extend almost to the edge of the test. The test has become quite flattened, the lower side is concave, undulating, the ambulacral zones are now much narrower than the interambulacral ones. Each plate still has only one tubercle; the lines of separation between the two zones run straight from the edge of the test to the apex. It is only in somewhat older stages, when the rosette loses its radiating outline, and assumes a slightly petaloid shape, that we find the angle formed at the base of the petal in the ambulacral zone, from which point the ambulacral plates widen rapidly; each plate now carries from two to six smaller tubercles. The outline is quite pentagonal, the lower surface concave, but little undulating, the anus placed near the edge, and covered, as in all preceding stages, by one plate; the anal system in older specimens has five plates, the plate first formed remaining somewhat the largest. As the young Echinarachnius increases in size its outline becomes more circular, and in specimens measuring one fifth of an inch in diameter has the general appearance of the adult. The furrows joining the ambulacral pores appear soon after the first traces of a true rosette are seen; they become deeper and the pores separate in proportion with the petaloid structure of the abactinal part of the ambulacrum. The tubercles are proportionally much smaller and more numerous, and soon after the ambulacra have a well-developed rosette, bear nearly the ratio to the plates which they have in the adult.

Young specimens of Mellita hexapora, measuring $\frac{3}{32}$ of an inch in diameter, are almost circular, with a thickened raised edge, as in Laganum, and as yet have no lunules. The rosette is simply a series of radiating pores, three and two in each poriferous zone, for each ambulacrum, extending but a short distance from the apex. The ambulacral and interambulacral plates are of the same size, hexagonal, forming twenty equal zones, carrying but a single large tubercle in the centre of each plate; seen from below the surface is deeply concave, the mouth much larger in proportion to the test than in adult specimens, and we see forming from this side the posterior interambulacral lunule as a deep pit, at one extremity of which is placed the anus near the mouth, about one third the distance from the edge of the test. We find also rudimentary phyllodes made up of a few of the small pores, which eventually extend in the ambulacral furrows to the edge of the test, but are now restricted to a small number clustered round the mouth. The outline in a subsequent stage becomes slightly pentagonal, the plates elongate; the lunule pierces through to the abactinal side; the rosette is also radiating, made up of five to six pairs of pores for each poriferous zone. The ambulacral area is now slightly narrower than the interambulacral zones. When the posterior lunule has become a small round opening, encroaching upon the plates of the posterior interambulacral area, extending as a lobe beyond the outline of the test, the rosette is slightly petaloid. There are from two to five tubercles on each plate; they are quite elongate, having lost their hexagonal outline; the lower surface is flat, and on the lower side the ambulacra have broadened very rapidly, the interambulacra forming narrow bands carrying larger tubercles between the ambulacral zones. The edge of the test is still quite thickened, and it is only when the young Mellita has attained somewhat less than half an inch in diameter that the ambulacral lunules appear as pits, seen at first from the lower side only, and gradually forcing their way through the test. The posterior interambulacral lunule increases rapidly in size; the test and the groove in which the anus is placed become somewhat separated from it, being simply a depression in the continuation of the lunule. After the appearance of the lunules as slight pits, which develop unequally, not appearing simultaneously, the changes are limited to the increase in size of the lunules and of the poriferous ambulacral zone on the lower side; the outline and general facies, with the exception of the larger size of the tubercles, being that of the adult.

The general character of the changes undergone by Echinarachnius and Mellita hexapora, as far as they relate to the transformations of the ambulacral rosette, the growth of the tubercles, the changes in the proportions of the relative breadth of the ambulacral and interambulacral zones, are identical in Mellita testudinata and Encope emarginata. What is remarkable in Mellita testudinata is that the mode of formation of the ambulacral lunules is not identical with that of M. hexapora. The interambulacral lunule alone is developed from a depression formed on the lower surface pushing its way through the test, while the ambulacral lunules are the result of the closing in of notches appearing on the edge of the test, which remain open until the Mellita has attained a considerable size, — three quarters of an inch and sometimes more; long after the arrangement of the plates, the shape of the rosette, the size of the tubercles, and the extent of the poriferous zone on the lower surface have the character of the adult. In fact, the mode of development of Encope and of Mellita testudinata (also M. longifissa) are far more closely allied than that of the two species of Mellita of the types of hexapora and testudinata.

In Encope emarginata we have, as in Mellita, an early stage in which no posterior interambulacral lunule exists. The outline of these young Encopidæ is not Laganum-like, as in Mellita, but is elliptical, as in very young Echinarachnius; the ambulacral zones extending uniformly from edge to apex, are narrower than the interambulacral. The plates of both areas carry one to two large tubercles and a couple of very small ones. The ambulacral pores extend from the apex to the mouth. One pair of pores, not connected by grooves, is situated in the suture of each ambulacral plate. The outline seen from above is deeply scalloped — in fact, it is a Moulinsia, — and the figure given by Agassiz in the Monographie des Scutelles is only a young Encope emarginata. The posterior interambulacral lunule commences as a pit from the lower side, and by the time the young Encope has attained a diameter of three quarters of an inch, the lunule is seen from above, also as a small elliptical opening. The edge of the test is deeply scalloped, especially at the median ambulacral sutures, where notches soon appear, and the young Encope gradually takes a deeply lobed outline. These cuts may or may not close, and thus we have the basis of the great number of species established upon the depth of lobes, the presence or absence of certain lunules, which are nothing but features of the young either retained in the adult or greatly exaggerated. The ambulacral rosette is formed as in Mellita and Echinarachnius by the independent growth of the upper part of the ambulacral area, which in Clypeastroids grows more rapidly than the rest of the test, from the moment the pores are joined by grooves, the plates crowding upon one another, and pushing them or part of them towards the edge of the test. In the Scutellæ the pairs of pores of the rosette are placed in the sutures of the ambulacral plates, while in the Clypeastroids, besides the pair of pores in the sutures an additional pair pierces the middle of each ambulacral plate.

The development of Stolonoclypus prostratus and flat Clypeastroids of the type of Clyp. placunarius is most instructive, tending to show that in connection with the development of the Scutellidæ above described, we must probably introduce a complete reform among the genera recognized as Lenita, Scutellina, Runa, Echinocyamus, and other minute Echinoids, which may eventually prove to be nothing but the young of other Clypeastroids, as Mellita, Scutella, Laganum, Stolonoclypus, Clypeaster, Encope, and the like; but want of sufficient material prevents me from entering into this comparison more in detail. Though we know now, from what has been said above, that the Scutellidæ pass through phases which cannot be distinguished from Moulinsia, Fibularia, Runa, Scutellina, and the Clypeastroids proper pass, as I shall show below, through a stage of growth identical with Echinocyamus. For similar reasons I am inclined to consider Fibularia as the early stage of some Clypeastroid. The absence of partitions in some species, I think, can easily be accounted for, as they are developed only later. We have a species of Fibularia from the Sandwich Islands, in which there are no partitions when very small, while in the adult these partitions are most rudimentary. Greater material than I possess is necessary to elucidate the affinity of the genus, which certainly has all the features of immature Clypeastroids.

Among the Echini, collected in great numbers by Mr. Pourtales, was a small species showing, on careful examination, the facies of Echinocyamus, and which, after a minute comparison with Echinocyamus pusillus, I could only distinguish from it, by its more circular outline, larger tubercles, less crowded and thinner interior partitions; observing, however, in the horizontal sutures of the ambulacral plates, rows of minute pores, extending from the imperfect rosette to the mouth, I at once saw that it must be a young Clypeaster, and on comparing them with young Stolonoclypus prostratus, measuring half an inch in length, recognized a similar arrangement in the ambulacral zone, below the rosette. It was now plain that our Florida Echinocyamus was only a young Stolonoclypus prostratus, which in the earlier stages is identical in every structural feature with Echinocyamus; for European specimens of Echinocyamus show the presence of similar horizontal rows of pores, as in our young Stolonoclypus from Florida. I am well aware that no Clypeaster has been found in European seas, yet we have evidently such an incomplete knowledge of the marine Fauna, existing at great depths, to judge from the collections made by Mr. Pourtales, that negative evidence can no longer be admitted in opposition to such positive proof as we find in Florida. The larvæ referred by Müller to Echinocyamus were not raised by artificial fecundation; they do not resemble Spatangoid or Clypeastroid larvæ, but seem closely allied to true Echinidæ larvæ. Can they not be larvæ of Cidaris hystrix and of Cidaris papillata — which would account for the presence of such forms in the North Sea and Mediterranean — rather than be referred to Echinocyamus? Very small specimens varied in the number of the tubercles on each plate, the number of pores of the imperfect rosette, the changes being similar in kind to those observed in the Scutellidæ. From the Echinocyamus stage they become more pentagonal; the concavity of the lower side increases, the partitions increase by the addition of needle-shaped processes, and they soon attain the shape and structure given by Lütken in his figures of young Stolonoclypus prostratus. The tubercles increase more rapidly near the edge of the test, and a remarkable feature of these stages is the presence of minute glassy tubercles similar to those of Echinoneus, developing side by side with young tubercles, the function of which is as obscure as it is in Echinoneus, and which are not found in older specimens.

The development of Echinolampas has thrown unexpected light upon the affinities of the toothless Galerites and of the Cassidulidæ. It shows conclusively that Echinoneus is only a permanent embryonic stage of Echinolampas, thus becoming allied to the Cassidulidæ, and that it has nothing in common with the Galerites as I would limit them, confining them entirely to the group provided with teeth. This reduces the type to a most natural division, and from what we now know of the simple nature of the ambulacra of all Echini in their early stages, I would not give to this feature the significance which it has received, but would be inclined to unite the toothed Galerites with Echinidæ proper in the same suborder, as a prophetic family, approaching the Clypeastroids by the separation of the anus from the apical system, and retaining the teeth and general symmetrical structure of the regular Echini. Though I am aware that the great development of Galerites in former geological periods, and the relation of the anus and test, may, on further acquaintance with living representatives, entitle them to rank as a suborder intermediate between the Echini proper and Clypeastroids. Young Echinolampadæ, measuring a trifle over one eighth of an inch, are elliptical, resembling Echinoneus, with a large transverse elliptical mouth, the anus placed in the truncated posterior extremity above the ambitus. The outline in profile is almost globular, each plate of the narrow ambulacral zone carries a single principal tubercle, surrounded by a circle of miliaries. The pores are arranged in a vertical row of a single line of pores, three or four for each plate, extending from mouth to apex. The interambulacral plates are elongated horizontally, and carry from one to three principal tubercles, with numerous small miliaries arranged in circles round the primaries, or irregularly scattered. In specimens twice the size of the above, the test is less elliptical, more flattened, and the first trace of a rudimentary rosette appears as a short row of double pores extending from the apex, consisting of from eight to nine pairs, only in one of the poriferous zones of each of the pairs of ambulacra — in the anterior zone of the posterior pair and the posterior zone of the anterior pair of ambulacra — the odd ambulacrum remains simple. In specimens measuring above half an inch this rudimentary one-sided rosette has increased in length, and traces of the second row of double pores are seen in the simple zones near the apex. In specimens measuring an inch these rows have grown to be half as long as the arc of the rosette first formed; the same structure has also extended to the abactinal part of the odd ambulacrum. The elliptical outline is entirely lost in these specimens, the shape having gradually become more circular, pentagonal, and ovoid. At the same time the miliary tubercles increase rapidly in number, forming clusters of small tubercles, embossing the plates of both areas. The anal system is covered by three large triangular plates, the anus opening near the edge of the system, in a narrow slit covered by very minute plates. The mouth, as the young increase in size, becomes more and more sunken. The buccal membrane is covered with minute plates, the mouth opening in the centre. There are as yet no signs of phyllodes or of bourrelets, which appear only later, the bourrelets being at first accumulations of small tubercles between the phyllodes. When measuring about half an inch in length, the young Echinolampas resembles Caratomus to such an extent that this stage was considered for a time a living representative of Caratomus. The larger series collected by Mr. Pourtales, in his second expedition, showed conclusively the relationship to Echinolampas, and proves the correctness of the step taken by Desor in removing Caratomus and allied genera from the Galeritidæ, and placing them among the Cassidulidæ, on account of the semipetaloid nature of the apical portion of the ambulacra. Pedicellariæ with a short stem are irregularly scattered over the test; the spines resemble those of Clypeastroids, being short, slender, straight, the secondary spines silk-like. The tentacles, as far as could be ascertained from alcoholic specimens, are provided with a powerful sucking disk, as long as they retain the aspect of Caratomus.

Among Spatangoids proper, the examination of young specimens shows that they undergo great changes in outline during their growth, that the posterior part of the test is especially subject to variation, that the position of the anus is exceedingly variable in one and the same species, that the mouth is not labiate in the young as in the adult, that the peripetalous fascioles and lateral fascioles do not change in their limits, but that the subanal and anal fascioles are liable to great modifications during their growth, and cannot be used as distinguishing features of generic value, while the permanence of the peripetalous and lateral fascioles is of great systematic value. The ambulacral petaloids also are greatly modified with age, generally becoming confluent, while in the young they are remarkably distinct and the pores not conjugated. The semitæ are not covered by regular pedicellariæ, as is universally stated to be the case. We find on the fascioles minute tubercles carrying embryonic spines. Troschel was the first to call attention to this, and Müller has subsequently, in his Embryology of the Echinoderms, given accurate figures of the spines of the fascioles of S. canaliferus, in his sixth Memoir, Plate VII. figs. 7 – 9. Yet these observations, dating back to 1852, seem to have escaped the attention of recent writers, who persist in stating that the fascioles carry true pedicellariæ. These are found irregularly scattered over the test, generally more abundantly round the mouth. From the examination of the pedicellariæ made in some of the genera of this collection (Podocidaris), there can now be no doubt that pedicellariæ are nothing but modified spines; the existence of pedicellariæ surmounting a tubercle and moved by the same mechanism as spines, as well as the mode of formation of the pedicellariæ, as observed in Asteracanthion and Spatangoids, by Müller and myself, proves conclusively that they are only more sensitive spines, performing the functions of scavengers or of providers, according to their position.

The Cassiduloid-shaped mouth of young Spatangoids, as well as the existence of several Spatangoids, both fossil and recent, in which the mouth has a similar structure, is as convincing a proof as necessary of the correctness of uniting Cassiduloids and Spatangoids in the same suborder, though the name given by Albin Gras, of "Irregular," is hardly what could be desired.

Young Brissopsis lyrifera, less than a quarter of an inch in length, are cylindrical, the mouth having a flat, crescent-shaped edge, the test truncated vertically at the posterior edge, surrounded by a prominent elliptical sub-anal fasciole; the peripetalous fasciole is elliptical, undulating; the anus is placed near the posterior extremity of the fasciole. The odd ambulacrum carries four or five large tentacles with lobed disk; the pores of the odd ambulacrum are single, not in pairs; the other ambulacra are short, straight, well defined, consisting of three and four pairs of pores not yet conjugated. In older specimens the posterior edge of the mouth becomes labiate, the anus approaches the subanal fasciole, which sends out a rudimentary anal branch, eventually uniting with the peripetalous fasciole, the outline of which becomes more pentagonal, undulating, and elongated with the increasing size of the petaloid ambulacra. The posterior edge becomes more bevelled with age, the subanal plastron more prominent, the lateral pairs of ambulacra gradually tend to unite, passing from a strictly Brissopsis outline to one considered hitherto characteristic of Toxobrissus. The spines in all young Spatangoids are strikingly larger in proportion to their size than in the adult.

In Echinocardium cordatum the changes of the mouth, of the outlines of the internal ambulacral fasciole, and the gradual confluence of the lateral ambulacra are similar to those of Brissopsis; the posterior extremity undergoes the greatest change in outline; the subanal plastron is very prominent; in fact, the outline of young E. cordatum recalls E. gibbosum. The subanal fasciole and anal branch are at first united, but as the specimens increase in size, the anal branch separates from it. The odd ambulacral pores are at first two single rows of pores, which by closer crowding eventually alternate, but are not arranged in pairs.

The young Agassizia, a quarter of an inch in length, is a flat elliptical Spatangoid resembling Gualteria. The peripetalous and lateral fascioles have the same general limits as in the adult, but the arrangement of the pores in all the ambulacra is identical; there is but a single pore for each ambulacral plate, as it exists in the anterior pair and odd ambulacra of the adult; the ambulacral grooves are not yet formed, the anterior groove alone being slightly indicated; the mouth is not labiate.

The great number of Spatangoid genera established upon differences in the subanal fasciole, the existence or absence of the anal branch, the depth of the ambulacral grooves, the confluence or distinctness of the lateral ambulacra, all based upon characters subject to great variation during growth, show the necessity of a careful revision of the whole group of Spatangoids with the data here furnished; and such closely allied genera as Maretia, Spatangus, Hemipatagus, and Macropneustes; Eupatagus, Plagionotus, and Metalia; Meoma and Linthia; Agassizia, Prenaster, and Periaster; Gualteria and Brissopsis; Tripylus, Desoria, Abatus, and many others, must be re-examined and critically revised before we can attempt an arrangement of Spatangoids into natural families.

The subordinal divisions usually adopted since their introduction by Albin Gras do not seem satisfactory, if tested by our present information. In the first place, the whole classification is based upon the separation of the anus from the abactinal system. From what the Embryology of Echini has taught us, the position of the anus has not the physiological importance attributed to it by authors who have so generally received this classification. The unstable position it occupies in the same animal at different stages of growth — at one stage opening next to the mouth, then on the margin, and finally opening in the central part of the apical system in the adult — should make us hesitate to adopt a single anatomical feature as our sole guide. In the first place the order of Perischœchinidæ, a most natural one, is founded upon characters derived from the structure of the interambulacral and ambulacral systems. The other two suborders, regular and irregular, usually recognized, can scarcely be called natural. The suborder of regular Echini is more satisfactory than the other, though, from what I have said of the Galerites with teeth, I should be inclined to add them to the suborder as one of its three subdivisions, which, as here limited, are the Cidaridæ, the Echinidæ proper, and the Galerites. The suborder of "irregular" Echini, after the withdrawal of the Galerites, still contains the Clypeastroids. From the structure of the ambulacral system, they have some affinity with the Spatangoids; yet the presence of partitions and teeth, combined with petaloid ambulacra, seem to constitute good subordinal characters for the Clypeastroids as contrasted with the Spatangoids proper, which include all edentate forms, taking in also the edentate genera formerly placed among Galerites as well as the Cassidulidæ, sometimes regarded as independent suborders.

III. *Bathymetrical and Geographical Distribution.*

The accompanying table (pp. 298 and 299) shows at a glance the principal features of distribution of the different zones of depth. We can distinguish a strictly littoral fauna, extending from tide-mark to generally less than 10 fathoms, though a few of the species characteristic of this zone extend to a depth of 34 and 40 fathoms. This fauna consists of

Diadema antillarum.
Echinometra Michelini.
" viridis.
Lytechinus variegatus.
Tripneustes ventricosus.
Clypeaster rosaceus.
Stolonoclypus Ravenellii.
Mellita testudinata.
Encope Michelini.
" emarginata.
Echinoneus semilunaris.
Brissus columbaris.

A second set of species, less numerous, extends from the shore to a much greater depth, — from 80 to about 120 fathoms. They are

Cidaris annulata.
Echinocidaris punctulata.
Meoma ventricosa.
Plagionotus pectoralis.
Mœra atropos.

At a depth of 30 to 40 fathoms commences a third set of species, the majority ranging to about 160 fathoms, though two species range to 270 fathoms, marked *, and a few species commence at a greater depth, 80 to 90 fathoms. These species are

* Dorocidaris abyssicola.
Echinus gracilis.
Genocidaris maculata.
* Trigonocidaris albida.
Rhyncholampas caribbæarum.
Echinolampas caratomoides.
Neolampas rostellatus.
Brissopsis lyrifera.
Agassizia excentrica.
Echinocardium ovatum.
" lævigaster.
" Kurtzii.
Schizaster cubensis.

At a depth of about 140 fathoms, extending to over 310 fathoms, are found most interesting species:

Cænopedina cubensis.
Podocidaris sculpta.
Echinus Flemingii.

While near the lowest depth reached by the above species we strike upon a peculiar fauna recalling types of the cretaceous period, extending from 315 fathoms to the greatest depth attained in the straits between Florida and Cuba. These are

Salenocidaris varispina.
Pourtalesia miranda.
Lissonotus fragilis.

Two species — Stolonoclypus prostratus and Mellita hexapora — have the greatest bathymetrical range, extending from the shore, the one to 270 fathoms and the other to 325 fathoms. I would state, however, that it is only the young which have this great range; the adult specimens are limited to a quite shallow zone, — about 40 fathoms. In the young of our common northern Cuvieria the reverse takes place, the young being quite common at low-water-mark, while young Echinarachnius and T. drobachiensis are found at a much greater depth than the adult. I

NOTE. — Figures denote depth in fathoms; range of a species is indicated by the horizontal lines; thus, 138——270 in Cænopedina shows its range from 138 to 270 fathoms. Figures at head of column to be taken, where no others are given.

	Lit.	10	20	40	60	80	100	120	140	160	180	200	220	240	260	280	300	320	340	360	380
Cidaris annulata GRAY	—	—	—	—	—	—	—	116													
Dorocidaris abyssicola A. AG.					—	—	—	—	—	—	—	—	—	—	—	270					
Salenocidaris varispina A. AG.																		315			
Diadema antillarum PHIL.	—	—	17																		
Cænopedina cubensis A. AG.									138	—	—	—	—	—	—	270					
Echinocidaris punctulata DESML.	—	—	—	—	—	—	—	—	125												
Podocidaris sculpta A. AG.									138	—	—	—	—	—	—	—	—	315			
Echinometra Michelini DES.	—7																				
" viridis A. AG.	—7																				
Echinus gracilis A. AG.							93	—	—	—	—	—									
" Flemingii BALL												195									
Genocidaris maculata A. AG.			30	—	—	—	—	—	—	—											
Trigonocidaris albida A. AG.					—	—	—	—	—	—	—	—	—	—	—	270					
Lytechinus variegatus A. AG.	—	—	—	34																	
Tripneustes ventricosus AG.	—																				
Clypeaster rosaceus LAM.	—5																				
Stolonoclypus prostratus AG.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	325		
" Ravenellii A. AG.	—	—	—	34																	

	Lit.	10	20	40	60	80	100	120	140	160	180	200	220	240	260	280	300	320	340	360	380
Mellita testudinata KL.	—7																				
" hexapora AG.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	270					
Encope Michelini AG.		11																			
" emarginata AG.	—7																				
Echinoneus semilunaris LAM.	—																				
Echinolampas caratomoides A. AG.				35	—	—	—	—	—	160											
Rhyncholamaps caribbæarum A. A.						106															
Neolampas rostellatus A. AG.							—	—	125												
Pourtalesia miranda A. AG.																				349	
Lissonotus fragilis A. AG.																		—	—	—	368
Brissus columbaris AG.	—																				
Meoma ventricosa LÜTK.	—	—	—	—	—	—	85	115													
Plagionotus pectoralis AG.	—	—	—	—	—	—	—	—	—	156											
Brissopsis lyrifera AG.				55	—	—	—	115													
Agassizia excentrica A. AG.			36	—	—	—	—	—	128												
Echinocardium ovatum GRAY.						79	—	—	121												
" lævigaster A. AG.						79	—														
" Kurtzii GIR.	—	—	—	—	—	—	85														
Schizaster cubensis D'ORB.							—														
Mœra atropos MICH.	—	—	—	—	—																

have given the greatest depth of living young, as the dead tests may have been dropped by fishes or carried by currents. The character of the Echinian fauna, on the three belts developed by the soundings of Mr. Pourtales, are tolerably well defined; the first zone being littoral, and extending to 90 fathoms, is characterized by species, the majority of which do not range beyond 40 fathoms, with a few species ranging somewhat beyond, to about 120 fathoms.

The second zone (from 90 to 250 fathoms) is characterized by species extending into the first somewhat and attaining a range of about 270 fathoms, with an admixture of a few species extending from 140 to 310 fathoms.

The third zone contains the typical deep-sea species of Florida, extending from 315 to 500 fathoms.

Although we have not a sufficient number of soundings to establish homogeneous zones of geographical and bathymetrical range, an analysis of the above grouping of species shows us something analogous to the distribution of animal and vegetable life in latitude and height; the oceanic distribution being of course an identity for northern latitudes and southern depth, or a representation by species closely allied.

For instance, we find littoral, as far north as North Carolina, Mœra atropos, Echinocardium Kurtzii, and as far as the southern part of Cape Cod Echinocidaris punctulata, species which in Florida have a range in depth to 125 fathoms. Of their range further north we know nothing.

The following North-European species — Cidaris papillata, Schizaster fragilis, Echinus Flemingii, Echinocardium ovatum, E. cordatum, Echinocyamus? pusillus, Brissopsis lyrifera — are represented by their allies or by the identical species: viz. Dorocidaris abyssicola, Schizaster cubensis, Echinus gracilis, E. Flemingii, Echinocardium ovatum, E. Kurtzii, Stolonoclypus prostratus, Brissopsis lyrifera, which have a range somewhat more extensive than the previous species. These same species, with the addition of Brissus columbaris, Echinocardium lævigaster, Diadema antillarum, and Echinocidaris punctulata, are again the representatives of a Mediterranean fauna strikingly similar, consisting of Cidaris hystrix, Schizaster canaliferus, Echinus melo, Echinocardium cordatum, Echinocyamus? pusillus, Brissopsis pulvinata, Brissus Scillæ, Echinocardium gibbosum, Diadema europæum, Echinocidaris æquituberculata. The specific representation on both sides of the Isthmus of Panama is becoming every day, as far as Echinoderms are concerned, more strikingly identical. Since the list given by Mr. Verrill, several species have come to light, and the following comparative list of species on both sides of the Isthmus, extending from Peru to the Gulf of California on the Pacific, and including on the Eastern side the Gulf of Mexico, Florida, the northern coast of South America, the West Indies and Bahamas, may not be out of place. (I have examined all the species here named.) This list would undoubtedly be greatly increased by additional dredging.

Eastern Fauna. (*Caribbean.*)	Western Fauna. (*Panamic.*)
Cidaris annulata Gray	Cidaris Thouarsii Val.
Dorocidaris abyssicola A. Ag.	
Salenocidaris varispina A. Ag.	
Diadema antillarum Phil.	Diadema mexicanum A. Ag.
	Astropyga venusta Ver.
Cænopedina cubensis A. Ag.	
Echinocidaris punctulata Desml.	Echinocidaris stellata Ag.
Podocidaris sculpta A. Ag.	
Echinometra Michelini Des.	Echinometra Van Brunti A. Ag.
" viridis A. Ag.	" rupicola A. Ag.
Echinus gracilis A. Ag.	
" Flemingii Ball.	
Genocidaris maculata A. Ag.	
Trigonocidaris albida A. Ag.	
	Toxocidaris mexicana A. Ag.
Lytechinus variegatus A. Ag.	Lytechinus semituberculatus A. Ag.
	Psammechinus pictus Ver. is the young.
	Boletia rosea A. Ag.
Tripneustes ventricosus Ag.	Tripneustes depressus A. Ag.
Clypeaster rosaceus Lam.	
Stolonoclypus prostratus Ag.	
" Ravenellii A. Ag.	Stolonoclypus rotundus A. Ag.
Mellita testudinata Kl.	Mellita longifissa Mich.
" hexapora Ag.	" pacifica Ver.
Encope Michelini Ag.	Encope grandis Ag.
" emarginata Ag.	" micropora Ag.
	Echinoglycus Stokesi Gray.
Echinoneus semilunaris Lam.	
Echinolampas caratomoides A. Ag.	

Eastern Fauna.	Western Fauna.
Rhyncholampas caribbæarum A. Ag.	Rhyncholampas pacificus A. Ag.
Neolampas rostellatus A. Ag.	
Pourtalesia miranda A. Ag.	
Lissonotus fragilis A. Ag.	
	Lovenia sp.
Brissus columbaris Ag.	Brissus obesus Ver.
Meoma ventricosa Lütk.	Meoma grandis Gray.
Plagionotus pectoralis Ag.	Plagionotus nobilis A. Ag.
Agassizia excentrica A. Ag.	Agassizia scrobiculata Val.
Brissopsis lyrifera Ag.	
Echinocardium ovatum Gray.	
" lævigaster A. Ag.	
" Kurtzii Gir.	
Schizaster cubensis D'Orb.	
Mœra atropos Mich.	Mœra clotho Mich.*

With the exception of three Panama species, all the West Coast species have representatives on the Eastern Coast. The Eastern species which have not as yet been found represented on the West Coast are the deep-water species of Mr. Pourtales's collection, and, what is very peculiar, a few species, like Clypeaster rosaceus, Echinoneus semilunaris, Echinocardium Kurtzii, and Echinolampas, belonging to genera which have a most extensive range, — in fact, an almost cosmopolitan one, — are found everywhere in the great Indo-Pacific belt, and its continuation on the West Coast of Africa, extending also to the temperate zones, on both sides of this equatorial belt.

The relation of the Caribbean Fauna with the existing geographical distribution of Echini is shown by the accompanying faunal table (p. 303), including only strictly representative species.

We have in Genocidaris maculata and Trigonocidaris albida representatives of the Temnopleuridæ, thus far limited almost entirely to the Indian and China seas. The littoral species having the most limited bathymetrical range are those which have the widest geographical distribution. They are Tripneustes ventricosus, Diadema antillarum, Cidaris annulata, Echinometra Michelini, Lytechinus variegatus, Mellita testudinata, Encope emarginata. Some of these species extend from the southern part of Brazil to the Bermudas. They all belong to

* Astriclypeus Manni Verrill is found in Japan. Mr. Verrill did not know the exact origin of his specimen.

Caribbean.	Panamic.	Europ. Boreal.	Mediterranean.	Senegal.	Indo-Pacific.	Chinese.	Japanese.	Patagonian.
Cidaris annulata Gray	*			i.	*			
Dorocidaris abyssicola A. Ag.		*	*		*			*
Salenocidaris varispina A. Ag.								
Diadema antillarum Phil.	*		*	*	*	*	*	
Cænopedina cubensis A. Ag.								
Echinocidaris punctulata Desml	*		*	*				
Podocidaris sculpta A. Ag.								
Echinometra Michelini Des.	*			*	*		*	
" viridis A. Ag.	*				*			
Echinus gracilis A. Ag.		*	*					
" Flemingii Ball		i.	i.					
Genocidaris maculata A. Ag.							*	
Trigonocidaris albida A. Ag.						*		
Lytechinus variegatus A. Ag.	*				*			
Tripneustes ventricosus Ag.	*				*		*	
Clypeaster rosaceus Lam.				*				
Stolonoclypus prostratus Ag.		*	*		*		*	
" Ravenellii A. Ag.	*							
Mellita testudinata Kl.	*							
" hexapora Ag.	*							
Encope Michelini Ag.	*							
" emarginata Ag.	*							
Echinoneus semilunaris Lam.					*		*	
Echinolampas caratomoides A. Ag.				*	*			
Rhyncholampas caribbæarum A. Ag.	*							
Neolampas rostellatus A. Ag.								
Pourtalesia miranda A. Ag.								
Lissonotus fragilis A. Ag.								
Brissus columbaris Ag.	*		*		*			
Meoma ventricosa Lütk	*							
Plagionotus pectoralis Ag.	*							
Brissopsis lyrifera Ag.		i.	*		*			*
Agassizia excentrica A. Ag.	*							
Echinocardium ovatum Gray		i.	i.					
" lævigaster A. Ag.			*					
" Kurtzii Gir.		*	*				*	
Schizaster cubensis D'Orb.		*	*		*			
Mœra atropos Mich	*							

Note. — *i* denotes identity of species; * denotes representative species.

genera having representatives in the great tropical belt surrounding the globe, formed by the Indo-Pacific, Mediterranean, Senegalian, West Indian, Panamic, and Polynesian faunæ, — such as Cidaris, Diadema, Echinometra, Tripneustes, Clypeaster, Stolonoclypus, Echinolampas, Echinoneus, Brissus, the species of which have a great geographical range, and are represented by the following species: —

Cidaris metularia, Tripneustes sardicus, Echinometra lucunter, Diadema Savignyi, Clypeaster Rangianus, Stolonoclypus placunarius, Echinolampas oviformis, Echinoneus cyclostomus, Brissus carinatus, all of which have an immense geographical distribution.

The effect which currents play in shaping the geographical distribution of marine animals is very great; we have an example in the Gulf Stream and the northern branch of the Amazonian current flowing into the Gulf of Mexico, which account fully for the great range of the more common littoral species. The Japanese current makes itself felt as far as San Diego, two species of Echini extending in the Northern Pacific from the northern part of Japan along Kamtchatka, the Aleutian Islands, Sitka, Vancouver's Island, the one as far as Cape Mendocino (T. drobachiensis), the other (Dendraster excentricus) to San Diego. The Indo-Pacific equatorial current has undoubtedly been the main agent of the extensive geographical range of such species as Cidaris metularia, Echinoneus cyclostomus, Heterocentrotus mammillatus, Diadema Savignyi, Tripneustes sardicus, Echinolampas oviformis, Brissus carinatus, Stolonoclypus placunarius.

The effect of currents in thus extending the distribution of marine animals would act very differently upon the several classes of the animal kingdom, and its efficiency depends to a great extent upon the nature of their earlier stages, and upon their habits during that period. The time during which the Pluteus of Echini remains helpless at the mercy of the currents is considerable: from early spring till late in the summer is the usual time required for the full growth of the Pluteus in many species of Sea-urchins, and the distance which the young could thus be transported, even by a sluggish current, during a single season, must be considerable, even under the most unfavorable circumstances.

Various writers have attempted to retrace, in former geological periods, the probable course of the currents and their effect upon the geographical distribution of marine animals; they all agree in representing up to the cretaceous period an unbroken equatorial current, passing through Central Asia, Arabia, the northern part of Africa, and connecting with the Pacific by a narrow strait through the Isthmus of Panama. The existence of this connection in the cretaceous period is placed beyond doubt by the presence of an Ananchytes, which I am unable to distinguish from Ananchytes radiata, collected on the Isthmus of Panama, and now in the Museum of Yale College, kindly loaned me for examination by Professor Verrill. From the small number of identical species, either of Mollusca, Crustacea, or Fishes, recorded on both sides of the Isthmus, this connection must have been very imperfect at a comparatively recent geological period, — since the existence of the present Faunæ.

The question naturally arises, Have we not in the different Faunæ of both sides of the Isthmus a standard by which to measure the changes which these species have undergone since the raising of the Isthmus of Panama and the isolation of the two Faunæ? If the upheaval of the isthmus has been gradual, it must, of course, have cut off the deep-water species on both sides of the isthmus, and gradually have isolated the more shallow, till the littoral species also became separated. As a natural consequence, the deeper we go, the farther back in time we must expect to find the representation, — a result which is strikingly confirmed by the nature of the deep-water Fauna of the West Indies. Unfortunately we have not, as in the case of the littoral Faunæ, a standard of comparison. At the same time, with the gradual closing of the Isthmus of Panama, the greater part of Central Asia, of the Arabian Peninsula, and of Northern Africa was emerging from the sea, reducing the range of the equatorial current, and thus confining the course of the currents much as they are at the present time. This would thus cause a limitation in the range of the species formerly having the greatest distribution, and extend that of those which were more local.

If migration on land when continents were joined together, and subsequent variations after their isolation through submergence, has been the main agent in the distribution of the existing terrestrial Faunæ, we must acknowledge a similar agency to currents in the distribution of marine Faunæ; and by the submergence or rise of various portions of the continents, we shall be able, if we can trace these changes, to reconstruct within certain limits the altered courses of the main oceanic currents, and get some idea of the probable geographical distribution at different geological epochs. The greater the bathymetrical range of littoral species, the longer will such species remain unaffected, while deep-sea species may early become isolated and remain as outliers as it were, — mementos of a former condition of currents, or even of a previous geological period. The careful analysis of the Fauna of a given point, its comparison with other Faunæ, and accurate bathymetrical data, would go far towards reconstructing the Natural History of the sea in former ages, and showing its relation to the present and past times.

The representative species of Echini, Echinocardium, Psammechinus, Schizaster, in the Arctic and Antarctic boreal zones would be considered as the living representatives of a cosmopolitan Fauna existing at the time when the great equatorial current flowed unbroken round the globe, sending branches north and south along Eastern North and South America, along Eastern Japan and Australia, and the eastern coast of Africa; while the tropical species of the genera Diadema, Clypeaster, Echinoneus, Echinolampas, &c., existing at that time, had a more limited equatorial geographical distribution. The subsequent period of isolation of Atlantic and Pacific currents is shown by the existence of truly Atlantic and Pacific species; while as we go down in depth we go back also in time, and find at first representatives of the genera found in our Tertiaries, while at greater depth the species are representatives of genera found in the Cretaceous. A more detailed comparison than can be given here of the Caribbean Fauna, with the fossils of the tertiary and cretaceous deposits of our coasts, would be most interesting; but unfortunately the materials thus far collected are too fragmentary, and we must await a careful geological survey, accompanied by deep dredgings of a considerable extent of coast, before we shall have the data needed to follow up the important results to be gained in this way for palæontology and geography, of which our present incomplete materials give us such an interesting glimpse.

IV. *List of the Star-fishes.*

Asterina minuta GRAY, Synopsis; Ann. Mag. Vol. VI, 1841

Syn. Asteriscus brasiliensis LÜTK., Vidensk. Medd. 1859.
" stellifer MÖB., Neue Seesterne.
Littoral, to 7 fathoms.

Pteraster militaris M. T., Syst. d. Asteriden.

From 120 to 125 fathoms.

Pentaceros gigas AG.

Syn. Pentaceros grandis, reticulatus, gibbus GRAY, Synops.
Oreaster reticulatus, O. aculeatus, M. T., Syst.
Oreaster gigas LÜTK.
Littoral, to 128 fathoms.

Astropecten antillensis LÜTK.

Littoral, to 147 fathoms.

Astropecten articulatus LÜTK., Vidensk Med. 1864.

Syn. Asterias articulata SAY., Journ. Acad. Nat. Sciences, Phila. 1825.
Littoral, to 5 to 6 fathoms.

Astropecten variabilis LÜTK.

Littoral, to 7 fathoms.

I have thus far only met with three species of Astropecten from Florida and the West Indies, though as many as six or seven nominal species are known. The names of Lütken are given for want of authentic specimens of the others.

Luidia clathrata LÜTK.

Littoral, to 101 fathoms.

Luidia alternata LÜTK.

40 fathoms.

Ophidiaster (Linckia LÜTK.) **ornithopus** VAL.

Syn. O. ornithopus M. T., Syst. d. Ast.
" " LÜTK.
Littoral, to 26 fathoms.

Ophidiaster flaccidus LÜTK.

Littoral, to 123 fathoms.

Othilia spinosa GRAY, Synops.

Syn. Echinaster spinosus M. T., Syst.
Littoral, to 6 fathoms.

Othilia braziliensis AG.

Syn. Echinaster braziliensis M. T., Syst.
Littoral, to 5 or 6 fathoms.

Asteracanthion mexicanum LÜTK.

From 80 to 120 fathoms.

Asteracanthion tenuispinum LÜTK.

Syn. Asterias tenuispina LAM.
Asterias atlantica VER., Trans. Con. Ac.
From 120 to 174 fathoms.

With the exception of the Pteraster and Asteracanthion tenuispinum, the bathymetrical and geographical distribution of the Star-fishes does not show any striking features. The presence of a northern and of a Mediterranean species in Florida is fully in accordance with the results derived from other classes; as with Echini and Ophiurans, we find the young in much deeper water than the adults. This is particularly well shown in a series of Pentaceros gigas; the smallest specimens (Pteraster-like in shape) are from 128 fathoms, more advanced stages (Goniodiscus-like) are from 68 fathoms, a still more advanced stage from 42 fathoms. The same is the case with Luidia clathrata and Astropecten antillensis.

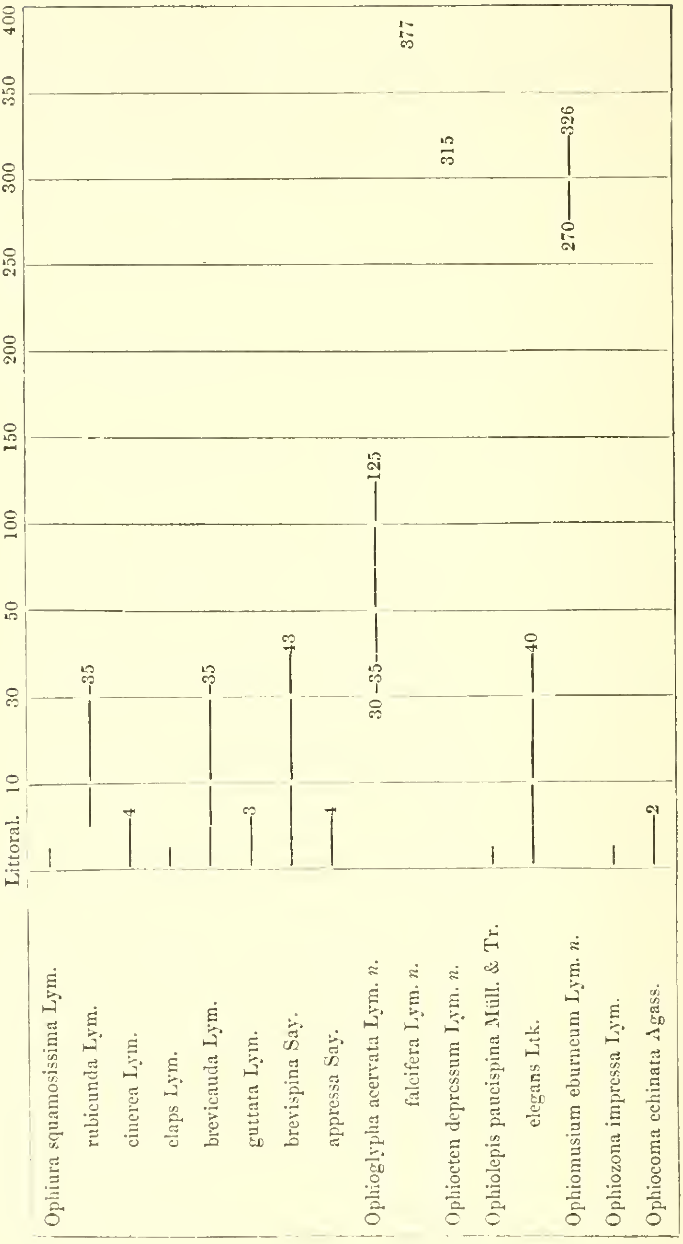
CAMBRIDGE, October, 1869.

No. 10. — *Preliminary Report on the Ophiuridæ and Astrophytidæ dredged in deep water between Cuba and the Florida Reef, by* L. F. DE POURTALES, Assist. U. S. Coast Survey. Prepared by THEODORE LYMAN.

(COMMUNICATED BY PROFESSOR B. PEIRCE, SUP'T U. S. COAST SURVEY.)

I. *General Remarks.*

FROM the small circle of the Caribbean waters there are now known sixty-three species of Ophiurans and Astrophytons, nearly all of which are critically determined. The standard work of Müller and Troschel, published in 1842, did not contain a greater number of well-defined species from the whole world! Considering their number and their bathymetric range (which goes nearly to 400 fathoms) we are justified in looking upon their faunal data as of real importance. First, then, considered within their own peculiar sea dominion, to what depths do these species descend, and to what shallows do they rise? A glance at the following table will reply. Those species with which naturalists have been most familiar as "West Indian" are pretty much *littoral.* The abundant forms of *Ophiocoma echinata*, *Ophiura cinerea*, *Ophiactis Mülleri*, &c., swarm among the sponges and madrepores of the warm shallows. A few descend to 35 or 40 fathoms, as if to reach a hand to their deep-sea relations; such are *Ophiura brevispina* and *Ophiolepis elegans;* there are even two, *Ophiostigma isacanthum* and *Amphiura tenera*, that have been found respectively at 75 and 128 fathoms. But these are exceptions, for if the dredge sometimes brings up a littoral brittle-star, it is a straggler and not an inhabitant. Between 15 and 75 fathoms there is a mixed region where dwell the more venturesome of the littoral species and certain new-comers, that either recall the European fauna (*Ophioglypha acerrata*) or seem a continuation of the littoral types (*Ophiactis plana*, *Ophiocnida olivacea*). It is below 100 and even 200 fathoms that the really *new* types are found. The seven new genera herein described have all a maximum depth of more than 100 fathoms, and only one, *Ophiothamnus*, runs into less than 75 fathoms. All the species below 250 fathoms are either of new genera, or are singular forms of old genera (*Ophioglypha falcifera*,



The *horizontal* lines show the range of the species in depth.

	Littoral.	10	30	50	100	150	200	250	300	350	400
Ophiocoma Riisei Ltk.	–										
pumila Ltk.	–										
Ophioblenna antillensis Ltk.	–										
Ophiacantha { meridionalis Lym. *n.* = (O. pentacrinus Ltk. ?) }							237—	———	——327		
Ophiomitra valida Lym. *n.*					120–130						
sertata Lym. *n.*									315		
Ophiostigma isacanthum Lym.	———	———	—36——	——75							
Ophiochondrus convolutus Lym. *n.*								270			
Ophiactis Krebsii Ltk.	———	-12——	—35								
Mülleri Ltk.	–										
humilis Lym. *n.*					125——	———	———	———	——324		
loricata Lym. *n.*					110						
plana Lym. *n.*		-13-17—	———	———	-117-140						
Amphiura Riisei Ltk.	——4										
gracillima Ltk.	–										
Stimpsonii Ltk.	———	-13									

	Littoral.	10	30	50	100	150	200	250	300	350	400
Amphiura tenera Ltk.	–4—	—	—	—	–117–128						
grandisquama Lym. *n.*						174					
semiermis Lym. *n.*										377	
pulchella Lym. *n.*			39								
Ophiophragmus septus Lym.	–										
Wurdemani Lym.	–										
Ophiocnida scabriuscula Lym.	–										
olivacea Lym. *n.*			40—	—79—	–117						
Ophionephthys limicola Ltk.	–2										
Ophionema intricata Ltk.	–2										
Ophiothamnus vicarius Lym. *n.*		15—	—	—	–117–135						
Ophionereis reticulata* Ltk.	–3—	—	—35								
Ophiopsila Riisei Ltk.	—	—15									
Ophiomyces mirabilis Lym. *n.*							237—	—	—320		
frutcetosus Lym. *n.*				77—	—	—160					
Ophiothrix violacea Müll. & Tr.	—	—	—45								

* Prof. Verrill has shown (Proceed. Boston Soc. Nat. Hist. XII, 381, 1869) that *O. porrecta* is from the Pacific islands. I am therefore inclined to think that this species, with *O. crassispina* Ljn. and *O. squamata* Ljn., may all be synonymes of *O. dubia* Lym. (Savigni, Descr. de l'Egypte, 1809, Pl. I, Figs. 3[1] to 3[10]).

	Littoral.	10	30	50	100	150	200	250	300	350	400
Ophiothrix Örstedii Ltk.	-										
Suensonii Ltk.	———	-12									
lineata Lym.	-										
Ophiomyxa flaccida Ltk.	———	———	—36								
Ophiocreas lumbricus Lym. *n.*					125—130						
Astrophyton costosum Seba.	———	-12									
arborescens Müll. & Tr.*	(Range ?)										
cœcilia Ltk.	-										
Krebsii Ltk.				50							
mucronatum Lym. *n.*					120-125						
Astrogomphus vallatus Lym. *n.*				94-	—119						
Astroporpa annulata Örst. & Ltk. †				50							
affinis Ltk.	-										
Astroschema oligactes Ltk.		20									
Hemieuryale pustulata Martens.	[Locality ?]										

* At the Jardin des Plantes are two Astrophytons, brought the one from the Antilles by Maugé, 1799; the other from Guadaloupe, by Beaupertuis, 1837. They are of the same species; and I could detect no difference between them and a specimen of *A. arborescens* from the Mediterranean.

† Dujardin and Hupé (Hist. Nat. des Zoophytes, 1862) speak of *Astroporpa dasycladia*, in the Jardin des Plantes, as a new species. I saw these specimens in 1861, and they are nothing but *A. annulata*; also their *Astroschema affinis* is too dubious to be admitted.

Ophiactis humilis, &c.). If, therefore, these zones of sea bottom were to-morrow turned to stone, we should find a certain separation of species, but there would be *overlapping* species that would connect the fossils, as of one formation. Such are the *vertical* relations. The horizontal relations can only partially be known, except in the direction of the European coast, because there have been no considerable dredgings on the American side, either to the north or the south, and comparisons must be made only with the littoral forms. It is well known that a few of the Florida Ophiurans (*Ophiactis Krebsii*, *Ophiolepis elegans*, &c.) have been found as far as Charleston, S. C., while in the direction of Brazil many species are found (*Ophiomyxa flaccida*, *Ophiactis Krebsii*, *Ophionereis reticulata*, *Ophiothrix violacea*, *Ophiolepis paucispina*, *Ophiura cinerea*, *O. appressa*, *Amphiura Riisei*, *Ophiopsila Riisei*). One species, *Hemipholis cordifera*, has been collected in Charleston and in Rio, but not yet between those points.

Naturalists seem to overlook the fact, that, although the edges of the Caribbean fauna spread thus wide, they encounter two other faunæ, north and south. At Charleston, *Ophiothrix angulata* and *Amphiura atra* are forms not seen on the Florida coast, while at Rio the *Ophiura Januarii*, *Ophioceramis Januarii*, and several species of *Amphiura* attest a region of new marine life. It is already well known that the littoral Ophiuran faunæ of North and Middle Europe and the Gulf of Mexico are not comparable with each other, even the genera being often different. How is it with the deep-sea forms? One species is *identical*, — *Ophiomyces frutectosus*, — and this, strangely enough, was never seen by human eye until within a few months. Two other species *may* be identical, — *Astrophyton arborescens* and *Amphiura tenera* (= *elegans*?). One species is, in the true sense, *representative*, — *Ophioglypha acervata* (comp. *O. albida*). The remaining fifty-nine species are, so far as we now know, Caribbean. As to the Panama fauna, the similarity between the opposite sides of the Isthmus has already been shown by Lütken, Verrill, and myself. The correspondence of the twelve twin species shown in the following table is something more than casual: —

Caribbean Fauna.	Panama Fauna.
Ophiura cinerea Lym.	Ophiura teres Lym.
Ophiolepis elegans Ltk.	Ophiolepis variegata Ltk.

Caribbean Fauna.	Panama Fauna.
Ophiozona impressa Lym.	Ophiozona pacifica Lym.
Ophiocoma pumila Ltk.	Ophiocoma Alexandri Lym.
Ophiactis Krebsii Ltk.	Ophiactis virescens Örst. and Ltk.
	Amphiura violacea Ltk.
Amphiura tenera Ltk.	" puntarenæ Ltk.
	" microdiscus Ltk.
Amphiura Riisei Ltk.	Amphiura grisea Ljn.
Ophiophragmus septus Lym.	Ophiophragmus marginatus Lym.
Ophiocnida scabriuscula Lym.	Ophiocnida hispida Lym.
Hemipholis cordifera Lym.	Hemipholis affinis Ljn.
Ophionereis reticulata Ltk.	Ophionereis annulata Lym.
Ophiothrix violacea M. and T.	Ophiothrix spiculata LeC.

How is it that the vast Pacific fauna, common to the waters between Zanzibar and the Sandwich Islands and between Loo Choo and the Kingsmill group, changes its character near Panama, and takes on a *partial* Caribbean form? We might think that the mingling of the two oceans, before the upheaval of the isthmus, was the origin, and that the differences between these species was the measure of their variation since the cretaceous period. But then the Caribbean forms appear on the Pacific side, while the Pacific forms seem not to come over; and no matter whether there is or is not a difference of level between the oceans, it would scarcely have availed to prevent a mixture in *both* directions by storms, or by currents. It is also perfectly credible that water-birds should mix the faunæ across an isthmus which has a minimum width of twenty-eight miles, just as they convey fish eggs to distant and isolated ponds. But again there is the same objection as before. I must therefore content myself with saying that of these twelve pairs of species there are several that would probably be considered only as *varieties*, if they lived in the same waters. Speculation is, after all, of small value, because the facts are insufficient, and because there is a prospect of getting many more facts. For example, all the diligent dredging on the European coasts had failed to show a species of brittle-star identical with the Caribbean; but, almost at the same time, two expeditions bring up, from a depth of only 75 fathoms, a species new to science and common to the two sides of the warm Atlantic. Such is the value of negative evidence!

II. *Descriptions of New Genera and Species, with Critical Remarks.*

Here follow descriptions of seven new genera and twenty-one new species. There were, besides, two specimens of *Ophiothrix*, brought up from 110 and 206 fathoms. The one had the disk completely hidden by little thorny stumps, showing only the points of the radial shields; the arm-spines were long, slim, and very jagged; the other specimen had a small, compact disk, with naked radial shields spotted with green, and green cross lines on the arms; in the centre of the disk, spines; arm-spines short and very jagged. Both were young, and I did not choose to add to the present complication of this difficult genus by describing them. The *Ophiothrix violacea* displays certain variations at a depth that are not seen in shallows, but I believe the species is the same. There also were two species of *Amphiura*, probably new, but too imperfect to describe; and one soft-bodied little thing that may be the young of *Ophiomitra*, or may be new.

OPHIURIDÆ.

Ophioglypha acervata Lyman, sp. nov.

Special Marks. — Three arm-spines of unequal lengths; the middle one commonly shortest; towards the tip of the arm the spines are longer as compared with the side arm-plates. Under arm-plates with a peak or point without. Those papillæ of the "arm-comb," which are beneath the disk, are flat and square, so as to form an even close-set row.

Description of a Specimen. — Diameter of disk 9 mm. Length of arm (broken) about 40 mm.* Mouth papillæ seven to each angle, of which the innermost is central, lying just below the teeth, and of similar form, so that it might as properly be considered a true tooth; the mouth-papilla on each side is of the same shape, but the two outer ones are flattened, angular, much wider than long, with a cutting edge re-enteringly curved, or notched. Teeth three, four, or even five, shaped like a blunt spear-head, swelling in the middle, and rounded. Mouth-shields as long as broad; broader without than within; outer side cleanly curved, inner side making an angle; length to breadth 1.8 : 1.8. Side mouth-shields narrow, and of equal width, meeting within, and thence running along the inner angle of the mouth-shield to the head of the genital slit. First under arm-plate as

* The arm is doubtless much longer than this, usually. In some smaller specimens it ran out in a thread-like way, something after the manner of *O. robusta*.

large as any; broader than long; of a rounded diamond-shape, with a distinct, rounded peak without; length to breadth .6 : .9. Second plate touching the first; third plate barely separated from the second by the juncture of the under arm-plates; fourth plate well separated from its successor, as are all those beyond. Fifth plate bounded within by two re-entering curves, which come to a point on the median line; without, it has a little peak in the centre which gives it a faintly *tri-lobed* appearance; the laterals are short and straight; length to breadth .5 : .8. The plates beyond this one have a similar form, but continually grow smaller by the increased encroachment of the side arm-plates. Side arm-plates meet below at the third under arm-plate; and, above, at the ninth upper arm-plate: their upper edges are re-enteringly curved, which gives a peculiar shape to the upper arm-plates. These last are, near the disk, broader without than within, with a strongly curved and thickened outer side; and their laterals are curved by reason of the peculiar form of the side-plates; further out, where they do not touch each other, they come to a point, within; length to breadth (sixth plate) .8 : .7. Disk, above, covered with crowded, irregular, flattened scales, none of which are much swelled, so that the surface is nearly smooth. The primary plates are not conspicuous either by size or thickness, except the central one, which is very distinct, nearly round, and .6 mm. in diameter. Radial shields large, thick, and conspicuous; irregular pear-seed shape, and strongly diverging; length to breadth 2 : 1.4; they are entirely separated by a very irregular wedge of scales, which sometimes consists of a double row; sometimes of a mixture of a single and double row, respectively of larger and smaller scales. The large, thick radial-scales carry all the papillæ of the arm-comb, which are about twenty in number on each side and of two sorts; those seen from above are sharp and diverge from each other; those seen from below are flat and square, so as to form an even, close-set row; there are about ten of each kind, and those at the ends of the row differ most. The arm-comb is continued, along the edge of the genital slit, by a row of about seventeen very fine papillæ. On the upper arm-plates within the notch is a row of fine papillæ corresponding to those of the arm-comb. The scales of the interbrachial spaces below are thin and crowded. Arm-spines cylindrical, blunt, scarcely tapering; lengths to that of the under arm-plate (eighth joint) .4, .2, .3 : .5. Further out on the arm they are proportionately much longer, and towards the last third of the length the lowest spine is nearly or quite as long as the side arm-plate; there, also, they are more slender, and taper to a fine point. Twelve tentacle scales on the first pore, seven being on the side next the interbrachial space; six scales on the second pore; five on the third; four on the fourth; three on the fifth; two on the sixth; and one scale on the joints beyond that.

Color, in alcohol, light gray.

Variations. — A specimen with a disk of 6 mm. had the arm-spines nearly equal (the lowest rather shortest), and three fourths as long as the side arm-plate. In general the middle spine is shortest, but in a considerable series examined numerous variations were to be seen; rarely, the spines on some part of the arm were equal; yet, even then, they would be of unequal lengths on other parts. A specimen with a disk of 3 mm., had the under arm-plates comparatively smaller, but still exhibiting in one way or another the characteristic peak or lobe on the outer side; the fourth plate was broad, regular, heart-shape, but with a little point within where the outer sides of the side arm-plates joined on the median line; the tenth plate was similar, but the outer side being wavy gave greater distinctness to the little lobe; on the upper surface of the disk, a greater proportionate space was occupied by the primary plates, though none of them touched each other; the radial shields were quite separated by two large rounded plates; the notch of the disk only included a part of one upper arm-plate, and the side arm-plates met above, at the third joint from the disk. In a very young specimen, having a disk only 1 mm. in diameter, nearly all the surface of the upper disk was covered by six large, round primary plates, one in the centre and one opposite each arm; immediately round the centre plate were five small ones, situated opposite the interbrachial spaces; over each arm were two very small radial shields like scales, and, in the interbrachial space, on the edge of the disk, a large plate; finally, there was one more small plate in each interbrachial space, making a total of thirty-one pieces. The notch of the disc was scarcely indicated, and there was no arm-comb. Below, the interbrachial spaces were almost filled by the mouth-shields. The side arm-plates bore three short spines about one third the length of the joint resembling those of *O. albida*, and met both above and below, on all the joints; although the upper and lower arm-plates were well defined and had nearly their true shapes.

This species, brought up in numbers from 30 to 125 fathoms, is of high interest; first, because it seems not to live in company of any species of the same genus; and secondly, because it much resembles *Ophioglypha albida*, so widely distributed in the North European seas and in the Mediterranean. It is, however, distinguished by the different form of the arm-spines, arm-comb, and under arm-plates. *Ophioglypha Grubei* has very similar under arm-plates (if Heller's drawing is accurate),* but differs in the arm-spines and in the curious swelling of the upper arm-plates. Mr. Ljungman kindly examined the specimens and decided that they did not agree with any of the numerous varieties of *O. albida*, with which he is familiar He also

* Sitzungsb. der Kais. Akad. der Wissens. XLVI, p. 415, pl. II, figs. 13 – 16.

stated that *O. Grubei* was only a variety. I examined specimens of *O. albida* dredged by the "Josephine" at the Azores, and they were as different from *O. acervata* as those of Scandinavia.

Several localities, in from 30 to 125 fathoms.

Ophioglypha falcifera Lyman, sp. nov.

Special Marks. — Three arm-spines, the middle one is a strong hook, turned upwards. Arm-comb single, running along the genital plate and along the outer edge of radial shield, above the arm.

Description of Specimen. — Disk 4.5 mm. Arm 10 mm. Width of arm, 1 mm. Mouth-papillæ very short and broad and so closely soldered as to appear like a plain line; usually, however, there may be distinguished four on each side, of which the two outer are longest; besides these, there is a central, inner one, not soldered with the rest, having a blunt diamond shape, somewhat like the teeth, under which it lies.

Mouth-shields rounded heart-shape, with a wide curve without, and a decided obtuse angle within; length to breadth 1.1 : .8. Side mouth-shields rather narrow, meeting within, and extending outwards to the lateral corner of the mouth-shield. Under arm-plates, near base of arm, as long as, or longer than, broad; much wider without than within; bounded without by a curve, within by a small angle whose sides are re-entering curves, and on the sides by re-entering curves; a little further out the curves of the inner angle and of the side of the plate are blended in one, and the plate then resembles a broad wedge with curved outlines. This wedge widens and shortens as it is found further out on the arm, so that, near the end, it consists of a very obtuse angle without, and of a wavy border within, having a little central peak; length to breadth (4th joint) .4 : .4. Side arm-plates meeting everywhere below, and also above, beyond the first joint from the disk. Their line of juncture at the fourth joint is equal to half the length of the under arm-plate; the total length of the joint being .6 mm. This proportion rapidly increases, and, near end of arm, this line is double or treble the length of the under arm-plate. Upper arm-plates fan-shape, bounded without by a curve and within by two re-entering curves, which meet on the median line; length to breadth .4 : .5. Disk covered above by numerous rounded scales in concentric rows, each row standing higher than that outside; the central primary plate is highest of all, and has a diameter of .8 mm. Among these are a few smaller, irregular scales. There are three of these concentric circles, whereof the outermost includes the radial shields, which are of a rude pear-seed form, touching near their outer third, so that they diverge widely within, and less widely without, forming a notch in the disk which includes part of an upper arm-plate; length to breadth .8 : .8. They are separated within by part of a large scale, which has a rude diamond form. Below, the disk is covered by half a dozen plates, in each interbrachial space, arranged in two concentric rows; besides which a wide genital plate runs along the slit, bearing on its edge a row of short, stout, rounded papillæ, which run from the second under arm-plate upwards along the outer edge of the radial shield to a point about opposite the lateral corner of the upper arm-plate. Arm-spines three, very short and small; lengths to that of under arm-plate (3d joint) .2, .2, .2 : .4. At, and beyond the first joint outside the disk, the middle spine takes on the form of a broad, strong hook, having two curved teeth on the upper edge. At the tip of the arm there are but two spines, of which the upper is the hook. Tentacle scales of the mouth-tentacles six; three on each side of a very narrow incision, which is squeezed between the side mouth-shield (which bears three of the scales) on one side, and the large first under arm-plate and the outermost mouth-papilla on the other side. Second pore with six scales, arranged round a narrow oval; third pore, two scales, side by side; and those beyond, only one scale, which, at some distance out on the arm, is very minute and difficult to be seen.

Color, in alcohol, white.

Variations. — Another smaller specimen had the disk 3 mm. and the arm 9 mm. The mouth-shields were proportionately longer than in the first mentioned, — a variation common to the whole genus.

Two specimens, in 377 fathoms, south of Rebecca Channel.

The plates on the disk indicate that these specimens, although by no means fully grown, are yet large enough to show the adult characters. Thus *O. Sarsii*, with a disk of 4.5 mm. (see Lütken Addit. ad Hist. Oph. Pt. I, Pl. I, fig. 3), is more *young*, in this respect, than *O. falcifera*, and yet has taken on all the parts needed for ready recognition of the species. We may look for an adult of this curious species about the size of *O. Sarsii*, or rather smaller, and having a large number of small plates on the disk. The stout, double-toothed hook, as a middle arm-spine, is only an embryonic organ carried forward. In the very tip of the arm of *O. acervata* I have found, on the last fourteen joints, only two spines; and of these the upper one was flattened, and bore on its *upper* edge (just as in *O. falcifera*) about nine microscopic, hooked teeth. It may be that the fully grown *O. falcifera* has the middle hook, at the base of the arm, so overgrown as to form a stumpy spine.

Ophiocten depressum LYMAN, sp. nov. *

Special marks. — Disk very thin and flat, with a sharp edge. The granules of the disk are numerous, but irregularly scattered; none on the

* This species departs a good deal from the typical *Ophiocten*. The disk granulation is not continuous, but scattered; there are no combs of spines on the outer edges of the

interbrachial species, below. A row of papillæ along the outer end of the radial shield and the edge of the disk. Two arm-spines.

Description of a Specimen. — Diameter of disk 8 mm. Length of arm (broken) about 50 mm. Mouth-papillæ seventeen to twenty-one to each angle: of these, usually three are rounded, tapering, spear-head shape, and point to the centre of the mouth, being placed at the apex of the angle; the remainder are much smaller, and are flat and squarish; they form a connected row, the two outermost usually borne on the edge of the side mouth-shield, the remainder on the mouth-frames. Teeth, four; flat, delicate, long, and tapering to a point. Mouth-shields broad, rounded heart-shape, with a little peak within. Side mouth-shields long and narrow; they begin at the junction of the first under arm-plate with the side arm-plate of the second joint, and run thence across the end of the genital slit, meeting nearly, or quite, at the inner point of the mouth-shield. Under arm-plates in contact with each other along the whole basal part of the arm. First plate small, round hexagonal, longer than broad, and wedged between the outer ends of the neighboring side mouth-shields. Second plate narrowed within, and bounded by six sides; as follows: outer side nearly straight; laterals short and straight; inner laterals re-enteringly curved, to admit the large tentacle pores, and converging on the inner side, which is straight and very short. Fifth plate as broad as long; outer side slightly re-enteringly curved; inner side a little curved; laterals nearly straight, inner laterals short, and a little re-enteringly curved; length to breadth .6 : .6. Two thirds out on the arm, the side arm-plates meet below, along a line about one-half as long as the under arm-plate, which is there triangular, with its sides a little curved, and the apex directed inward. Side arm-plates robust, but not meeting below or above till near the end of the arm. Upper arm-plates four-sided, broader than long; outer side curved; inner side re-enteringly curved; laterals straight; length to breadth (4th plate) .6 : .8. The first upper arm-plate is very small, and fits in the little notch made by the outer ends of the radial shields. Two thirds out on the arm the plates have the same form, though much more elongated. Disk covered, above and below, with numerous rather large plates of very irregular outline, all of which, except those of the lower surface, are more or less studded with small, smooth granules; on the under surface is an irregular double row of granules, extending round the inner end of the genital slit, and along the genital plates as far as the third joint of the arm: a row of large granules, or short, stout papillæ, runs along the edge of the

basal upper arm-plates; the arm-comb of papillæ is continued along the edge of the disk; the side arm-plates do not join below; the first pair of pores of the arm-tentacles are surrounded by scales. Nevertheless, I am not clear enough as to the generic differences in this group to make a separation.

disk, and over the arm on the outer edge of the radial shield. The edge of the disk, in each interbrachial space, is composed above of three plates, and below of six.

Radial shields, of a very irregular triangular form, with the point inward; they nearly, or quite, touch without, but immediately diverge and are separated by a wedge of one small, one large, and part of another large plate; length to breadth 1.5 : .8. Two small, rounded, tapering arm-spines; the lower slightly longer; lengths to that of under arm-plates (5th joint) .4, .5 : .6. Tentacle scales, on second joint, six to each pore, arranged in an oval, three on each side; on third joint, two, arranged side by side; on joints beyond that, one. They all have the same shape of a small, thickened scale, but those towards tip of arm are proportionately larger. The mouth tentacles, of the first joint, have scales on either side, in form of an incision, somewhat as in *Ophioglypha:* on the side next the jaw, the two mouth-papillæ that stand on the side arm-plate are tentacle scales; and, on the side next the mouth slit, there are two more, which stand on a little plate, the homologue of a side arm-plate, running upwards into the mouth slit from the first under arm-plate.

Color, in alcohol, light brown.

Two specimens, off Double-headed Shot Keys, in 315 fathoms.

Ophiomusium, gen. nov.*

Teeth: no tooth-papillæ; mouth-papillæ soldered in a continuous row, so that their former outlines are scarcely to be seen. Disk covered by plates and radial shields, all of which are intimately soldered, forming a surface like porcelain. Upper and under arm-plates minute: side arm-plates meeting above and below; swelled, intimately soldered with the neighboring parts. No tentacle pores beyond the basal arm-joints. Small arm-spines on outer edge of arm-plates. Two genital slits in each interbrachial space.

In the nature of its covering, this singular genus has some affinity with *Ophiolepis*, as now restricted. But it is unique in having no tentacle pores on the greater part of the arm.

Ophiomusium eburneum Lyman, sp. nov.

Special Marks. — Two very small, blunt arm-spines, less than one third as long as the arm-joint. No tentacles beyond the first two joints. Surface of the disk and arm-plates microscopically granulated.

Description of a Specimen. — Diameter of disk 9 mm. Length of arm 25 mm. Width of arm 1 mm. The mouth papillæ, though closely soldered to each other, may be distinguished, in a partly dry specimen, by the light

* ὄφις, snake; μουσεῖον, mosaic.

lines between them; there are seventeen to each angle, of which the outer one is tooth-like and minute, and may be partially detached from the rest; the innermost, odd one is diamond-shaped, and lies immediately under the teeth; the others are squarish. Teeth four, flat, pointed, narrow; sometimes not placed regularly over each other. Mouth-shields small, of a truncated diamond shape, the truncation directed outward; length to breadth .8 : .6. Side mouth-shields broader without than within, where they meet, extending outwards beyond the mouth-shield, and joining the first side arm-plate; length 1.2 mm. Disk smooth above and below, and covered with a close mosaic of rounded scales, so intimately soldered that their outlines are indistinct. Radial shields blunt pear-seed shaped, widely separated by a group of small disk scales; length to breadth 1.8 : 1.2; they swell a little above the level of the others, and their surface, under the microscope, is composed of smooth grains, as is that of all the arm and disk plates. In the interbrachial space, between the pairs of radial shields, a single large scale occupies the margin of the disk. Under arm-plates three-sided and very small; the outer side is nearly straight, the laterals are re-enteringly curved and meet in a point within; length to breadth (5th joint) .5 : .4. Further out they rapidly become smaller, and, towards the tip of the arm, are scarcely to be seen. Side arm-plates very thick and swollen, meeting above and below, from the very innermost joint; at the fifth joint, their line of juncture is as long as the under arm-plate; and, further out, they constitute almost the whole of the joint. Upper arm-plates very small; longer than broad, diamond shape, with the outer angle shorter than the inner one; length to breadth (2d joint from disk) .8 : .6. Genital slits extending from the outer corner of the mouth-shield to a point about two thirds the distance to the margin of the disk; they are very narrow, and are bounded by two genital plates, which grow wider at their outer end, and are placed in a single line; moreover, there is a very narrow plate between the inner part of the slit and the side arm-plate. Arm-spines two, very short, scarcely tapering, cut square off at the end, nearly equal; lengths to that of the under arm-plate (5th joint) .3, .3 : 1. Near the tip of the arm the under spine is toothed, and hooked at the end, and the upper spine somewhat rough. There are tentacle-scales on the second and third joints, one to each pore; beyond this, neither tentacles nor scales; these scales are small, curved, and broader than long, and are situated close to the inner angle of the little under arm-plate, which gives them the look of being crowded towards the centre of the arm. The tentacles are short and small.

Color in alcohol, white.

Variations. — A young one had the disk 1.8 mm., the arm 6 mm. The scales of the upper disk were swollen and distinct, though closely soldered together; in the centre a large rosette of primary plates, a large round one in the centre; a large, rounded pentagonal one in each brachial space; a small narrow one, wedged between these last, in each interbrachial space. Outside this rosette were the radial shields, touching each other; and, finally, there were two narrow plates, on a radiating line, in each interbrachial space between the pairs of radial shields, making thirty-one plates on the upper surface. Below there were only three plates in each interbrachial space, arranged side by side. The mouth-shields were broad, heart-shape; the side mouth-shields and mouth-papillæ nearly as in the adult. Of under arm-plates there were but two (including the one at the corner of the mouth-slit): of upper arm-plates, only one, on the first joint. There were tentacles on the second and third joints, just as in the adult, and none beyond. The place where upper and lower arm-plates will appear is indicated by a depression, just where the side arm-plates meet; and in this depression appears a little papilla, or lump, which at last takes on the form of a true plate. Thus, a larger specimen with a disk of 3 mm. and arm of 10 mm. had already nine upper and three lower arm-plates, but none beyond. Off Sand Key, 270 and 325 fathoms.

Ophiacantha meridionalis Lyman, sp. nov.

Ophiacantha pentacrinus? Lütken, Addit. ad. Hist. Ophiur. Pt. III, 1869, p. 46.

Special Marks. — Disk closely beset with minute stumps, each bearing a crown of fine thorns. Six long, very slender arm-spines. Arms five or six times as long as the diameter of the disk, rounded and slender.

Description of a Specimen. — Diameter of disk 4 mm. Length of arm 22 mm. Seven mouth-papillæ to each angle of the mouth; three on each side, which are short, bluntly tapering, stout, and separated from each other, and one situated immediately below the teeth, which it resembles in form. Teeth three, short, flat and wide, with a much curved cutting edge. Mouth-shields between a diamond and a heart shape, much broader than long, with the outer side nearly straight, except a projection at the middle point, and a rounded angle within; length to breadth .4 : .7. Side mouth-shields wide and strong, nearly straight, meeting within, and resting without, on the rudimentary first arm-plate, which is conspicuous and strong. Under arm-plates separated by the side plates along the whole arm, wider without than within; bounded without by a clean curve, on the sides by a slightly re-entering curve, and within by an obtuse angle; nowhere do they present a sharp corner, their outline being much rounded. Length (4th joint) .4 mm. Side arm-plates meeting above and below, their line of juncture being, at the base of the arm, quite as long as the lower arm-plate. Upper arm-plates small, not as wide as the arm, strongly curved without, and with an angle within, so that they form a sort of broad diamond-shape. Disk completely covered, above and below, with very minute stumps, each of which bears a crown of microscopic thorns; on the back of the disc there are about 250 to a square mm. Radial shields entirely obscured, except just over the arms, where their outer ends are indicated by two little swellings. Arm-spines rounded, tapering, transparent, and very slender; under the microscope they appear finely prickly; on the basal joints six, of which the upper three are much the longest; lengths to that of the under arm-plate (4th joint) 1.5, 1.8, 1.8, 1.2, 1., .8 : .4. The two joints within the disk have but three spines, which are short, equal, flattened at their base, and quite rough. The end joints have three spines, also quite rough, and proportionately shorter and stouter than those of the basal joints, but there are no hooks, or toothed spines. Tentacle scales flat and sharp pointed, one to each pore. Color, in alcohol, pale blue gray for the disk, and white for the arms. The description given by Lütken of *O. pentacrinus* corresponds pretty nearly to this species. There is, however, one arm-spine less in *O. meridionalis*, and the under arm-plates appear to be of a different shape. Only a comparison of originals can determine the doubt.

In 237 and 327 fathoms.

Ophiomitra Lyman, gen. nov.*

Teeth: numerous, small, nearly equal mouth-papillæ; no tooth-papillæ. Disk flat, circular, and erect, covered with scales and radial shields, and beset with thorny spines, or stumps. Arm-spines rough. Side arm-plates large and nearly or quite meeting above and below.

So far as concerns the arms and the chewing apparatus, this is an *Ophiacantha*; but the disk, with its naked scales and conspicuous radial shields, separates it from that genus, which is characterized by the long, very narrow, radial shields, covered, together with the disk, by a thick skin bearing more or less thorny appendages.

Ophiomitra valida Lyman, sp. nov.

Special Marks. — Disk beset with thorny stumps; arm-spines about 9; the upper ones a little tapering, the lower ones flattened.

Description of a Specimen. — Diameter of disk 12 mm. Length of arm about 65 mm. Mouth-papillæ stout, rounded, tapering to a blunt point; from 10 to 11 to each angle of the mouth; of which one or two point directly inward. Teeth long, flat, tapering to a blunt point; 8 in number. Mouth-shields small, of a rounded diamond form, with a peak within; length to breadth 1.5 : 1.8. The madreporic shield has an ill-defined circular depression. Side mouth-shields large, meeting within, of a rude oval shape. They are quite as large as the mouth-shields proper. Under

* ὄφις, a snake; μίτρα, a cap.

arm-plates broader without than within, and broader than long; on 6th joint, length to breadth 1 : 1.3. The plates lying within the disk are much squeezed, laterally, by the large tentacles and their scales; beyond the disk they have a more regular shape, with the outer side strongly curved. Side arm-plates rather prominent, meeting above, but not below. Upper arm-plates wide fan-shape, with outer side strongly curved, and coming to a point within. Length to breadth 1 : 1.7. Disk, with a well-marked, round outline, standing off the bases of the arms; all its upper surface, except the radial shields, beset with little, rounded, thorny knobs or stumps, about .5 mm. high; they have a short, club form, like a folded toad-stool, and bear a thorny crown; there are about eight of these stumps to a square mm., where they are thickest. Interbrachial spaces below have likewise a few of these stumps. The scaling of the disk, in a partly dried specimen, is easily seen. Radial shields of a blunt pear-seed shape, with a rather irregular and ill-defined outline; they are slightly separated, and are naked; length to breadth 2.2 : 1.5. Genital slits large and extending nearly to the margin of the disk. Arm-spines rough, and resembling those of the smoother species of *Ophiothrix;* the five upper ones slender, rounded, tapering gradually; the four lower ones somewhat flattened, scarcely tapering, blunt; lengths to that of the under arm-plate (6th joint) 3.8, 3.5, 2.5, 2.5, 2.2, 2.2, 2., 1.8, 1.8 : 1. Tentacle scales, two on the first pores; after that only one; those at base of arm are large, thin, longer than broad and cut square off at the tip; those farther out are much smaller and tend to become pointed. In alcohol, the specimens are of a uniform faded straw-color.

Variations. — A specimen with a disk of 9 mm. had only eight arm-spines next the disk, and seven a little farther out on the arm. The uppermost spine is sometimes shorter than the second, but the rest usually follow the proportions laid down. In large specimens the upper arm-plates have their outer curve very prominent.

This species has a rough resemblance to *Ophiothrix rosula:* and the genus has affinities with *Ophiothrix.* The lowest arm-spine, on the very tip joints, is a little curved and is strongly toothed on one edge, so as to form a partial hook.

Dredged off Sand Key, Florida, in 120 fathoms.

Ophiomitra sertata Lyman, sp. nov.

Special Marks. — Disk with small radial shields and beset with small spines and grains. Sixteen mouth-papillæ.

Description of a Specimen. — Diameter of disk 11 mm. Length of arm about 55 mm. Width of arm between the joints 2 mm. Mouth-papillæ about sixteen to each mouth-angle; two outer ones thin and nearly as wide as long, with the end cut square off; the next five thin, narrow, sharp; the innermost one lies under the teeth, and, with its mate from the other side, forms a pair of papillæ much stouter than the rest and having a spear-head shape. Teeth five; the lowest one similar to the pair of mouth-papillæ just below it; the other four flat, rather stout, with a curved cutting edge. Mouth-shields broad heart-shape, with a slight peak without; length to breadth 1.2 : 1.5: just along their outer edge, in the interbrachial space, are five or six little spines. Side mouth-shields stout, broader without than within, running along the inner side of the mouth-shield and meeting within; they enclose the lateral corners of the mouth-shield by a little curved projection. Under arm-plates a little broader than long; bounded without by a clean curve, on the sides by slightly re-entering curves, and within by two curves which meet in a little peak on the median line. Side arm-plates stout, with a prominent ridge for the spines, meeting above and below, even at the first joint; they do not, however, encroach much more as they get farther out on the arm; and it is only near the tip that they occupy as much as half of its upper surface. Upper arm-plates broad-triangular, the outer side cleanly curved, and the lateral sides straight and meeting within in a sharp point; length to breadth (4th plate) .8 : 1. Disk above beset with rounded, rough grains, mingled with delicate, rounded spines, .8 mm. long, and shaped like those of the arm; through this covering appear the delicate disk scales; and, just over each arm, a pair of short radial shields, of a blunt pear-seed shape; these are smooth, but are separated from each other, and from the arm below, by bands of grains and spines; length to breadth 1.5 : 1. In the interbrachial spaces below, the spines and grains are less numerous. Genital slits large and occupying the full length of the interbrachial space; the edge next the interbrachial space is bounded by the five disk scales. Arm spines seven, all rough, slender, and regularly tapering; upper ones cylindrical, lower ones, especially the lowest, a little flattened; lengths to that of the under arm-plate (6th joint) 3.3, 2.5, 2.3, 2.2, 1.8, 1.5, 1 : .8. Tentacle scales large and regularly oval, length .5 mm. Color, in alcohol, disk blue gray, arm yellow gray. A single specimen, off Double-headed Shot Keys in 315 fathoms.

Ophiochondrus, gen. nov.*

Teeth and mouth-papillæ: no tooth-papillæ. Disk granulated; contracted, so that the interbrachial spaces are re-enteringly curved, and are further much reduced by the encroachment of the stout arms. Side mouth-shields wide and thick and meeting within. Side arm-plates meeting below, and there closely soldered so as to form a continuous belt. Two genital slits in each interbrachial space.

* ὄφις, snake; χόνδρος, granule.

Ophiochondrus convolutus Lyman, sp. nov.

Special Marks. — Six nearly equal, rounded, tapering arm-spines. Radial shields twice as long as wide and considerably separated. Seven mouth-papillæ. One tentacle scale.

Description of a Specimen. — Diameter of disk 7.5 mm. Length of arm 24 mm. Mouth-papillæ seven, all short, stout, and flattened; the two outer ones on each side squarish; the third more tapering, like a blunt tooth; the innermost one lying just under the teeth, and similar to them, except that it is more pointed. Teeth four, flat, squarish, with a cutting edge a little curved at its corners. Mouth-shields broader than long, rounded heart-shape; length to breadth .8 : 1.2. Side mouth-shields large and stout, meeting closely within: wider without, where they are soldered to the first side arm-plates. Under arm-plates wide oval, with a slightly re-entering curve without, strongly separated by the side arm-plates; length to breadth (6th joint) .5 : 1. Side arm-plates large, thick and swollen, not joined above, but meeting below, even at the base of the arm, where they are so soldered together that their line of juncture cannot be seen; their surface is rough, contrasting with that of upper and under plates, which is smooth. Upper arm-plates broad fan-shape, with the wide curved side outward; the two lateral sides are straight, and converge to the inner side, which is very short; the first upper plate is more or less covered by the encroachment of the disk; length to breadth (3d plate) 1 : 1.4. Three fourths out on the arm the upper plate is long wedge-shaped, with a curved outer side; this shape is determined by the juncture above of the side arm-plates. Interbrachial spaces below, and upper surface of disk, except radial shields, closely granulated with minute, rough, nearly equal grains, about 150 to a square mm. Radial shields widely separated; long oval, wider without than within; length to breadth, 2 : 1. The disk rises well above the arms, on which it encroaches somewhat by growing out on them in a sloping direction, as is often seen in *Ophiura*. Over the arm there is a slight irregular notch in the disk. Arm-spines short, rounded, tapering, moderately stout, nearly equal; second one from top a little the longest; lowest one somewhat the shortest. Second joint, two spines; third joint, three; sixth joint, six; lengths to that of the under arm-plate, .6, .7, .6, .6, .6, .5 : .5. At the very tip of the arm the under spine becomes somewhat hooked on its side and end. Tentacle scale, one, small, short, and tooth-like.

Color, in alcohol, light yellow.

Variations. — A small specimen brought up in the same cast is supposed to be the young of this species. Disk 2 mm. Arms 16 mm. The upper surface of the disk is entirely occupied by the eight radial shields, which are broad wedge-shape, and have the outer side bevelled, so as to make a notch or re-entering angle in each interbrachial space. In the centre of the disk, and on the dividing lines between the shields, are a few rough grains or rather thorny stumps, of which each shield bears one or more near its outer end. Interbrachial space below wholly occupied by the very stout and swollen side mouth-shields, and the mouth-shield which closely fills the angle made by them. Under arm-plates bounded without by a curve, on the sides by re-entering curves, and within by an angle. Side mouth-shields stout and meeting above and below. Upper arm-plates fan-shape, with a curve without and a sharp angle within. Arm-spines (2d joint from disk) six; the three upper ones shaped as in the adult; the three lower much shorter and stouter, and suddenly swollen at the base; on the joints just beyond, five spines, which are short and stout. The chewing apparatus and other characters are nearly as in the specimen first described. It will be seen that, in character of arm-spines, armature of disk, and proportionate length of arm, this specimen differs much from its supposed adult; but I shall consider it as the young form, unless intermediate stages shall prove it a distinct species.

Both specimens from off Chozera, Cuba, in 270 fathoms.

This animal has a tendency to roll the tips of the arms upon themselves, which, with the contracted disk and the character of the arm-plates, give it the look of a young *Astrophyton*.

Ophiactis humilis Lyman.

Special Marks. — Disk covered with coarse scales, which are beset with short spines and short thorny clubs. Five spines, the two uppermost much the longest.

Description of a Specimen. — Diameter of disk 4 mm. Length of arm 11 mm. Seven long, rough, stout, spine-like tooth-papillæ .2 mm. long, standing well apart; the innermost one is broader and flattened, and very like the teeth, below which it stands. Three teeth, which are flat, longer than broad, with their cutting edge bluntly pointed. Mouth-shields broad heart-shape, broader than long, curved without, bounded within by two re-entering curves; length to breadth .3 : .5. Side mouth-shields large, extending outward as far as the outer corner of the mouth-shields; and loosely joined within, along a line equal nearly to the length of the mouth-shield itself Under arm-plates broader without than within; bounded without by a slight curve, within by an obtuse angle, and on the sides by re-entering curves: length (3d plate) .3 mm. Side arm-plates large, meeting below along a line equal to more than half the length of the lower arm-plate; and above, equal to the whole length of an upper arm-plate. Upper arm-plates thick, but small, only about half as wide as the arm itself; heart-shaped, being curved without and pointed within. Disk covered with coarse, somewhat irregular, overlapping scales, of which there are five or six in a line from the centre to the margin of the disk. These scales are beset with numerous bodies of two sorts; the first are short, stout, rough spines, similar in size and shape to the mouth-papillæ; the second are shorter but much thicker and have a thickened club form. In the interbrachial spaces below these spines are more scattered. Over each arm the outer points of the radial shields can just be seen; the rest is covered. Five rough, rounded, tapering, rather stout arm-spines; lengths to that of the under arm-plate (4th joint) 1.7, 1.5, .8, .7, .6 : .3. Towards the end of the arm there still are five spines, and the two upper ones much the longest. Tentacle scales, one to each pore; on the first two pairs of pores long, flat, and spine-like, resembling the mouth-papillæ; on the joints beyond, smaller and proportionately shorter.

Color, in alcohol, light brown.

Variations. — The two specimens from 125 fathoms had no spines on the disk, and only a few of the club-shaped grains.

In 125 and 321 fathoms.

This species, with *O. clavigera* Ljung., stands at one extremity of the genus and approaches *Ophiacantha* just as *O. Krebsii*, at the other extremity, tends towards *Amphiura*. The typical *Ophiactis* of Lütken is distinguished by great radial shields, flat arms, stumpy arm-spines, and feebly developed mouth-frames; its scaling is heavy, and the arm-plates are large and conspicuous; and, as such, it was set off from *Amphiura*. *Ophiacantha* is distinguished by the development of thorny appendages on the disk, which cover it closely; feeble upper and lower arm-plates; long, rough arm-spines; a stout chewing apparatus, which is somewhat like that of *Ophiocoma*, except the absence of tooth-papillæ; and very slender linear radial shields covered with skin.

O. clavigera is remarkable for its high arched disk.

Ophiactis plana Lyman, sp. nov.

Special Marks. — Disk scales smooth, without spines or grains. Four mouth-papillæ to each angle. Side mouth-shields touching the under arm-plate.

Description of a Specimen. — Diameter of disk 3.5 mm. Length of arm 10 mm. Mouth-papillæ,* two to each angle, situated at the outer corner

* It has been explained (see remarks on *Amphiura*) that this papilla is really the tentacle scale of the second pair of mouth tentacles. In describing *Ophiactis* there has been some confusion in this respect: thus, Mr. Ljungman says of *O. carnea*, "papillæ orales binæ" (four to each angle), "*altera* in summo sinu orali collocata"; but this *second* one is the tentacle scale of the first pair of mouth-tentacles; and at that rate the species usually described as having four papillæ to each mouth-angle ought to be reckoned as having *six*, because these tentacle scales of the first pair are commonly overlooked.

of the slit; large, round, scale-like. Teeth four, flat, a little swelled, with a convex cutting edge, which in the lowest one (and to a less degree in those above) has a little lobe at its inner point. Mouth-shields small, swelled, broad heart-shape; length to breadth .2 : .3. Side mouth-shields small and narrow, not meeting within; soldered without to the inner lateral side of the second under arm-plate. Under arm-plates nearly pentagonal, with the angle directed inward, and truncated, making a very short sixth side; outer side curved; laterals re-enteringly curved; inner laterals straight; length to breadth (5th plate) .3 : .3. Side arm-plates stout, meeting above and nearly below. Upper arm-plates as wide as the arm, broader than long, bounded without by a clean curve, within by a very obtuse angle; length to breadth (3d plate) .3 : .4. Disk covered above and below with neatly imbricated scales, which are rather larger near the centre, where there are about 30 to a square mm. Radial shields slender pear-seed shape; a little bent so as to present a concave side to each other; separated for nearly or quite their length by a wedge of two or more elongated scales; length to breadth .8 : .4. No grains or spines on the disk scales, which are quite smooth. Arm-spines smooth, moderately stout, rounded, regularly tapering to a blunt point; nearly equal; lengths to that of the under arm-plate (5th joint) .5, .5, .5 : .3. One large, round tentacle scale, which resembles the mouth-papilla. Color, in alcohol, pale brown.

This species is distinguished from others by its lobed teeth and the entirely naked disk scales. It belongs to the group that have the side mouth-shields joining the under arm-plate. Off Carysfort Reef, 117 fathoms; off Key West, 140 fathoms; off Boca Grande, 125 fathoms; off Tortugas, 13 fathoms.

Ophiactis loricata Lyman, sp. nov.

Special Marks. — Side mouth-shields with their outer side touching the side arm-plate, and the first and second under arm-plates. Radial shields small. Upper and lower arm-plates long. Six arms.

Description of a Specimen. — Diameter of disk 2 mm. Length of arm 7 mm. Mouth-papillæ usually four to each mouth-angle, two on each side mouth-shield, of which the inner is very small and spine-like, but situated at the same level. Sometimes this second minute one is wanting, sometimes it is nearly as large as the outer. These variations may be looked for, because these creatures are peculiarly liable to mutilation, so that, of five specimens dredged, only one was perfect and symmetrical. Teeth, four; the upper one more sharp and narrow; the lowest sometimes divided into two papillæ. In the teeth, again, there seems some variation. Mouth-shields small, broad oval, rather swollen. Side mouth-shields stout, long triangular, nearly meeting within; the inner corner of the outer side fits in just where the first and second under arm-plates touch each other; the outer side itself rests against the first side arm-plate. Under arm-plates longer than broad; touching each other; bounded within by a truncated angle, without by a curve, and on the sides by re-entering curves. Side arm-plates not meeting either above or below. Upper arm-plates much broader without than within; as long as, or longer than, broad; bounded without by a curve, on the sides by straight converging lines. Disk finely scaled below; above covered with irregular, rather coarse and swollen scales, some of which bear little, stout spines. Radial shields broad wedge-shape, small, their length not more than one fifth the diameter of the disk; touching each other only at their outer end; strongly diverging and separated by a wedge of two scales, placed end to end. Near base of arm, four short, stout, rough, nearly equal arm-spines; further out, three; one stout tentacle scale. Color, in alcohol, brown. In the covering of the disk, and especially the size and position of the radial shields, this species resembles the figures of *O. Ballii* and *O. abyssicola;* * but the upper and lower arm-plates are quite different, and *O. Ballii* has five arm-spines; and the upper arm-spine of *O. abyssicola* is much the longest. *O. virens* has the side mouth-shields joined in a continuous ring.† There is a single specimen of a different species, dredged in 45 fathoms, which comes perhaps nearer to one of the above European species; but I propose to disregard it until I can have originals for careful comparison.‡

In 110 fathoms.

Amphiura semiermis Lyman, sp. nov.

Special Marks. — No scales on disk underneath. Six mouth-papillæ to each mouth-angle, of which two are above the others, in the mouth-slits. Side mouth-shields broad triangular and meeting within.

Description of a Specimen. — Diameter of disk 4 mm. The arms were broken, but their length seemed to have been about 30 mm. Mouth-papillæ six to each angle of mouth; a pair at the point of the angle, which are stout and rounded and run upwards to the teeth; one spiniform on the inner edge of the side mouth-shield; and one intermediate on each side, also spiniform, and situated high up in the mouth-slit. Teeth three, flat, strong, squarish, with a slightly curved cutting edge. Mouth-shields rounded oval, with a slight point within; length to breadth .5 : .4. Side mouth-shields broad triangular, large, meeting within; they extend nearly to the median line of the arm and overlap the first, rudi-

* Sars, Oversigt af Norges Echinodermer, Tab. II.

† Ljungman, Ophiuroidea Viventia, p. 323.

‡ In Catalogue No. 1, of Museum of Comp. Zoölogy, I have placed *O. abyssicola* under *Ophiocnida*, because I mistook the drawing given by Sars. I have not the same excuse for my blunder in putting *O. Ballii* there, for I had seen a specimen at Berlin.

mentary under arm-plate; under arm-plates nearly pentangular, but there is a very short inner side, because the inner laterals do not meet on the median line; they are bounded without by a slight curve; on the sides by curves a little re-entering; the inner laterals are also somewhat re-enteringly curved: length to breadth (5th plate) .5 : .4. Side arm-plates quite large, and encroaching both above and below; nearly meeting above. Upper arm-plates rounded, with a peak within; they do not cover the whole upper surface, but on each side appear the side arm-plates; length to breadth (3d plate from disc) .5 : .5. Disk finely scaled above, naked below; scales rather larger towards middle of disk; near its edge there are about 140 to a square mm., all thin, and overlapping. Radial shields narrow, broader without than within; their sides overlapped by the disk scales; nearly, or quite, touching without; diverging a little within; separated near their outer ends by a single long scale, and, further inward, by a bunch of the imbricated disk scales, length to breadth 1 : .3; they vary somewhat, accordingly as they are more or less encroached on by the disk scales. Just outside and below each of them is a small radial scale. Arm-spines, near base of arm, five; further out, four; stout, rounded, tapering to a point, swelled at the base; the two upper ones slightly longer and more slender; lengths to that of under arm-plate (5th joint) .5, .5, .4, .4, .4 : .5. Tentacle scales two, small, broader than long, curved; placed at right angles to each other, one on the lateral side of the under arm-plate, the other on the outer edge of the side arm-plate.

Color, in alcohol, disk greenish gray, arms yellowish.

A single specimen, from 377 fathoms, south of Rebecca Channel.

The specimen was somewhat injured, and therefore I wait better examples before separating the species from *Amphiura*, from which it differs by its naked disk underneath, just as does *Hemipholis*. Otherwise, it belongs to the *Amphiura* group, in which are found the well-known European *A. Chiajii* and the Florida *A. Stimpsonii*. This group is commonly described as having one *mouth-papilla* at the outer corner of the mouth-slit, and *another* high up in the mouth-slit itself. As the term mouth-papilla is understood, this description is not true. The papilla at the outer corner of the mouth-slit is the *tentacle scale* of the second pair of mouth-tentacles; that within the mouth-slit is the tentacle scale of the first pair of mouth-tentacles. The scale of the second pair of tentacles may easily be found in such genera as *Ophiocoma*, but naturalists do not there speak of it, because it is hidden by the continuous row of true mouth-papillæ. The group, therefore, should not be spoken of as having six mouth-papillæ, but as having *two* mouth-papillæ at the apex of the angle, and one large scale to each of the mouth-tentacles. Its species are, moreover, characterized by the number of the arm-spines, which are rarely less than five and occasionally as many as eight, while the other group has three or four. When we can be sure of the full value of the characters these two divisions will doubtless appear as generically distinct.

Amphiura grandisquama LYMAN, sp. nov.

Special Marks. — Five arm-spines, the lowest much the longest, and a little bent. One rounded tentacle scale, larger than is usual in the genus. Six mouth-papillæ to each mouth-angle, of which two are above the others in the mouth-slits.

Description of a Specimen. — Diameter of disk 6 mm. The arms, which were broken, had been not far from 28 mm. long. Of the six mouth-papillæ, to each mouth-angle, the innermost are stout and rounded, and stand side by side at the apex of the angle, running upwards to the teeth; the outer ones are very stout and taper to a blunt point, and one stands on the inner edge of each side mouth-shield; the intermediate ones are smaller and sharp spiniform, and are high up in the mouth-slit. Teeth flat, rather stout, with a cutting edge, a little curved. Mouth-shields broad, rounded diamond shape, more obtuse without than within; length to breadth .5 : .4. Side mouth-shields long triangular, small, not meeting within. Under arm-plates broader without than within; bounded without by a curve; on the sides by re-entering curves, which incline toward the median line; the inner laterals are short and nearly meet on the median line, so that the inner side is very small; length to breadth (6th plate) .5 : .5. Side arm-plates encroaching somewhat both above and below. Upper arm-plates extending quite across the arm, broader than long; they have a clean curve without, and a broken curve within, and these meet, on either side, in an obtuse point; length to breadth (3d plate from disk) .5 : .6. Disk covered with fine, overlapping scales, above and below, which are coarsest near the centre of the disk, and finest underneath; near the edge, above, there are about 100 to a square mm. Radial shields narrow; wider within than without, their side turned toward the other nearly straight; the opposite side curved; they are separated by a narrow wedge of two or three long scales; length to breadth 1 : .4: their size varies with the encroachment of the disk scales. Arm-spines five; further out on arm, four; rounded, tapering regularly, little or not at all swelled at the base; lowest one longest, and generally a little bent; lengths to that of the under arm-plate (7th joint) .6, .7, .7, .7, 1 : .5. Tentacle scale large, and round oval, resembling that in *Ophionereis*; length to that of the under arm-plate .2 : .5. Color, in alcohol, pale brown, with a light spot at the outer end of each radial shield.

Off Tennessee Reef, in 174 fathoms.

The species belongs to the same group as its neighbor, *A. Stimpsonii*, but is readily distinguished by its larger tentacle scales, and longer, more tapering arm-spines. *A. Sunderalli* is also similar, but has the side mouth-shields meeting within, and very broad, and the arm-spines more stumpy. *A. Stimpsonii*, hitherto only known by Lütken's description (Addit. ad Hist. Ophiur., Part II, p. 116) has the proportions of the disk and arms much as in *A. grandisquama*. The mouth-shields are longer than broad; the side mouth-shields small and narrow, meeting within, closely soldered to the surrounding parts, and, at their outer end, to a very small rudimentary under arm-plate; at base of arm, one very small tentacle scale; further out, none at all; radial shields closely joined at their outer ends; within, separated by a couple of long scales: five short, stumpy arm-spines.

Remarks on the Groups in the Genus Amphiura. — Any one who is really familiar with the range of species in this genus will, on the one hand, recognize striking differences, while, on the other, he will find a real difficulty in dividing the groups in a way to bear criticism. Lütken very properly set off the genus *Ophiactis:* and I have since separated the *Amphiuræ* with spiny disks under the name *Ophiocnida*, and those with a fence of scales round the discs as *Ophiophragmus.* Professor Agassiz had already recognized the generic position of the species with a naked disk below, under the name of *Hemipholis.* Mr. Ljungman * further distinguishes a genus *Amphipholis*, of which the type is *A. Januarii*, which seems to belong with such species as *A. elegans* (*Amphiura squamata* Ltk.) and *A. tenera.* It is by no means clear on what characters Mr. Ljungman grounds this new genus; because, after giving a number of characters common to nearly the whole of the old genus, he concludes with this distinction: "A generibus *Hemipholide* et *Amphiura* numero et dispositione papillarum oralium differt." But the species which he includes under *Amphipholis* do not at all agree *among themselves* in the number or disposition of their mouth-papillæ; e. g. *A. tenera*, *A. occidentalis*, and *A. atra.* There certainly is a group which includes *Amphiura elegans* (*squamata*), *A. tenera*, *A. violacea*, and *A. pugetana*, whereof the members are not only closely allied generically, but are even difficult to distinguish *specifically*, though coming from faunæ the most widely separated. Thus, Mr. Ljungman gives *A. elegans* as coming from the shores of Northwestern Europe, and also the Cape of Good Hope (!). And since this species has been shown to vary so considerably in its arm-spines, it seems difficult to separate it any longer from *A. tenera* of the West Indies; and, further, from *A. violacea*, *A. microdiscus*, and *A. Puntarenæ* of the Pacific coast of America. Should all, or a part, of these species prove identical, we must look upon this animal as the common thread that binds together distant faunæ, just as characteristic

* Ljungman, Öfversigt af Kongl. Vet. Akad. Förhand., 1866, p. 165.

fossils determine stratified rocks in different parts of the world. This idea of community of existence gets some strength from the varying depths at which *A. tenera* is found (4 to 128 fathoms), while its northern representative, *A. squamata* or *elegans*, is found from the Mediterranean, on the east, to Cape Cod, on the west; and from low water to three hundred fathoms * (var. *tenuispina*). The new genus *Amphilepis* Ljung.† seems better grounded. It contains the new species *A. norvegica*, and is characterized by only four mouth-papillæ to each angle and by absence of tentacle scales. However this may be, there are groups in *Amphiura* quite as clearly marked generically as is *Amphilepis*, and especially that already referred to as including *A. grandisquama*, which is characterized by having only two mouth-papillæ placed just under the teeth, a deficiency made up by the development of the tentacle scales of the two pairs of mouth-tentacles; furthermore, the many-spined *Amphiuræ* (4 to 8) are all found in this group. Its species, eighteen in all, are embraced in the table on pp. 338 and 339.

I by no means wish to suggest, because so many minor differences are thus indicated, that an equal number of generic differences should be recognized; on the contrary, no naturalist has a right to take such a step, unless he has had most of the species *under his own eye* for critical comparison.

Next to *A. planispina* stands the genus *Hemipholis*, which has two species, — *H. cordifera* Lym. and *H. affinis* Ljn.‡ *Ophiocnida* and

* Sars, Over det dyriske Livs Udbredning i Havets dybder, 1868.

† Ljungman, Ophiuroidea Viventia, p. 322.

‡ Its synonyme is *H. gracilis*, Vll. Professor Verrill (Proceed. Boston Soc. Nat. Hist. XII, 391) thinks that he has priority in the name, because, in a separate publication of Ljungman's Ophiuroidea Viventia, there is a note by Lovèn dated May 18, 1867. But this note has nothing to do with the original publication which is in the Öfversigt af Kongl. Vetenskaps-Akademiens Förhandlingar, 1866, No. 9. Ljungman's paper was read November 14, 1866. Verrill's was read January, 1867, and published in Trans. Connecticut Academy, March, 1867. This whole matter of priority in descriptions is of no sort of interest to science, except as a matter of *registration*. Nor is it profitable to enter on the question of what constitutes *publication*. But we may say, that the partial distribution of loose sheets of an incomplete paper, though a useful and praiseworthy custom, constitutes no greater claim for *priority* than the reading of a paper before an ancient and distinguished Academy, and the speedy publication of that paper in its complete and connected form. There are now many zoölogists who seem to think that species must be continually "reported," just like stocks at the brokers' board. Agassiz showed, twenty-three years ago, in his preface to the Nomenclator Zoologicus, that the "authorities" placed after names were merely *references of registration*, and not marks of praise to the authors. Thus when we read *Ophioderma longicauda* Müll. and Trosch., it means not, "The illustrious zoölogists Johannes Müller and F. H. Troschel had the honor to give the above (wrong!) name to this species"; *but*, "If you look in the System der Asteriden, you will find what Müller and Troschel thought or knew of this species."

Ophiophragmus are distinguished, not by the chewing apparatus, but by the covering of the disk. The former has four species, — *O. hispida* Lym., *O. brachiata* Lym., *O. scabriuscula* Lym., *O. olivacea* Lym.* The latter has five species, — *O. septus* Lym., *O. Wurdemani* Lym., *O. marginatus* Lym., *O. antarcticus* Ljn., *O. gibbosus* Ljn.

Finally, to complete that part of Müller and Troschel's genus Ophiolepis, which centres in *Amphiura*, we must mention *Ophiostigma* and *Ophiactis*. The latter approaches *Amphiura* in one direction (*O. Krebsii*), *Ophiopholis* in another (*O. Kröyeri*), and *Ophiacantha* in a third (*O. clavigera*). See description of *Ophiactis humilis*.

Amphiura pulchella Lyman, sp. nov.

Special Marks. — Six mouth-papillæ to each angle, the inner pair thick and running upward to the teeth. Radial shields very narrow, and closely joined for nearly their whole length.

Description of a Specimen. — Diameter of disc 3.2 mm. The arm was broken off at 21 mm., but had apparently been about 28 mm. long. Mouth-papillæ three on each side, all on the mouth-frames; the two outer ones small, rounded, and scale-like; the innermost one thickened and running upwards to the teeth. Mouth-shields longer than broad, rather narrower within than without. Side mouth-shields very narrow within, where they meet; much broader without, where they touch the minute first under arm-plate with their corner. Under arm-plates separated; as broad as long, pentagonal with the angle inward; lateral sides re-enteringly curved; outer side nearly straight on the first three or four plates; beyond that, with a decided notch in the outer side. Side arm-plates meeting below and (after the second joint) above also; the separation, however, of the upper and under plates is narrow; length of third plate .2 mm. Upper arm-plates broader than long, of an oval form, with the inner curve greater than the outer. Beyond the second joint they are slightly separated. Disk closely covered with minute imbricated scales, of which there are about 100 to a square mm., where they are smallest, on the upper surface. In the centre is a distinct circle of five round primary plates, with a sixth in the middle. Radial shields narrow, and sunk in the disk, joined for their entire length closely, except just at their inner extremities; length to breadth .9 : .2. Arm-spines three; short, smooth, rounded, tapering, nearly equal; lengths to that of under arm-plate .3, .3, .3 : .2. One small, nearly circular tentacle scale.

Color, in alcohol, disk greenish gray, arms lighter.

In 39 fathoms.

* To these should apparently be added *Ophiophragmus Loveni* Ljn. and *O. echinatus* Ljn. Why he placed them thus, and still admitted the genus *Ophiocnida*, is not clear.

Amphiuræ with only a pair of mouth-papillæ just under the teeth; the tentacle scales of the two pairs of mouth-tentacles strongly developed; 4–8 arm-spines.

Two tentacle scales.	4 arm-spines; often an additional mouth-papilla	A. Eugeniæ Ljn. Near R. La Plata.
	5–6 arm-spines; under arm-plates pentagonal	A. Chiajii Fbs. W. Europe.
	5–7 arm-spines; under arm-plates pentagonal	A. complanata Ljn. Off Rio de Janeiro.
	7 divaricate arm-spines	A. divaricata Ljn. Near Batavia.
	7 rather long arm-spines; side mouth-shields separated	A. flexuosa Ljn. Brazil.
	8 sharp arm-spines; disk large (11 mm.)	A. crassipes Ljn. Off Rio de Janeiro.
	Outer mouth-papilla scale-like	A. candida Ljn. Mozambique.
	5 arm-spines; long arms; (probably belongs here?)	A. perplexa Lym. Sidney.
	Side mouth-shields wide triangular; no scales below	A. semiermis Lym. Florida.
	Two tentacle scales at base of arm; none beyond	A. verticillata Ljn. Gallapagos.
One tentacle scale.	Minute tentacle scales	A. Stimpsonii Ltk. Florida.
	Side mouth-shields wide triangular	A. Sundevalli Ljn. W. Europe.
	Tentacle scales large, rounded oval	A. grandisquama Lym. Florida.
	7 rough arm-spines; lowest longest	A. magellanica Ljn. Str. Magellan.
	6 or 7 wide arm-spines	A. capensis Ljn. C. Good Hope.
No tentacle scale.	5–7 arm-spines	A. latispina Ljn. Off R. La Platta.
	6 arm-spines; arms very long	A. atlantica Ljn. St. Helena.
	Very long arms; 5–7 arm-spines	A. filiformis Fbs. W. Europe.

It is for this group that *Amphiura* must be retained, if the genus is to be subdivided. (See Forbes in Trans. Linn. Soc., Vol. XIX, p. 150.)

The rest of the genus embraces	A. elegans Norm. W. Europe and N. E. America.* A. pugetana Lym. Puget Sound. A. tenera Ltk. W. Indies.
Two tentacle scales. Mouth-shield small, and wedged between two wide, thick, side mouth-shields, which meet within. Outer mouth-papilla much wider than the rest. The whole mouth apparatus with its shields forms a conspicuous raised pentagon. These species form part of *Amphipholis* Ljn., and are noted for their close resemblance........................	A. depressa Ljn. Near Batavia. A. violacea Ltk. W. coast of tropical America. A. microdiscus Ltk. " " " A. puntarenæ Ltk. " " " A. Örstedii Ltk. " " " A. integra Ljn. Port Natal, S. Af. A. hastata Ljn. Mozambique. A. Januarii Ljn. Rio de Janeiro.†
Mouth-papillæ equal. Radial shields, short and stout and closely joined ..	A. grisea Ljn. W. Cent. America. A. Riisei Ltk. W. Indies.
7 or 8 short, wide (except the innermost) mouth-papillæ, under arm-plates wider within than without	A. atra Ltk. S. Carolina.
Six mouth-papillæ to each angle: radial shields very narrow and joined closely	A. pulchella Lym. Florida.
Mouth-papillæ equal. Side mouth-shields small and not meeting within ..	A. chilensis Ltk. Chili. A. occidentalis Lym. N. W. America. A. urtica Lym. N. W. America.
Outer mouth-papilla widest. Side mouth-shields small and not meeting within	A. geminata Ltk. W. Cent. America. A. gracillima Ltk. S. Carolina.
Four mouth-papillæ to each mouth-angle. No tentacle scales (*Amphilepis* Ljn.)	A. norvegica Ljn. Norway.
Two mouth-papillæ to each mouth-angle	A. planispina Pet. Rio de Janeiro.
Eight mouth-papillæ; two tentacle scales	A. impressa Ljn. Near Batavia.
Six arm-spines, two tentacle scales..................................	A. lobata Ljn. Sidney, N. H.
Six unequal mouth-papillæ to each angle. Radial shields separated	A. limbata Ltk. Rio de Janeiro.

* Norman. Ann. and Mag. of Nat. Hist., 1865, p. 109.
† Mr. Ljungman informs me that *A. albida* and *A. subtilis*, Ljn., are probably identical with *A. Januarii*.

Despite the number of *Amphiuræ* described from the Gulf of Mexico and waters of Brazil, the species seem well defined and distinct; and there is promise of many more. This genus is remarkable fort he well-defined specific differences it presents in the character and position of its side mouth-shields, arm-plates, mouth-papillæ, radial shields, &c. For example, no other *Amphiura* presents the following combination found in *A. pulchella:* 1. Three mouth-papillæ on a side, the innermost thickened. 2. Slender radial shields, closely joined. 3. Upper and lower arm-plates separated. 4. Three arm-spines. 5. One tentacle scale.

Ophiocnida olivacea Lyman, sp. nov.

Special Marks. — Radical shields deeply sunk in the disk, long and narrow. Disk puffy, with a narrow notch over each arm. At the base of the arm two tentacle scales, of which one is small and stands on the side arm-plate, the other long spiniform and borne on the lateral side of the under arm-plate.

Description of a Specimen. — Diameter of disk 12 mm. Length of arm about 85 mm. Mouth-papillæ, twelve to each angle, arranged in three sets: first, two small, flat, tooth-like papillæ, one at each outer corner of the mouth-slit, standing well above the outer end of the side mouth-shield (these, of course, are the tentacle scales of the mouth-tentacles); secondly, four sharp, stout, rounded, tapering papillæ on each side, standing in a row, which runs from the middle point of the side mouth-shield, upwards and inwards, along the mouth-frames to a level with the second tooth; of these the outer one is largest, .7 mm. long; thirdly, two stout, conical papillæ standing on the point of the mouth-frames, and directed inward, but inclined from each other, so that they have the appearance of a blunt fork. Teeth six, of which the lowest is pointed somewhat like the mouth-papillæ next to it; the other five are flat, squarish, with a curved cutting edge. Mouth-shields small, of a broad, rounded heart-shape; length to breadth 1.4 : .7. Side mouth-shields narrow and small, pointed within (where they nearly meet), broader without, where they run to the lateral corner of the mouth-shield. Under arm-plates longer than broad, bounded within by a nearly straight line, on the sides by re-entering curves, and without by two little re-entering curves, which join in a small peak on the median line; length to breadth (10th joint) .8 : .6. Inside the disk these plates are especially encroached on by the tentacles, which are very large, and occupy much of the under surface of the arm. Side arm-plates moderately prominent, and conspicuous from below by reason of the narrow under arm-plates; they do not, however, meet, except at the very tip of the arm, where they come together above. Upper arm-plates broader than long, a little broader without than within; all their sides nearly straight; the outer one lightly curved; length to breadth (3d joint from disk) .8 : 1.1. Towards the tip of the arm they are triangular, with the outer side curved, and the apex directed inward. Disk covered with fine scales and radial shields; the former nearly hidden by the skin, except on the lower surface. Radial shields very narrow, and joined for their whole length; pointed within, swollen at their outer ends; length to breadth 2 : .5. They are sunk below the puffy surface of the disk, and are placed at the inner point of a notch in the disk, which exists over each arm; this inlacing of the soft disk is as deep as one or two arm-plates, portions of which are thus exposed, together with their spines, which are bent outward by the overlying disc margin. The sides of the notch are formed of an upward prolongation of the genital plate. The entire disk is pretty evenly beset with very slender, sharp spines about .6 mm. long. Genital slits with a distinct genital plate, whose edge is visible for its whole length, and which turns over and widens at each end, especially at the outer, where it runs upwards above the arm. Arm-spines, outside the disk and near base of arm, nine, whereof the two lowest are stout, rounded, pointed, and longer than the others; the next four flattened, tapering, and most slender; the three highest also flattened and tapering, but rather stouter; lengths to that of under arm-plate (10th joint) 1.1, 1.1, .9, .7, .7, .7, .7, .7, .7 : .8. On the second joint only two spines; on the other joints, within the disk, about three. Near tip of arm, four spines, lowest longest, slender, tapering, rounded, rather longer than the joint. Tentacle scales two, — one short, sharp, tooth-like and about .4 mm. long (10th joint), standing on the edge of the side arm-plate; the other slender, sharp, spiniform, and borne on the lateral edge of the under arm-plate; length (10th joint) .6 mm. The former of these scales is found to the very tip, where it takes on the form of a pointed oval; but the spiniform scale is only seen on the first third of the arm, where it disappears, having grown gradually shorter and smaller.

Color, in alcohol, dull olive for the disk; arms, light olive brown.

Three specimens, in 79 fathoms, off Alligator Reef; and two arms, in 40 and in 117 fathoms, off Carysfort Reef.

Ophiothamnus Lyman, gen. nov.*

Teeth: no tooth-papillæ: mouth-papillæ, of which the outer is much the broadest. Side mouth-shields long and stout, extending outside the mouth-shields, and making, with them, a conspicuous raised pentagon. Side arm-plates large, meeting above and below, and bearing slender, rough spines on their sides. Disk puffed, and overlying the bases of the arms, covered with scales and radial shields, which are beset with spines.

This genus, by its arm-plates and chewing apparatus, is allied to

* ὄφις, a snake; θάμνος, a thicket.

Amphiura; by its spinous disk and rough spines, to *Ophiacantha* and *Ophiomitra.*

Ophiothamnus vicarius* Lyman, sp. nov.

Special Marks. — Disk beset with numerous slender spines. Seven or eight arm-spines; the upper ones longest, and all slender and tapering. Seven mouth-papillæ.

Description of a Specimen. — Diameter of disk 3.5 mm. Length of arm 20 mm. Mouth-papillæ, seven to each angle, whereof the innermost one stands immediately below the teeth, and is just like them; of the three papillæ on each side, the two inner ones are together about as broad as the outer one. The seven make an even, crowded row, and are all stout. Teeth four, short, broad, flat, with the cutting edge slightly curved, the uppermost one thinnest. Mouth-shields small, .3 mm. long, pointed within, a little curved without, making a sort of heart-shape; they are closely wedged into the angle formed by the union of the side mouth-shields. Side mouth-shields large and strong, .5 mm. long, meeting within, and extending well outside the mouth-shield proper; they bear the outer wide mouth-papillæ, while the other mouth-papillæ are attached to the mouth-frames, except the central innermost one, which grows on the jaw itself. Under arm-plates wider without than within; outer side curved slightly, laterals encroached upon by the tentacle scales; inner side making a small peak or angle; length (4th joint), .3 mm. The first under arm-plate is oblong, and tightly pressed between the bases of the side mouth-shields. Side arm-plates large, and rather prominent, meeting above and below; their line of juncture below is about half as long as the under arm-plate. Upper arm-plates, .3 mm. long: outer side cleanly curved, and nearly as wide as the arm: within they are bounded by outer curves of the preceding side arm-plates, which give them the appearance of having a peak. Disk beset, above and below, with long slender spines, which are more numerous on the upper surface, where their length is .5 mm., while, in the lower interbrachial spaces, the longest are .3 mm. In a dry specimen, the somewhat coarse and irregular scaling of the disk is everywhere visible. Radial shields, roughly semicircular, so that together they make a round figure; their outline, however, is not regular, and they have a slight swelling at their outer point; they touch each other near the disk margin; but, within, are separated by one, and sometimes by two, large scales, on their edges they often have two or three spines. Arm-spines slender, rounded, gradually tapering, sharp, all similar in shape, upper ones longest; close to the disk they are much longer than just beyond; fourth joint, eight spines, whose lengths are, to that

* So called because it seems to replace the common *Ophiothrix* of the shallower water.

of the lower arm-plate, as 1.1, 1.1, 1.3, .9, .7, .6, .6, .5 : .3. Seventh joint, longest spines, .5 mm., and the rest are not much shorter. On the first two or three joints beyond the disk the two ranges of spines meet on the median line of the arm above. The second arm-joint has but three spines, and of these the lowest is, as an exception, longest, namely, .6 mm. Tentacle scales blunt, pear-seed shape, the apex outward; further out on the arm they grow more pointed; their length is about half that of the under arm-plate. The color, in alcohol, is pale brown for the disk, and light straw for the arms.

Variations. — The chewing apparatus shows few exceptions: sometimes, however, the central inner mouth-papilla is somewhat narrower than the teeth above it: very rarely one of the small, side mouth-papillæ is wanting. The number and lengths of the disk spines is not always the same; and especially are those near the margin sometimes shorter. In the larger specimens the second joint has four spines.

Among numerous specimens there was found one that had scarcely any spines on the disk, and those very short; while the radial shields were buried by the disk scales, except their outer ends. The arm-spines were essentially the same; on the fifth joint, lengths to that of the under arm-plate, 1., 1., .8, .8, .8, .6, .6, .5. : .3.

Numerous specimens, in 15 to 135 fathoms.

Ophiomyces Lyman, gen. nov.*

Teeth: no tooth-papillæ; numerous wide, flat mouth-papillæ, which are turned downwards and outwards, and arranged in two or more imbricated rows, covering the whole mouth-angle. Side mouth-shields large, and meeting above. Disk finely scaled, without visible radial shields. Arm-spines within the disk shorter, stouter, and of a different character from those of the joints further out.

This singular genus stands quite by itself, unless we compare its curious mouth-papillæ with the spatula-like tentacle scales of *Ophiopsila*. All the specimens I have seen had a tendency to raise the arms above the disk, vertically; which shows that the muscular tension must have some peculiar proportion.

Ophiomyces mirabilis Lyman.

Special Marks. — Six arm-spines, nearly equal; on the second joint a connected row of ten short, flat arm-spines, running across the under side of the arm, two of these spines being on the under arm-plate, and four on each side arm-plate.

Diameter of disk about 6 mm. Length of arm 17 mm. The inner mouth-papillæ are rounded, sharp, spiniform, and eight or ten in number;

* ὄφις, a snake; μύκης, a mushroom.

they form an irregular row about the inner mouth-angle, and usually are turned more or less downwards. The outer mouth-papillæ are all more or less widened and flattened; arranged rudely in four radiating rows, but so spreading and overlapping as to almost hide the whole outer part of the mouth-angle. There are five or six to each side (ten or twelve to each mouth-angle) all foliate in form (much like the wooly fungus that grows from dead trees) the outer ones largest, and sometimes 1 mm. wide. Teeth five, flat, sharp, spear-head shaped. Mouth-shields very small, diamond shape, and almost totally hidden by the mass of papillæ and spines about them. Side mouth-shields large, meeting within, with a vacant space between their enclosed angle and the mouth-shield proper. They carry all the characteristic foliate mouth-papillæ, and are very much larger than the mouth-shield. The lower and inner point of the jaw, which in most Ophiurans is scarcely to be seen, is here quite large, and carries all, or nearly all, the spine-like mouth-papillæ. Under arm-plates much wider without than within; outer side curved, with a lateral projection from each corner, which joins the side arm-plate; laterals strongly re-enteringly curved, by the encroachment of the tentacle pores, which are very large; inner side making a sharp angle; length of plate (6th) to greatest breadth .5 : .5. Side arm-plates meeting above and below; above they cover almost the whole surface, the upper arm-plate being reduced to a minimum. Upper arm-plates with a curved outer side; the inner side with a rounded angle; they occupy only a small spot of about half the width of the arm, between the bases of the arm-spines. Disk uniformly covered with very fine, thin scales, about fifty to a square mm. Scattered over the upper surface are a very few short, delicate spines; in the lower interbrachial spaces, just outside the mouth-shield, a group of little flat papillæ. Arm-spines on joints beyond the disk six; the three upper ones slender, rounded, tapering; the three lower a little flattened and more blunt; upper spines longer; the longest (6th joint) .7 mm. Within the disk the spines have an entirely different form. Second joint with an unbroken row of ten equal, short, flat, scale-like papillæ, whereof two are on the under arm-plate, and four on each side arm-plate. Third and fourth joints the same, except that the papillæ get more rounded and longer, and that the fourth joint has only three on each side arm-plate. Tentacle scales of second joint two; of a shape similar to the outer mouth-papillæ, and lying on the side of the pore opposite the under arm-plate. All succeeding joints have but one scale, which lies on the inner angle of the under arm-plate. The two scale-like spines on the under arm-plate disappear beyond the sixth joint; they may, indeed, be considered *tentacle scales* just as properly as *arm-spines*. Some species of *Ophioglypha* give similar instances. The tentacle scales, except those of the second joint, are flat, oblong, and similar to the arm-spines which lie within the disk; far out on the arm they grow somewhat pointed.

Color, in alcohol, uniform pale gray.

The chief variations noticed were in the shape of the singular outer mouth-papillæ, which are sometimes more spreading in their form, or narrower. The number of these, as well as of the inner mouth-papillæ, varies by one or two, for each angle of the mouth.

Off Sand Key, Florida, in 237 to 306 fathoms.

The specimens, many of which had cast their disks, were singularly distorted, probably by the change of pressure from so considerable a depth. The arms were twisted upwards, so that they made a parallel bunch, in the midst of which was the disc, much elongated. By this torsion the mouth parts were all turned outwards, and almost inverted. This singular twisting is unusual.

The species may readily be distinguished from *O. frutectosus* by the fewer spines and their comparative equality.

Ophiomyces frutectosus Lyman.

Special Marks. — Twelve arm-spines, of which the uppermost is close to the median line of the arm. The five upper ones are short and sharp; the next three long, tapering, slender; the last four shorter, flattened, and equal.

Description of a Specimen. — Diameter of disk 7 mm. Length of arm about 28 mm. The inner mouth-papillæ are rounded, stout, spiniform, seven or eight in number; they form an irregular row about the inner mouth-angle, and are often turned more or less downward. The outer mouth-papillæ are flattened and broad; wider at their ends, which are cut square off, than at their bases; rudely arranged in four radiating rows, but inclining downwards and outwards, and so overlapping as to cover the outer part of the mouth-angle, like tiles; there are fourteen or sixteen to each mouth-angle; the longest are .7 mm., and are outside. Teeth four (rarely five), short, flat, stout, with a curved, cutting edge. Mouth-shields very small, diamond-shaped, and almost hidden by the numerous spines and papillæ about them. Side mouth-shields completely hidden by the outer mouth-papillæ. Under arm-plates nearly as wide within as without; their lateral sides with a strong re-entering curve from the encroachment of the large tentacle pores; length to breadth (6th) .6 : .5. Side arm-plates meeting above, but not below; near the base of the arm they barely meet above. Upper arm-plates very thin and delicate, except a median, thickened crest; their outer side strongly curved, their inner side with a slight peak; they occupy only about half the width of the arm; length to breadth .5 : 1.2. Disk covered with fine, slightly thickened scales; about

70 to a square mm. In the centre of the disk they are somewhat larger; and, in the interbrachial spaces below, much more minute; everywhere they are closely imbricated and somewhat irregular in size. The entire disk, above and below, is beset with a considerable number of very fine, sharp, slender spines; the longest about .8 mm.; just outside the mouth shields is a patch of stouter and blunter spines. Arm-spines, on the joints just outside the disc, twelve, arranged from the median line of the arm above to the tentacle pore below. The uppermost spines are very short and sharp, and project over the succeeding upper arm-plate. The sixth, seventh, and eighth spines long, slender and tapering; the four lowest spines not so long, but stouter, blunt, flattened, and smallest at the base. Lengths to that of the under arm-plate (6th joint) 3., .3, .4, .4, .5, 1., 1., .8, .6, .6, .6, 6, : .6. On the joints within the disk, the lower spines are wider, blunter and more flattened; while the upper ones are slender, but not so long as those on the joints beyond the edge of the disk. Third joint with twelve spines; the six lower ones are arranged on the side arm-plate, nearly at right angles with the length of the arm, but here the side arm-plate makes a sudden bend outwards and upwards, and this part bears six slender, sharp spines, of which the upper ones are somewhat the shortest; all these last are difficult of detection, wedged, as they are between the arm and the lower side of the disk. Tentacle scales two to each pore. On the first five or six joints the scales are shaped just like the peculiar outer mouth-papillæ, and are attached to the under arm-plate near the curved margin of the pore. On the joints beyond, the inner scale is pointed oval in shape, and attached to the side arm-plate next the lowest spine, while the outer scale is more elongated and is attached to the under arm-plate.* Close to the end of the arm the inner scale only remains, and gets somewhat more pointed. In alcohol, grayish straw color.

A single specimen off Sand Key, Florida, in 100 fathoms; others in 77 and 160 fathoms.

This species, when examined with a lens, presents a confused mass of thousands of spines and papillæ of all shapes and sizes; and it is only by patient study that all its parts can be properly referred. It is distinguished from *O. mirabilis* by its numerous arm-spines and by the different shape of the outer mouth-papillæ. It showed the same tendency to twist the arms upwards, above the disk.

By the kindness of Dr. Smitt and Mr. Ljungman, naturalists of the

* It will be noticed that the parts here called *outer tentacle scales* are, under *O. mirabilis*, Lym., termed *arm-spines*, because, in that species, they are continuous with the arm-spines and have the same shape. This is done to show that arm-spines and tentacle scales are homologous parts, and are differently named only to indicate their form or position.

Swedish frigate "Josephine," I was shown the Ophiuridæ dredged in 117 fathoms on the newly discovered Josephine Bank, southwest of Lisbon; and among them I recognized two fine specimens of *this very species!* We have, therefore, the same animal living on two sides of the Atlantic, and separated by nearly seventy degrees of longitude, but not yet discovered in the many deep dredgings made off the British and Scandinavian coasts.

Mr. Ljungman describes the color of the living creature as white underneath; yellow bars on the arms, two or four joints wide; a reddish spot at the insertion of each arm; a purple-gray, five-sided patch on the back of the disc. According to M. de Pourtales, the arms are white with an orange dorsal stripe; disk pink, with a greenish star; spines white, with orange specks at their bases.

ASTROPHYTIDÆ.

Ophiocreas Lyman, gen. nov.*

Disk and arms uniformly covered with soft skin bearing microscopic grains. Disk small; its interbrachial outlines re-enteringly curved; five pairs of narrow, rather high, radial ribs, running from the margin quite to the centre. Arms simple, very long and smooth; the joints indicated by very slight depressions. Small arm-spines standing just above the tentacles. Teeth: one or more tooth-papillæ; mouth-papillæ arranged in a clump on the side of the mouth-frame, and above its lower edge. Two genital slits, nearly as long as the disk is high.

This genus belongs to the Astrophytidæ, as the insertion of the arms in the disk, the character of the skin covering, and presence of radial ribs show; but in its chewing apparatus it presents more the characters of the Ophiuridæ. It stands near Astroschema, which, however, has no teeth.

Ophiocreas lumbricus Lyman, sp. nov.

Special Marks. — Radial ribs running quite to the centre of the disk. Two arm-spines, the lower longer. Arms gradually tapering, and nearly twenty times as long as the diameter of the disk. Skin beset with scattered microscopic thorny grains.

Description of a Specimen. — Diameter of disk 12 mm. Length of arm 230 mm. Height of arm near base 3 mm.; width of arm 2.5 mm. Mouth-papillæ nine or ten, forming a close, irregular clump of rounded grains on the side of the mouth-frame; none of them are as low as the under surface of the mouth, and are scarcely to be seen without forcing

* ὄφις, snake; κρέας, flesh.

is open. Teeth ten, very stout and uniform, except the lowest and uppermost, which are smaller: all are flat, a little longer than broad, with a curved outer edge, coming to a point on the median line, nearly of uniform thickness. Under the teeth are from one to three tooth-papillæ of irregular form. The joints of the arms are easily seen, even in alcoholic specimens, being marked by the interior bones, which are indicated through the skin. The arms themselves are high and arched; narrow below and divided into ridges by the bases of the spines; they are even and without depressions between the joints (except when the specimen is dried). The arms keep a uniform size for some time, and then taper very gradually. Arm-spines rounded, tapering, blunt, a little rough, but covered by the skin; there are two on nearly all the pores, but none on the first; one on the second and third, and two on the fourth, whereof the upper one is very small; lengths to that of the arm joint, 1.2, 2.2 : 1.5. At the tip of the arm both spines have three or four little hooks on their edge. Disk with five pairs of narrow, prominent, radial ribs, which diverge from the centre, where they meet, and run quite to edge, over the arms; the margins of the disk are re-enteringly curved, and its sides slope from the upper edge downwards towards the mouth region. The genital slits extend from near the upper edge of the disk to the mouth-ring below. Over the whole disk and arms are scattered microscopic thorny grains, which adhere lightly to a thin epidermal coat, which seems to carry the coloring matter. In alcohol the animal is of a dull flesh color, except the interbrachial spaces on the sides of the disk, which are purplish brown.

Variations. — A young one with a disk of 4.5 mm. had arms only one half as long as the specimen just described, to wit: 50 mm., from which it appears that the arms increase in a greater proportion than the disk. The teeth were only six; the grains of the skin were less thorny and more closely set than in the adult. Among many examined, the largest individual had the disk 17 mm. in diameter, and thirteen teeth, of which the two lowest were broken, so that each looked like two or three papillæ side by side; below these there was a small single papilla.

In 125 to 130 fathoms.

Astrophyton mucronatum Lyman, sp. nov.

Special Marks. — Radial ribs high, and beset with strong conical spines, a few of which are also found as far out as the third fork on the upper side of the arm. One madreporic body.

Description of a Specimen. — Diameter of disk 39 mm. Length of arm and distances of its forks from each other: —

1st	fork	to	2d	12	mm.
2d	"	"	3d	20	"
3d	"	"	4th	17	"
4th	"	"	5th	21	"
5th	"	"	6th	17	"
6th	"	"	7th	16	"
7th	"	"	8th	15	"
8th	"	"	9th	14	"
9th	"	"	10th	15	"
10th	"	"	11th	13	"
11th	"	"	12th	13	"
12th	"	"	13th	12	"
13th	"	"	14th	12	"
14th	"	"	15th	18	"
15th	"	"	16th	8	"
16th	"	"	17th	9	"
17th	"	"	18th	9	"
18th	"	"	end	16	"
	Total . . .			257	mm.

Teeth: tooth-papillæ and mouth-papillæ sharp, slender, spiniform; those standing in the place of teeth are about nine, arranged partly in a single, partly in a double vertical row; the longest 1.5 mm. Those near the outer corner of the mouth-slit are smaller, stouter proportionately, and irregularly crowded; length not over .5 mm. One madreporic shield, like a small pimple, about 2 mm. long, placed in a depression near the inner angle of the interbrachial space. Top and sides of arms, down to the tentacle scales, covered with a smooth mosaic of flat, irregular, rounded grains. Lower surface of arm, between the tentacle pores, smooth. Skin of the lower surface of the disk studded with flat, smooth grains, somewhat rounded; from six to nine to a square mm. but not confluent so as to form a mosaic. The space between the upper and lower surfaces of the disk is quite concave and very distinct, its skin being nearly naked and only covered by scattered microscopic grains. Whole upper surface of disk covered with a mosaic of grains like that of the arms; in addition to which the high radial ribs and the round space enclosed by the inner ends of the ribs, bear stout, smooth, conical spines, the largest 1.5 mm. high; of these there are ten or twelve to each rib, arranged in an irregular double row; those in the centre of the disk are crowded and smaller; the same spines form a row along the top of the arm, as far as the third fork; they are smaller than those of the disk, and there is usually one to each joint. Toward the end of arm each joint is marked by an annular ridge, which consists of a double row of grains, each bearing a minute, usually simple, sickle-shaped hook; these correspond to arm-spines, but gradually disappear towards the base of the arm, where, however, the double rows of grains are still to be recognized. Tentacle spines short, small, tooth-like; on most of the pores two, but some within the disk have three. Genital slits large, 10 mm. long, and extending from the under to the upper skin of the disk.

Variations. — Another specimen of about the same size had some small spines in the interbrachial spaces of the upper disk, and from nine to fourteen spines on each radial rib. On the under surface of the disk the granulation of the skin near the mouth was prolonged into the under surface of the arms, between the tentacle pores.

Florida, in 120 and 125 fathoms.

Astrogomphus Lyman, gen. nov.*

Disk with ten low, very narrow radial ribs, running nearly to its centre, and beset with numerous spines. Arms simple. Skin of arms and disk covered by a mosaic of small flat grains; the joints of the former distinguished by ridges, each of which consists of belts of granules, some of them bearing minute hooks. Arm-spines like thorny stumps, and arranged in clumps just above the tentacle pores. Teeth: tooth-papillæ and mouth-papillæ all similar and spiniform. Two genital slits in each interbrachial space.

Astrogomphus belongs with the simple-armed Astrophytons. In the distinctness of its disk, and the character of the surface of its arms, it somewhat resembles *Trichaster*, while its dentition is rather like that of *Astroporpa*.

Astrogomphus vallatus Lyman.

Special Marks. — The whole upper disk beset with short, very stout spikes, arranged rudely in concentric rows; under surface paved with smooth, flat grains, except a fence of stout papillæ, which runs between the lower sides of the arms, where they join the disk.

Description of a Specimen. — Diameter of disk 17 mm. Length of arm 100 mm. Width of arm next the disk 3.5 mm.; height of arm 3 mm. Mouth-papillæ and tooth-papillæ similar to each other, short, sharp, stout; mouth-papillæ about ten on each side, arranged in two irregular rows, one above the other; tooth-papillæ about twelve, arranged in irregular pairs along the point of the jaw; the longest are .8 mm.; and both mouth and tooth papillæ are spiniform, sharp, rounded, and perfectly smooth. Arms high and rounded above, flattened below; they are divided by depressions

* ἀστήρ, star; γόμφος, spike.

into joints, except on the lower surface, which is smooth, and is uniformly paved with small flat grains, looking, under the lens, like a rough mosaic. Each of the raised joints is covered by a belt of four rows of grains running across the arm; the two middle rows have smaller grains, each of which bears a little saw, having four or five teeth, and at its end a strong hook; the two outer rows have larger grains, without any appendages. Each depression between the joints is paved with two or three cross-rows of more or less flattened grains, similar to the smooth grains of the raised joints. Towards the end of the arm the raised joints consist only of the double row of grains bearing the saw-hooks. Disk, above, covered with a mosaic of smooth, flat grains, from which rise a great number of short, blunt, tapering, very stout spikes, the longest .8 mm.; they are arranged in about seven, more or less distinct, concentric circles, growing confused at the centre of the disk, where there is a space about 3 mm. in diameter, from the periphery of which spring the ten radiating ribs, which are very narrow, though somewhat broader over the bases of the arms; over these ribs run the circles of spikes, giving them a rough, spinous appearance. The interbrachial spaces below have a strikingly smooth appearance, though really covered with minute, rounded, flattened grains of several sizes. Between the bases of the arms, below, and connecting the first groups of arm-spines, runs a little fence of three irregular rows of little, crowded spikes, more blunt and rounded than those of the upper disk. Just outside one of these fences lies the madreporic plate, which is small and elongated, and has about a dozen large pores in an irregular row. The disk about the mouth is quite flat and smooth, so that the animal, seen from below, is laid out in regular patterns; in the centre the stellate mouth rough with spines; outside this a five-sided smooth region, which is prolonged on each arm; outside this a five-sided fence of spikes, which separates the mouth region from the interbrachial spaces, and is prolonged by the bunches of arm-spines along the side of the lower surface of each arm; again outside is the smooth interbrachial space, where the genital slits run from the edge of the disk (marked by a margin of spikes) about two thirds of the way to the interbrachial fence of spikes. Arm-spines equal, rounded, a little bent, suddenly contracting at the end, where they bear a bunch of four or five thorns; they are arranged side by side, in close clumps, at the angle made by the under surface and side of the arm; length of the longest, 1.2 mm. The first tentacle pore has one little simple spine; the second has four thorny spines; the third, and several beyond, five; then the number is four; towards the end of the arm it diminishes to three, two, and one. Near the tip, where there are but two, these spines have hooks at their ends, and at the very end there is but one spine, which is like the saw-hook borne by the grains on the back of the arm. Color in alcohol, yellow gray, or straw color.

Variations. — A smaller specimen, with a disk of 10 mm., presented no important differences. The spikes on the ribs of the disk were proportionately larger; the concentric circles of spikes were ill marked; the arm-spines were more thorny.

In 94 to 119 fathoms.

As this number of the Bulletin was going to press I received from Dr. Lütken his Additamenta ad Historiam Ophiuridarum, Part III, 1869, in which he enters into a critical discussion of the relations of the genera of Ophiurans. The work is done with that ability and thoroughness which usually characterize the Scandinavian naturalists above all others of Europe. This is not, however, the place to give a review of the paper, and I shall merely notice a few points that particularly concern the Caribbean fauna.

Two interesting genera are added to those known, from the West Indies, — *Ophionema*, which stands in the Amphiura group next to *Ophiopeltis*, from which it differs by having no disk scales at all, and by having all the arm-spines of the same form; and *Ophionephthys*, which is in the same group, and characterized by a disk covered partly by naked skin, while there is a frame of scales round each pair of radial shields, and a line of them along the edge of the disk. The species are *Ophionema intricata* and *Ophionephthys limicola*. There is also an *Ophiacantha* (*O. pentacrinus*) which, as the description will show, is very near to, if not identical with, my *O. meridionalis*. In treating of *Ophiactis clavigera* Ljn., Dr. Lütken has run against the precise difficulty I have (see *Ophiactis humilis*); and the anomalous position of the species is shown by the fact that, while he places it with *Ophiacantha*, I incline to retain it with *Ophiactis*. The real trouble is, that so many new forms are constantly discovered, that the limits of the old genera are as constantly found to be defective, particularly when those limits are established on characteristics more or less partial. For example, take Dr. Lütken's description of *Ophiactis*: "Squamæ disci spinulis brevibus plus minus obsitæ. Brachia 5 – 6 satis brevia. Spinæ laterales 5 – 7, papilla ambulacris 1, orales 1 – 2." Now, then, what is to be done with *O. plana*, that has *no* disk spines? Or what should we do with a species that had *two* tentacle scales, or *four* arm-spines? Or what is the meaning of "satis brevia," as applied to the arms? I am free to acknowledge that my own genera *Ophiophragmus* and *Ophiocnida*, among the *Amphiuræ*, could be catechized in like manner; but I do not see that *Amphipholis* Ljn. is a better substitute.* In fact, Dr. Lütken, with his usual modest judgment, alludes to the transition state of his classification when he says: "Je ne doute nullement aussi que

* See remarks on the genus *Amphiura*, p. 335.

des découvertes ulterieures ne conduisent à un système encore plus naturel et plus satisfaisant."

The *Ophiothrix violacea* of the Caribbean is said to be different from the similar form found on the coast of South Brazil. This is to be taken with great caution, considering that many Caribbean species go as far. Nevertheless, as pointed out in the Introduction to this Bulletin, there are *also* species apparently peculiar to the Brazil coast.

CAMBRIDGE, November, 1869.

No. 11. — *List of the Crinoids obtained on the Coasts of Florida and Cuba, by the United States Coast Survey Gulf Stream Expeditions, in* 1867, 1868, 1869. By L. F. de Pourtales, Assist. U. S. Coast Survey.

(Communicated by Professor B. Pierce, Sup't U. S. Coast Survey.)

Antedon Hagenii Pourt. (*Comatula Hagenii* Pourt., Bull. Mus. Comp. Zoöl. No. 6.) This species approaches nearer *A. rosacea* than any of the other species found in this region; it differs, however, in some important parts, such as the form of the centrodorsal plate, of the ovaries, of the joints of the cirrhi, &c. The arms are round, more flexible, and can be coiled entirely over the back.

Found from 94 to 195 fathoms.

Antedon meridionalis A. Ag. This species has long been known, from the coast of South Carolina, under the manuscript name of *Comatula Holmesi* Ag., but appears to have never been described. The above name was given to it by Mr. A. Agassiz in the "Sea-side Studies of Natural History."

Ten arms, centrodorsal plate flat, with about 15 cirrhi around its circumference. These are rather short, formed of 9 or 10 joints somewhat compressed laterally, the 3d, 4th, and 5th longest. The last joint with a strong claw, penultimate with an opposing point. Radials very short, the first almost concealed by the central plate. Axial radial also short and triangular. First brachials short and in contact with each other in a pair by nearly their whole side. First syzygium at the 3d brachial. Joints — of which there are generally four to a syzygium — very oblique, with raised and serrated edges. First pinnule rather long; the 5 or 6 first joints webbed by the perisom. The succeeding pinnules rather short, increasing again to the middle of the arm, formed of 15 or 16 joints, of which the 5 or 6 first ones are short triangular. Mouth eccentric, anus central; small calcareous concretions in the neighborhood of the mouth and brachial channels.

Color purple or yellow, or variegated of those two colors. Diameter, when fully expanded, 4 or 5 inches.

One specimen in 35 fathoms west of the Tortugas, and a large number off French Reef in 45 fathoms. It is also found off the coast of South Carolina, but the *Alectro dentata* Say, from the coast of New Jersey, appears to be a different species, — at least, as far as his description goes.

Antedon armata Pourt. Ten arms; centrodorsal plate flat, rather large, bearing about fifteen cirrhi on its circumference. Cirrhi of about 20 joints, shorter than their diameter; all except the 3 or 4 first ones provided with a short spine on the concave side; last joint with a claw, and penultimate with an opposing spine. First radial protruding from the centrodorsal plate; second radial nearly as long as broad; radial axial pentagonal. First brachials nearly square, barely in contact by their lower corners; second brachial with a large socket for the first pinnule, which is twice as long and more than twice as thick as the second; of its 9 or 10 joints the 4th is remarkably long, forming about one fourth of the total length; the other pinnules are rather short, and are formed of the same number of cylindrical joints. Joints of the arms smooth, oblique, edges not prominent. Seven or eight joints form a syzygium.

One specimen only was dredged in 35 fathoms, west of the Tortugas. The spiny cirrhi make it resemble *Antedon* (*Comatula*) *Milberti* Müller, said to be from North America, but the other characters do not agree.

Antedon cubensis Pourt. Ten arms; mouth central. Centrodorsal plate conical, covered with cirrhi nearly to the tip. Cirrhi very long and slender, of 28 cylindrical joints. First radial concealed by the centrodorsal plate, second very short; axial radial pentagonal or shield-shape. First brachials very short. Arm-joints with imbricated, serrated edges; five to seven forming a syzygium. First pinnule not much longer than the second, the others rather short and slender, consisting of about ten joints, and increasing in length towards the end of the arm.

Two specimens in 450 fathoms on the coast of Cuba. It resembles somewhat *A. Sarsii*, but differs from it by its flatter centrodorsal plate, and by an entirely different shape in the 1st and 2d brachials, particularly the second, which has not the projection into the first brachial, like *A. Sarsii*.

Antedon rubiginosa Pourt. Ten arms; mouth central. Centrodorsal plate slightly convex, bearing 15 to 20 cirrhi in one or two rows around the circumference; each cirrhus of 10 nearly cylindrical joints, the 3d, 4th, and 5th longest, the penultimate with an opposing point. First and second radials visible, the latter about half as long as broad;

the axial pentagonal depressed in the middle into a shallow pit marked with a black spot. A similar pit on several of the brachials, which are long with imbricated and serrated edges. Buccal membrane filled with calcareous concretions. First pinnule much longer than the succeeding ones. All the pinnules are very slender, with fine spines on every joint, forming also a verticil at their distal end. The spines are directed forwards near the beginning of the pinnule, but gradually curve back, and the last joint terminates with several hooked claws; color rusty red, with a black dorsal stripe on every arm and black ambulacral furrow.

One small specimen was dredged in 9 fathoms off Orange Key, Bahama Bank, and several arms of a large specimen near the Tortugas in 17 fathoms.

Antedon brevipinna Pourt. (*Comatula brevipinna* Pourt., Bull. Mus. Comp. Zoöl. No. 6.) Was not obtained again since the first specimen was dredged in 1867.

Still another species was noticed, but the specimen was too mutilated for description.

Pentacrinus Mülleri Oersted. Joints of the stem of a *Pentacrinus* were dredged up off Havana in 270 fathoms, and again in 315 and 471 fathoms off Double-headed Shot Keys. No trace of it was found on the Florida side of the Gulf Stream.

A few of the joints, showing the mark of the attachment of cirrhi, and being double, show that they belong to this species, and not to *P. asteria* Linn., in which the cirrhiferous joints are single.

Rhizocrinus lofotensis Sars. (*Bourgueticrinus Hotessieri* d' Orb., Pourt. in Bull. Mus. Comp. Zoöl. No. 7.) This crinoid has been obtained again several times during the season's work of 1869; always in the foraminiferous bottom of the trough of the straits, in depths varying from 237 to 450 fathoms. An interesting addition to our knowledge of its geographical distribution is its occurrence on the "Josephine Bank," a new discovery of the Swedish Frigate Josephine between the coast of Portugal and the Azores.

During the stay of that ship in Boston Harbor, Dr. Smitt had the kindness to show me his dredging collections, among which I saw this species, also *Echinocucumis typica*, *Pteraster militaris*, and perhaps a few others, representatives of the Gulf Stream deep-sea fauna, which we know to occur also on the coast of Norway.

Cambridge, November, 1869.

	Lit.	10	20	40	60	80	100	120	140	160	180	200	220	240	260	280	300	320	340	360	
Antedon Hagenii Pourt.						94	—	—	—	—	-195										
meridionalis A. Ag.			35-	-45																	
armata Pourt.				35																	
cubensis Pourt.																					450
rubiginosa Pourt.		9-	—17																		
Pentacrinus Mülleri Oerst															270-	—	—	—	—	—	-471
Rhizocrinus lofotensis Sars														237-	—	—	—	—	—	—	-450

Note. — The depths at the head of the columns are in fathoms. The horizontal lines show the range of the species in depth.

No. 12. — *List of Holothuridæ from the Deep-Sea Dredgings of the United States Coast Survey.* By L. F. DE POURTALES, Assist. U. S. Coast Survey.

(COMMUNICATED BY PROFESSOR B. PEIRCE, SUP'T U. S. COAST SURVEY.)

THE Holothurians obtained in deep water off the Florida reef are few in number, and are very closely allied to, if not identical with, those of the deep-sea fauna of Norway.

The littoral species so abundant on the reef, and in the shallow waters encompassed by it, do not appear to extend into even moderate depths outside, — at least, they were never found in the dredge.

Cuvieria operculata POURT. (*C. squamata* Koren? Bull. Mus. Comp. Zoöl. No. 7.)

A satisfactory comparison of the two species could not be made from want of well-determined specimens of the northern species. From *C. Fabricii* it is easily distinguished by the suckers on the ventral disk, which in *C. operculata* are always in a single row on the circumference of the soft disk, and a single row in the marginal plates, whilst in *C. Fabricii* they form a dense band of three or four rows. Two rather mutilated specimens, without names, in the Museum of Comparative Zoölogy, received from Professor Sars, and which are probably *C. squamata*, have the suckers disposed as in *C. operculata*. The granulation of the scales in the latter is finer than in the two northern species.

It is not very rare in 120 to 135 fathoms.

Thyonidium conchilegum POURT. Ibid. = *Th. pellucidum* Vahl.?

Thyonidium gemmatum POURT. One young specimen off Tortugas, in sixteen fathoms.

Echinocucumis typica SARS. In 320 to 350 fathoms.

Cucumaria frondosa GUNNER. A rather small specimen of Holothurian, dredged in 118 fathoms, cannot be distinguished from this species by any satisfactory characters. The skin contains only a few calcareous needles and no plates. Its color was milk-white with yellow spots.

Molpadia borealis Sars. The differences between my only specimen and Sars's description and figures consist in the smaller number of calcareous granules and in the calcareous plates being somewhat more symmetrical in shape. I do not think the differences sufficient to establish a new species.

In my specimen the buccal disk is expanded as in Sars's figure, but no tentacles are visible. In the places they ought to occupy fifteen small holes can be counted. Sars never saw any tentacles, although he kept some specimens alive, dredged in 351 fathoms.

Why Selenka should have made out this species to be the same as my *Molpadia oolitica* I cannot well understand. My original specimens were in his hands, and I have re-examined them lately. The calcareous granules of *M. borealis* are small and irregular, in *M. oolitica* they are larger, always oval, and formed of concentric layers. The former has retiform calcareous plates, the latter none. The former has no visible tentacles, the latter has always distinct simple digitiform tentacles, even in mutilated specimens. One of the specimens sent from the Cambridge Museum to Mr. Selenka had received by some accident the label of "Cape Palmas?" and on this one he has based his new genus *Embolus*. I am perfectly satisfied that the *Embolus pauper* Sel. is the same thing as *Molpadia oolitica*. The figures he gives of the œsophagial ring of *Molpadia oolitica* and of a calcareous grain of *Embolus pauper* are both taken from specimens of *M. oolitica*. The absence of œsophagial ring in the specimen he examined is accidental, as is also the absence of the tail-like prolongation of the anal extremity of the body.

Cambridge, November, 1869.

	Lit.	10	20	40	60	80	100	120	140	160	180	200	220	240	260	280	300	320	340	360
Cuvieria operculata Pourt.								—	-135											
Thyonidium conchilegum Pourt.							—	-125												
gemmatum Pourt.		16																		
Echinocucumis typica Sars																		—	—	-350
Cucumaria frondosa Gunner								118												
Molpadia borealis Sars.																				351

Note. — The depths at the head of the columns are in fathoms. The horizontal lines show the range of the species in depth.

No. 13. — *Report upon Deep-Sea Dredgings in the Gulf Stream, during the Third Cruise of the U. S. Steamer Bibb, addressed to* Professor Benjamin Peirce, *Superintendent U. S. Coast Survey*, by Louis Agassiz.

(Communicated by Professor Peirce.)

The survey of the Gulf Stream, including soundings and dredgings in deep waters, had been going on for two years under your direction, when I was invited by you to join a third cruise. The surveying party this year, as before, was accommodated on board the United States Coast Survey steamer Bibb, master commanding Robert Platt, who had charge of the hydrographic survey, while Assistant L. F. Pourtales, who had hitherto superintended the dredging operations, still continued to direct the same work. The object of my own connection with the present cruise was to ascertain how far the last investigations covered the ground to be surveyed, and to what extent and in what direction further researches of the kind were desirable in the same region, and likely to furnish important information. The work of M. Pourtales had been so eminently successful, the results obtained in this short time so unexpected and of such high scientific value, that little more than a repetition, or perhaps, in some respects, a modification of his results could be expected from my participation in this year's operations. It is a pleasure for me to state that our cruise — extending farther to the east in the Gulf Stream, between Cuba and the Bahamas on one side and Florida on the other, than those of previous years — confirmed in every feature the conclusions already reached by M. Pourtales. His results may therefore be considered as settled facts, deserving the fullest confidence of the scientific world, and requiring only, in order to obtain the appreciation they deserve, that kind of publicity which illustrated descriptions and maps can give them. When thus made known, it will be seen that we owe to the Coast Survey the first broad and comprehensive basis for an exploration of the sea-bottom on a large scale, opening a new era in zoölogical and geological research. I speak thus emphatically, because the data hitherto obtained concerning the animals of the deep sea have been rather isolated, and not methodically connected with one another, and with a study of the inhabitants of shallower waters, and the immediate seashore; nor have the previous collections been made over extensive areas, and so combined that every newly surveyed point was determined with reference to earlier investigations, as was the case with the dredgings of the last two years. In your recent surveys of the Gulf, the dredging operations have been pursued over an area so large as to preclude the possibility of any accidental and ill-considered conclusions. I should not speak in such terms of investigations in which I have had a share, had not the main results been secured by M. Pourtales before I joined the cruise.

There can be no doubt now that the area occupied by the reef which rises to the surface of the ocean has a peculiar, independent fauna, totally distinct from that of deeper waters. To this area belong those species of corals known as the true builders of coral-reefs, and to which, in a previous report to your predecessor, I gave, on that account, the name of reef-builders. The range of this fauna in depth is very limited; it does not extend below ten fathoms, and is mainly occupied by corals acquiring in their aggregate communities very large dimensions, such as *Madrepora palmata*, *cervicornis*, and *prolifera*, *Porites astræoides*, *Oculina diffusa*, *Eusmilia fastigiata*, *Astræa annularis* and *cavernosa*, *Isophyllia dipsacea*, *Manicina areolata*, *Colpophyllia gyrosa*, *Meandrina mammosa*, and other species of the genus, *Diploria cerebriformis*, *Siderastræa radians* and *siderea*, *Agaricia agaricites*, *Mycedium elephantotus*, *Millepora alcicornis*, the coarser and larger kinds of *Gorgonia*, and a host of animals of all classes living in and upon the reef, among which *Rhipidigorgia flabellum*, *Diadema antillarum*, and *Strombus gigas* are the most conspicuous. From this region (the only one of the kind which has been carefully surveyed by naturalists) I formerly secured those large and beautiful collections of corals which now adorn the Museum of Comparative Zoölogy.

Beyond this area, the width of which varies along the coast of Florida from a few miles, in the neighborhood of Cape Florida, to twelve, fifteen, or twenty miles and more off Cape Sable, we find another zone, rather sterile, or at all events not marked by that richness of animal and vegetable life which characterizes the reef range. The bottom of this second zone is a muddy mass of dead and broken shells, broken corals, and coarse coral-sand; it is chiefly inhabited by worms, and such shells as by their nature seek soil of this character.

with a few small species of living corals, some Halcyonarians, and a good many Algæ. From the nature of the bottom of this zone, especially at a depth of from twenty to forty fathoms, it is evident that a large number of dead Mollusks and Zoöphytes are scattered over its surface by the agency of the currents and tides, after they have been broken up.

I do not now enumerate the particular animals and plants found in this and the other submarine regions herein described, because the work of identification is as yet very incomplete; moreover, some of the most common and characteristic species are as yet neither described nor named, and would therefore be necessarily omitted in any list of the characteristic species of the Gulf Stream fauna. Indeed, for the present, such a list could only be an enumeration of species with which naturalists have become acquainted from specimens cast ashore, and would give no idea of the actual living faunæ in their natural habitat. On that account it is particularly desirable that the scientific harvest of these surveys should speedily be made known, accompanied by the fullest illustrations.*

A third region or zone, beginning at a depth of about fifty or sixty fathoms and extending to a depth of from two hundred to two hundred and fifty fathoms, constitutes a broad slanting table-land, beyond which the sea-bottom sinks abruptly into deeper waters. The floor of this zone is rocky; it is, in fact, a limestone conglomerate, a kind of lumachelle, composed entirely of the solid remains of organized beings, a true concretionary limestone, such as we might find in several levels of the Jurassic formation, and more especially in that horizon which geologists call "Coral Rag." We have here a plateau extending for more than a hundred miles, beginning off the Marquesas and stretching to Cape Florida, corresponding to Coral Rag. It varies from eight to ten, twelve, or twenty miles in width, — the greatest spread facing Sombrero, — and is built up entirely of animals now living upon its surface, and constantly increasing the thickness of the bed

* The corals found in the two earlier cruises are described by M. Pourtales, in Numbers 6 and 7 of the Bulletin, pp. 103-141. A preliminary report on the Echinoderms is printed in Number 9 of the Bulletin, pp. 253-361. As I have not enumerated the species therein described, it may not be out of place here to remark, that, though I have made some additions since, this report was prepared before Numbers 9, 10, 11, and 12 of the Bulletin had been handed in. The remarks upon the growth of corals were written immediately after my return from Florida, in May last.

by their accumulation. Large fragments of this rock were brought up by the dredge; so that its structure and characteristic remains of animals could be studied at leisure. I do not know that there is on record in the annals of our science a more direct illustration of the manner in which mountain masses of calcareous deposits have been accumulated on the bottom of the ocean. The animals inhabiting this plateau are innumerable, and as varied as those found along the shores most fertile in animal productions. A great variety of corals occur there, all of small size, and, strange to say, belonging to genera never known before from our sea-shores. Their aggregate affinity is indeed not with the living corals, but rather with the types of the tertiary and cretaceous periods. Echinoderms are equally numerous; they are also small as compared to those found nearer shore, and likewise recall, by their zoölogical affinities, the types characteristic of the cretaceous period. Salenoid and Discoidea-like forms, never known among living Echinoderms before, have been discovered on this plateau. Among mollusks I may mention one species, — the *Voluta Junonia*, hitherto considered the rarest shell from the southern coasts of the United States, and known only from a very few worn specimens. Of that species, which is particularly interesting on account of its close affinity with *Voluta Lamberti* of the Crag, and with *Voluta mutabilis* of the Miocene beds of Virginia and Maryland, quite a number of living specimens, young and old, have been brought up by the dredge. Two species of Brachiopods, — *Terebratula cubensis* Pourt. and *Waldheimia floridana* Pourt. — are extremely common, and contribute greatly to give this fauna an antique character. Most of the other mollusks have not yet been identified. Worms and crustacea abound also, and a few fishes unknown to me have also been obtained. All these are still undetermined.

The extraordinary richness, profusion, and variety of animal life displayed upon this table-land amazed me, not only on account of the peculiarity of the types, but from the vast number of individuals found together. The dredge coming up from such a depth, laden and crowded with all sorts of living creatures, as if it had been dragged in shoaler waters, was indeed a rare and startling sight for a naturalist. Such a result is the more unexpected, on account of the current impression, fostered by Edward Forbes's and Captain McAndrew's extensive dredging operations in the Ægean Sea, that as we descend below the surface of the ocean animal life gradually and steadily diminishes, till in deep waters it entirely fades away. As we have already seen, this is not the case, and Captain McAndrew has himself lately helped to dispel the illusion. Nevertheless, it is true that a change is perceptible in the character and size of animals inhabiting respectively deeper and deeper waters, as compared with those of the shallow coast zone. It may very justly be said that we have in the sea something corresponding to the alpine and subalpine flora, when contrasting higher levels with the plains; only that our submarine deep-water flora, or rather fauna, consists mostly of creatures hitherto little known, or even entirely unknown.

It is a surprising fact that the variety of marine plants does not keep pace with the variety of animals; they make a poor show when compared with the many and diversified sea-weeds found in the littoral mud-flats and upon shoal rocky bottoms. The sponges, however, thrive in deep waters better than the ordinary algæ; but the large and valuable sponges now gathered in such quantity along the whole coast of Florida are found on the littoral shoals only. In deep water we find, with a variety of larger species, a great number of small species of the same type, and among them a diminutive *Hyalonema*.

Permit me a suggestion here. You have repeatedly commemorated the discovery, by officers of the Coast Survey, of some submarine ledge or ridge, or peculiar configuration of the sea-bottom, by associating their names with the field of their operations. It would be appropriate and just that this extensive coral plateau, the characteristic fauna of which M. Pourtales has so faithfully explored, should bear his name and be called the "Pourtales Plateau."

To the seaward of this coral table-land, the bottom sinks rapidly to a depth of four or five hundred fathoms, reaching even eight hundred fathoms and more, though our successive dredgings have hardly extended beyond seven hundred fathoms. Over the whole of this area, which properly constitutes the lower floor of the Gulf Stream, the sea-bottom presents a uniform accumulation of thick, adhesive mud,* in which animal life is much less profuse than upon the coral plateau. It cannot, however, be assumed that this diminution of life is owing

* When dried, this deep-sea mud, with its innumerable and characteristic Foraminifera, remarkably resembles the chalk-marls of the cretaceous formation. The green-sand formation I have not investigated myself, but it has been minutely studied by Mr. Pourtales, who has ascertained that it is the result of a peculiar alteration, disintegration, and final aggregation of Foraminifera.

to the depth and consequent pressure of the water, or to the absence of light, but rather to the nature of the soil; for we find in it many animals to which such a habitat is congenial, — a variety of worms, for instance, and such shells as seek muddy bottoms. I have not the least doubt that a rocky foundation at eight hundred or even a thousand and more fathoms would yield a large harvest of animals; unquestionably fewer than are found in shallower waters, but yet as varied and as numerous comparatively as are the Alpine plants on the very limits of perpetual snow, wherever, in various latitudes, that vegetation can be compared with the flora of lower levels. If we have not succeeded in finding such a fauna in the deepest waters of the Gulf Stream, I hold that the cause lies chiefly in the absence of rocky bottoms in the deepest parts of the basin through which the great current of our southern coast flows. The character of the mud in the channel of the Gulf Stream does not warrant the supposition that the mud deposits derived from the turbid waters of the Amazons and Orinoco have extended as far north as the Gulf of Mexico, even though the great equatorial current sweeps past the mouths of these rivers.

There is one subject of scientific research, the connection of which with deep-sea soundings cannot fail to lead to unexpected results. When attempting to explain the structure of the stratified rocks, and many other phenomena connected with the general appearance of the earth's surface, geologists have not hesitated to ascribe, in a general way, the facts under observation to the agency of water; but they have rarely entered into such specific details as would establish a causal connection between all these facts, and the cause appealed to. In proportion as the sea-bottom becomes more extensively known, and the character of the materials lying beneath the water and their mode of arrangement are ascertained with greater precision, more accurate comparisons, in consequence of which current views may have to undergo considerable modifications, will certainly be made between geological formations of past ages, including all their deposits of various kinds, and the materials at present scattered in special ways over the ocean floor.

From what I have seen of the deep-sea bottom, I am already led to infer that among the rocks forming the bulk of the stratified crust of our globe, from the oldest to the youngest formation, there are probably none which have been formed in very deep waters. If this be so, we shall have to admit that the areas now respectively occupied by our continents, as circumscribed by the two hundred fathom curve or thereabout, and the oceans, at greater depth, have from the beginning retained their relative outline and position; the continents having at all times been areas of gradual upheaval with comparatively slight oscillations of rise and subsidence, and the oceans at all times areas of gradual depression with equally slight oscillations. Now that the geological constitution of our continent is satisfactorily known over the greatest part of its extent, it seems to me to afford the strongest evidence that this has been the case; while there is no support whatever for the assumption that any part of it has sunk again to any very great depth after its rise above the surface of the ocean. The fact that upon the American continent, east of the Rocky Mountains, the geological formations crop out, in their regular succession, from the oldest azoic and primordial deposits to the cretaceous formation, without the slightest indication of a great subsequent subsidence, seems to me the most complete and direct demonstration of my proposition. Of the western part of the continent I am not prepared to speak with the same confidence. Moreover, the position of the cretaceous and tertiary formations, along the low grounds east of the Alleghany range, is another indication of the permanence of the ocean trough, on the margin of which these more recent beds have been formed. I am well aware that in a comparatively recent period portions of Canada and the United States, which now stand six or seven hundred feet above the level of the sea, have been under water; but this has not changed the configuration of the continent, if we admit that the latter is in reality circumscribed by the two hundred fathom curve of depth.

Geologists have appealed very freely to oceanic currents as accounting for the presence of loose materials upon the surface of the earth. But now that the actual mode of distribution of such loose materials, under the action of extensive and powerful currents, begins to be known, those who explain the facts in this way are bound to show that their arrangement actually agrees with the effects of oceanic currents. I must confess that I have looked in vain, in the trough of the Gulf Stream, for traces of the characteristic mud which pours from the mouth of the Amazons in quantities sufficient to discolor the waters of the ocean for a great distance from shore; and yet the equatorial current of the Atlantic is one of the greatest and most powerful of all known currents.

Another side of this subject is also immediately connected with deep-sea soundings. Geologists, and especially those of the school of Lyell, have again and again assumed the slow rising of extensive tracts of land from beneath the water, and taken all sorts of loose materials irregularly scattered over the surface of the land as evidence of its former submersion. But since the dredge has been applied to the exploration of the deep, and a great variety of animals, in a profusion rivalling that of shoal waters, have been brought up, not only from the immediate vicinity of the land, but at various distances, in increasing depth, from one to two and even many hundred fathoms, no observer is justified in considering extensive deposits of loose materials as marine in which no trace of marine organic remains are found. The very mud and sand of the deep teem with innumerable microscopic living beings, the solid parts of which are easily detected in the smallest samples of marine deposits, and may therefore afford a satisfactory test where larger animals or plants are wanting. Now, after surveying the whole width of our Western prairies, without finding anywhere a sign of marine animals or plants, I cannot see that there is any evidence of their marine origin, or of the influence of oceanic currents in accumulating or distributing the loose materials scattered over those vast plains. On the other hand, I have ascertained that the foundation rock, upon which these materials rest, is everywhere polished, grooved, and scratched in the same characteristic manner as the well-known glaciated surfaces, wherever exposed. I have seen such polished rocks in the valley of the River Platte, not far from Omaha, and am now satisfied that the whole extent of the country, between the Alleghanies and the Rocky Mountains, was one unbroken glacier bottom. The scratched pebbles found among the loose materials of the great prairies confirm this view. For similar reasons, I am satisfied that the valley of the Amazons has not been under the level of the ocean since the tertiary period.

The most perplexing feature disclosed to me by our deep-sea dredgings and by my observations of the sea-shores along the Gulf Stream, on the Florida and on the Cuba side, is the irregularity of the stratification of the Spanish banks as compared with the deposits on the American side.

Taken as a whole, the trough of the Gulf Stream, between Cuba and Florida, as well as farther east and north, presents features in its configuration widely different from the relief of any equally extensive area of the dry surface of our continents. The floor of this basin is gradually and slowly shelving from the Florida coast to greater and greater depth, while on the Cuban side it is rapidly rising again. The slope is, indeed, so rapid on the Spanish shore that, at a distance of less than two miles from the abrupt shore bluffs, the depth of the trough is generally from 3,000 to 4,000 feet, and here and there reaches 5,000 feet at a slightly greater distance. We have thus here a slope as steep as that of the steepest mountain ranges of that height, and even steeper; and, what is most surprising, the great inclination of this floor is not the result of uplifted and slanting beds of rock, but unmistakably the effect of the abrading action of the great current upon older coral formations, judging from the aspect of the shore bluffs, and their evident continuity with the general slope from the water-edge down to the greatest depth reached with the plumb-line and the dredge. This difference in the inclination of the slopes on the American and on the Cuban sides of the basin obtains for more than one hundred miles, — from the Tortugas to Cape Florida, — with the peculiarity only that in the direction of Salt Key Bank there rises, on the Cuban side, a low ridge from the deeper part of the trough, trending nearly parallel with the coast. Another remarkable feature of the edge of the great Florida reef consists in its having a less abrupt slope to the seaward than is ascribed to all the coral reefs of the Pacific Ocean. Nevertheless, the seaward slope of the reef is really steeper than the shoreward slope: and this is, it appears, an essential element in the growth and rise of all the coral reefs.

But while the great coral reef of Florida presents this exceptional character, the Bahamas and the reefs to the northeast of Cuba exhibit very abrupt slopes, and a great depth is reached close to the shores of these Banks; so that the Bahamas resemble the coral-reefs of the Pacific much more than the reefs of the coast of Florida.

The whole group of banks and keys embraced between Double-headed Shot Key, Salt Key, and Anguilla Key is a very instructive combination of the phenomena of building and destruction. The whole group is a flat bank covered by four or five and occasionally six fathoms of water, with fine sandy bottom; evidently corals reduced to oölithes of various sizes, from fine powder to coarse sand, mingled with broken shells, among which a few living specimens are occasionally found. The margin of the bank is encircled on several points by rocky ridges of the most diversified appearance, and at others edged by sand-dunes. A close examination and comparison of the different keys show that these different formations are in fact linked together, and represent various stages of the accumulation, consolidation, and cementation of the same materials. On the flat top of the bank the loose materials are pounded down to fine sand; in course of time this sand is thrown up upon the shoalest portions of the bank, and it is curious to notice that these shoalest parts are its very edge, along which corals have formed reefs which have become the basis of the dry banks. The foundation rock, as far as tide, wind, and wave may carry the coarser materials, consists of a conglomeration of coarser oölithes, rounded fragments of corals, or broken shells, and even larger pieces of a variety of corals and conchs, all the species being those now found living upon the bank, among which *Strombus gigas* is the most common; beside that, *Astræa annularis*, *Siderastræa siderea*, and *Meandrina mammosa* prevail. The shells of Strombus are so common that they give great solidity and hardness to the rock. The stratification is somewhat irregular, the beds slanting towards the sea at an angle of about seven degrees. Upon this foundation rock immense masses of Strombus, dead shells, and corals have been thrown in banks, evidently the beginning of deposits similar to those already consolidated below; but there is this difference in their formation, namely, that while the foundation rock is slightly inclined, and never rises above the level of high water, the accumulation of loose materials above water-level forms steeper banks, varying from fifteen to twenty and thirty degrees. In some localities broken shells prevail; in other, coarse and fine sand; and the ridges thus formed, evidently by the action of high waves, rise to about twelve and fifteen feet. This is evidently the foundation for the accumulation of finer sand driven by the wind over these ridges and forming high sand-dunes, held together by a variety of plants, among which a trailing vine (*Batatas littoralis*), various grasses, and shrubs are the most conspicuous. These dunes rise to about twenty feet; on their lea side and almost to their summit grows a little palmetto. The sand of the dunes is still loose, but here and there shows a tendency to incrustation at the surface. The slope of these dunes is rather steep, sometimes over thirty degrees, and steeper to the seaward than on the landward side.

In the interior of Salt Key there is a pool of intensely salt water, the tint of which is pinkish or flesh-colored, owing to the accumulation of a little Alga. When agitated by the wind, this pool is hedged all round by foam of the purest white, arising from the frothing of the viscous water. Along the edge the accumulation of this microscopic plant forms large cakes, not unlike decaying meat, and of a very offensive odor. The foundation rock of this key is exactly like what Gressly described as the "facies corallien" of the Jurassic formation; while the deposit in deep water, consisting chiefly of muddy lime particles, answers to his "facies vaseux."

Double-headed Shot Key is a long, crescent-shaped ridge of rounded knolls, not unlike "roches moutonnées," at intervals interrupted by breaks, so that the whole looks like a dismantled wall, broken down here and there to the water's edge. The whole ridge is composed of the finest oölithes, pretty regularly stratified, but here and there like torrential deposits; the stratification is more distinctly visible where the rocks have been weathered at the surface into those rugged and furrowed slopes familiarly known as "karren" in Switzerland. It is plain that we have here the same formation as on Salt Key, only older, with more thoroughly cemented materials. The uniformity of the minute oölithes leaves no doubt that the sand must have been blown up by the wind and accumulated in the form of high dunes before it became consolidated. The general aspect of Double-headed Shot Key is very different from that of Salt Key. The whole surface is barren, — not a tree, hardly a shrub, and the scantiest creeping vegetation. The rock is very hard, ringing under the hammer, and reminds one of the bald summits of the Jura, such as Tête de Rang, near La-Chaux-de-Fond. It is evident that what is beginning on Salt Key has here been not only completed, but is undergoing extensive disintegration in Double-headed Shot Key, both by the action of atmospheric agents over the surface and by the action of tides and winds against the base of the key.

Among these older oölithic deposits, forming the main range of Orange Key and of Double-headed Shot Key, we recognize formations of more recent date, occupying the cavities of ancient pot-holes, which have gradually been filled with materials identical with those of the older deposits. The pot-holes themselves show nothing very peculiar;

there are many such upon these keys, — some large ones many yards in diameter and others quite small, — evidently formed by the wearing action of loose pieces of harder coral rocks thrown upon the key by great waves, and only occasionally set in motion by the waters dashing over the key during heavy storms. The pot-holes nearest the water-edge are the most recent, and are mostly clean excavations, either entirely empty or containing sand and limestone pebbles lying loose at the bottom of the holes. Some of these excavations are circular, others oblong, still others have the form of winding caves opening towards the sea or upon the surface of the key. Beyond the reach of ordinary tides and of the waves raised by moderate winds, the pot-holes are generally lined with coatings of solid, compact, and hard limestone, varying from a thin layer to a deposit of several inches in thickness, and following all the sinuosities of the cavities in which they are accumulating. It is plain from their structure that these coatings are a subaerial formation, increasing by the successive accumulation of limestone particles left upon the older rock by the evaporation of water thrown upon the key when the ocean is so violently agitated as to dash over the whole key. Frequently the hollow of these coated pot-holes is further filled with consolidated oölithes ; or thin layers of minute oölithes alternate with a coat of compact limestone, throughout the excavation, which often has been filled again in this way up to the general level of the surrounding surface. Occasionally these regenerated surfaces are again hollowed out by the action of storms, and the result is a dismantled pot-hole, in which their structure and the mode of their filling is distinctly exhibited.

The stratification of the main mass of these keys is very peculiar. Though evidently the result of an accumulation of oölithes thrown up by high waves, the beds are pretty regular in themselves, but slant in every direction towards the sea, showing that they were deposited under the action of winds blowing at different times from every quarter. It is further noteworthy, that, while the thicker layers consist of oölithes readily distinguishable to the naked eye, there are at intervals thin layers of very hard, compact limestone, alternating with the oölithic strata, which have no doubt been formed in the same manner as the coating of the pot-holes.

As in their general aspect the coral formations of the Cuban side of the Gulf Stream differ from those of the American side, so do also the rocks of the latter differ from the rocks observed upon the banks of Salt Key, Double-headed Shot Key, and Orange Key. We find upon the Florida reefs, as well as between the innumerable keys stretching along the American coast, and upon the coral plateau sloping towards the main trough of the Gulf Stream, extensive beds of regularly stratified rocks of various kinds. I have already described the limestone conglomerate of the Pourtales plateau, p. 365. Such a formation exists nowhere else within the range of the Gulf Stream, unless it should be hereafter ascertained that a similar deposit extends along the submarine border of our continent, edging the American wall of the deeper part of the Atlantic trough. But in the shoal waters intervening between the coast of the peninsula of Florida and the keys and reefs there exist various deposits of an entirely different structure, the accumulation and increase of which is constantly going on. The most extensive of these formations is a regularly stratified oölithic rock, the grains of which vary from imperceptible granules to larger and larger oölithes, approaching the dimensions of pisolithes, and cemented together by an amorphous mass of limestone mud. The oölithes themselves are formed in the manner first described by Leopold von Buch. Hard particles of the most heterogeneous materials, reduced to the smallest dimensions, and tossed to and fro in water charged with lime, are gradually coated with a thin film of limestone, and then another and another, until it sinks to the bottom, to be further rolled up and down the sloping shore bottom until it becomes cemented with other similar grains, and forms part of the growing limestone bed. Of course the finer oölithes are seen nearest the shore line, and it is instructive to see at low tide the little ripples of successive larger oölithes left dry as the water subsides. Naturally these materials are frequently thrown up along the beaches in layers of varying thickness, and in course of time become cemented, and are transformed into solid rock, over which crusts of hard, compact limestone are in the end formed by the evaporation of calcareous water dashed upon the dry surfaces.

In very shallow waters, which are not powerfully affected by tidal movements, and upon the bottom of which no oölithes are forming, we find extensive beds of a dull amorphous limestone, formed of lime-mud, alternating with seams of a more compact, hard limestone, in which a few oölithes may occasionally be seen that were floated over the flats in which such formations are going on. These deposits resemble the marly limestone of the Oxford beds. Of course these different rocks may alternate with one another, as, owing to the increase of the whole formation, the conditions for the deposition of one kind of rock may be followed by those favoring another combination. Again, in consequence of the changes in the direction of the currents, or as the result of a heavy gale, considerable deposits which have been going on regularly for a long time may suddenly be worn away and destroyed, giving rise in turn to the formation of conglomerates made up of limestone fragments of various structure, united together into very peculiar conglomeratic pudding-stone with angular materials. The compact limestones are frequently as hard as the hardest limestones of the secondary formation, have a conchoidal fracture like the most compact Muschelkalk of the Triasic period, and may ring under the hammer.

Most of the keys consist of broken corals thrown up by the waves, including fragments of shells, sea-urchins, and occasionally bones of sea-turtles and fishes. At the Dry Tortugas and at the Marquesas, however, some of the keys are entirely made up of the decomposed fragments of corallines cemented together. The crescent-shaped joints of a large species of Opuntia are most prominent among them.

Nowhere, within the range of the Gulf Stream and its borders, have I seen a rock which could be supposed to have been formed by the materials accumulating in the greater depth of its trough, such as I have described above, p. 367. And no rock in the whole Jurassic formation could have been formed out of the kind of materials which are found in the deeper parts of the Atlantic basin, along the American shores; I therefore do not believe that any of the rocks of the Jura and the Suabian Alp have been deposited in very deep waters.

The extensive area occupied by the keys and reefs of Florida, including the sloping coral plateau of the American side of the Gulf Stream bottom, may fairly be compared to the Jurassic formation, as it stretches across Central Europe and farther east in the direction of the Caucasus and Himalaya Mountains. Indeed, the Jurassic formation, as a whole, bears the same relation to the older deposits upon which it rests, as the modern American coral formation sustains to the older parts of the coast of our continent. During the geological middle ages, the Jurassic formation was the submarine margin of a growing continent, as the Pourtales plateau forms at present the southern margin of North America.

These facts have an immediate bearing upon the question of the origin of submarine basins as compared with the inequalities of the mainland. The configuration and relief of our continents, as far as they are not the result of later denudations, have been determined by uplifts and the gradual rise of the land above the level of the sea, and hence have arisen the fractured ridges of mountain ranges, with their upright crests; while the areas of the great oceanic basins are surfaces of depression or subsidence, upon which prominent inequalities would of necessity be wanting, from the very fact that the breaks, where any occurred, must be turned downward. If this view is correct, it naturally follows that the main outlines and circumscription of the continents and of the oceans must have been determined at the very beginning of the formation of inequalities upon the earth's surface, and remained essentially the same through all geological ages, varying only as to their relative height and depth, as well as to their respective extension.

Such considerations enable us now to raise the question of the age of the Gulf Stream. Our present knowledge of the atmospheric and oceanic currents justifies the assumption that, — owing to the rotation of the earth upon its axis, and taking for granted that the latter has never changed its poles, — the great equatorial currents, fostered by the trade-winds, must flow in an east-westerly direction and be fed by northerly and southerly polar currents slanting westwards towards the equator. As long as the chain of the Andes did not intercept the Atlantic equatorial current, it must have been continuous with the great Pacific current; and, as stated by A. Agassiz, in another report, p. 305, there is palæontological evidence that during the cretaceous period the through channel was still open. I may add that I have myself seen the evidence, along the base of the Rocky Mountains, and on the western borders of the Amazonian Valley, of the post-cretaceous elevation of the great mountain range which rises like a huge barrier on the western side of the North and South American Continents, dividing the Pacific water-shed from that which feeds the Atlantic. We are thus justified in assuming that, even during the cretaceous period, there existed a great North Atlantic current, flowing from the northeast in a southwest direction, and that the Gulf Stream has assumed its present course in the opposite direction since that period; that is, since the Rocky Mountains and Andes have joined hands across Central America. This result adds greatly to the interest excited by the cretaceous and tertiary character of some of the animals discovered by M. Pourtales in the deeper parts of the Gulf Stream. The true significance of this fact is, however, too foreign to this report to justify a discussion of its bearing upon the question of the origin of the present faunæ.

It would be of the highest importance to ascertain, by actual observation, the whole extent of the range of the deep-sea fauna recently discovered in the Gulf Stream, between the coasts of Florida and Cuba. To secure this information a great amount of dredging must be done from the eastern shores of the United States to the deepest waters of the Atlantic Ocean, all along the coast from Florida to our Northern States. Until such a comprehensive survey has been carried out, we can only combine, as well as we may, the scanty data on hand, in our attempt to form any idea of the northerly extension of the animals now known to exist in that part of the Gulf Stream flowing between Florida, Cuba, and the Bahamas. Happily the English and the Scandinavian naturalists have already collected a vast amount of information concerning the marine faunæ of the coasts of Norway and the British Islands, and the recent expeditions undertaken by the Swedish and by the English governments, with a view of exploring the greatest depths of the Atlantic Ocean, cannot fail to afford the most valuable means of comparison between the faunæ of the two sides of the Atlantic in different latitudes. From the reports of the British Association for Advancement of Science, from the publications of Professor Sars, from the reports of Professors Carpenter, Thompson, and Jeffreys, and from the private communications received from Dr. Smitt and Mr. Ljungman, the naturalists of the Swedish man-of-war Josephine, which recently visited the harbor of Boston, we have been able to ascertain that some of the species of our deep-sea animals of Florida are found far to the north of the British Islands, on the western coast of Norway, and near the Azores, upon the newly discovered "Josephine Bank." Now all these stations lie in the course of the Gulf Stream, as it divides into a northern or Scandinavian and a southern or Lusitanic branch, after crossing obliquely the Atlantic Ocean from our own shores, in the direction of Ireland; and the question naturally arises, Is not this wide distribution of the Florida deep-sea fauna to be directly ascribed to the agency of the Gulf Stream? It can hardly be otherwise, at least within certain limits. But at the same time we must not forget that, in a comparatively recent period, the main motion of the North Atlantic must have been in a north-southerly direction, and that to this day there is a great northern current of cold water sweeping past the eastern shores of the United States; while the southern branch of the Gulf Stream flows in a southerly direction, past the western shores of Southern Europe; so that we may expect a strange mixture of arctic and subtropical animals in the great unexplored depths of the Atlantic, between America and Europe. It is to be hoped that the zeal with which the exploration of the deep ocean has begun may not flag before the whole problem is solved.

One of the most important results of this year's cruise, though not exclusively derived from deep-sea soundings, deserves a special mention in this Report.

Taught by former investigations, upon other classes of animals, that in their affinities and relative standing organized beings exhibit direct relations not only to the changes they undergo while growing, but also to their succession in past ages, and to their present distribution upon the surface of the earth, I lost no opportunity of ascertaining to what extent these relations may also be traceable among the corals. From their simpler organization, and the less prominent differences which distinguish their numerous representatives, it seemed hardly probable that facts could be ascertained plainly bearing upon these questions; and yet, the moment I proceeded with the investigation, I perceived that there was before me a vast field, thus far entirely unexplored, from the survey of which much valuable information could be secured.

A fortunate circumstance unexpectedly favored my researches. In consequence of injuries to a breakwater adjoining Fort Taylor, a large number of granite blocks, which had been three years under water, were hauled up on shore, and I found them covered with a great number of specimens of different species of corals, in various stages of growth. The sürfaces of the granite were still so clean that it was possible to detect the smallest young corals upon them, and to trace so many stages between them and larger ones as to leave no doubt of their specific identity. I made, with the assistance of M. Pourtales, a large collection of these young corals, which I afterwards leisurely compared with one another and with adult stocks of the same species. The result of this comparison I may express in few words: Corals undergo a succession of changes peculiarly their own, and yet hardly less marked than the embryonic changes already known among many animals. If we combine into a series all the changes thus far observed among different families of corals, an unmistakable gradation appears among them, akin to the series which may be traced among other animals in their adult condition, when we take the complication of their structure as a standard of their arrangement. Combining the evidence obtained from adult coral stocks, and their young at various stages of growth, it becomes evident that the representatives of the class of Polyps do not stand upon the same structural level with one another; but that there are higher and lower types among them, recognizable without the aid of embryological data. even though it was the study of the young which led me to the recognition of their relative standing. This is not the place for a discussion of the principles of classification of Polyps. I will only state, what I trust I shall be able to prove hereafter, that the Actinians proper stand lowest; next to them the Madreporarians, and highest the Halcyonarians. And as the Madreporarians form the most prominent feature in the coral reefs, I may add that among them the Turbinolians stand lowest, the Fungians next, then the Astræans, and highest the Madreporians. Now it is a most interesting fact that the successive changes which any representative of these different groups exhibit during their growth recall the characteristic features of the groups immediately below. For instance, young Astræans, before assuming their solid frame, are Actinia-like; their first coral frame is Turbinolia-like; and from that stage they pass into Fungia-like condition, before they assume their characteristic Astræan features.

I will only describe a few cases, in order to establish this correspondence of growth and relative standing of adults upon a firm scientific basis. Besides multiplying through eggs, Actiniæ increase also by budding, and this takes place by a spreading of their base of attachment (abactinal area), from the margin of which new individuals arise and finally detach themselves. Such a mode of enlargement or spreading of a simple individual, by a widening of its base of attachment, I have observed in many genera among Fungians, Astræans, Oculines, and Madrepores. If we take, for instance, a *Siderastræa*, which, by the way, is a Fungian, and not an Astræan, as is shown by the structure of its tentacles, as well as of its coral stock, we find that the large rounded masses formed by these corals are at first thin, spreading disks, which only increase in thickness at a later time. The genus *Mycedium*, which, even in its perfect condition, constitutes a thin, spreading blade, may be compared, making allowance for the generic differences, to a young spreading stock of *Siderastræa*. In Mycedium the mode of growth is very plain. A series of specimens collected by M. Pourtales shows the beginning of such a coral community to be a single individual, the margin of which gradually spreads; from this spreading edge are developed additional individuals in the trend of the radiating partitions of the parent individual, spreading in their turn, while they remain connected with one another and with the central individual; this process going on until the coral stock has assumed its ordinary dimensions. Let us now conceive that the individual Polpys, united as a coral-stock in *Mycedium*, should increase vertically, as well as spread and multiply horizontally, the process of elevation beginning in the centre, we should have a *Siderastræa*. It is worth noticing, further, that the original central individual, from which the Mycedium community arises, is a diminutive Fungia, up to the time when new individuals arise around its margin. I have before me such young Myceediums, which might be mistaken for small specimens of Fungiæ, such as have been figured by Stuchbury and Milne Edwards. We are therefore justified in considering the genus *Fungia* as an embryonic form of the type of Fungians, when we compare it to *Mycedium*, *Agaricia*, or *Siderastræa;* and the propriety of assigning to Fungia proper a lower position in a natural system than that belonging to the compound types of the family must be obvious to all. The genus *Zoopilus* is only a Mycedium in which the individuals of the community are more intimately blended together than in *Halomitra*, thus forming a transition to Fungia proper. I have had an opportunity of examining also the growth of *Agaricia*. With the exception of generic differences in its structure, it exhibits in its growth the same features as Mycedium. The very youngest Myceediums exhibit Turbinolian affinities, inasmuch as the interseptal chambers are open from top to bottom and exhibit neither traverses nor synapticules.

Among Astræans the early growth of a community takes place in the same manner as among Fungians. Naturalists are accustomed to consider the formation of the hemispheric masses of these corals as arising from the formation of vertical buds around and between those which preceded. This mode of enlargement of the communities obtains really in later periods of their growth; but it is not in that way that the foundation of the community is laid. *Astræa annularis*, the most common species among the Madreporarians of Florida, exhibits the formation of these stocks very plainly. The vast number of young stocks of this species which I have collected in every stage of growth leaves no doubt upon the subject. A simple individual Polyp spreads by the elongation of its radiating partition, Mycedium-like, in every direction, giving rise at appropriate distances to new centres or individuals around the first; and this goes on, without a marked vertical enlargement of the new individuals, until the community has acquired a diameter of several inches; just as in the cases of *Mycedium*, *Agaricia*, and *Siderastræa*. The appearance of this spreading margin of the young Astræa stock is so like that of a spreading Fungian, that, if detached from the well-defined circular individuals occupying the centre of the disk, it would unhesitatingly be taken for a fragment of a Fungian. It is only at a later time that in *Astræa annularis* the members of the community are developed in a vertical direction, and the community as a whole is enlarged by the interpolation of new individuals, to assume the form of a hemispheric mass. I have observed the same mode of growth in *Astræa cavernosa*, in *Manicinia*, in *Symphyllia*, in *Favia*, in *Colpophyllia* and in *Meandrina*. Of *Manicina* I possess a series of young still exhibiting their Turbinolian characteristics, with interseptal chambers open from top to bottom, and without a trace of traverses. The corals with undulating and meandering trenches arise also, like compound Fungians and compound circular Astræans, from single individuals, with circular outlines spreading from the margin, after the fashion of Fungians, just as much as Astræa proper. The peculiarities exhibited by each type cannot well be described without figures; I shall therefore not attempt here a detailed report of all the facts I have observed, reserving a fuller statement for a special memoir. But *Meandrina* exhibits some features so particularly interesting that I cannot pass on without giving some more special account of them. When the young spreading Meandrina has acquired the dimensions of about half an inch, still plainly exhibiting Fungian characteristics, its marginal extension gives rise to the formation of isolated clusters of rising radiating partitions, which stand distinct from one another, just like the characteristic hills of a *Hydnophora;* in fact, the young Meandrina passes from a Fungian into an Hydnophora state, and in its farther extension, which takes place when the community has about two inches in diameter, when the trenches and walls begin to curve, while the margin is still spreading horizontally, the young Meandrina assumes the appearance of an *Aspidiscus*, a genus of the cretaceous period ; in truth, it then resembles Aspidiscus and Hydnophora more than any adult representative of its own genus. We have here the highest complication of the Astræoid type, exhibiting successively Fungian characters, common Astræa characters, Hydnophora characters and Aspidiscus peculiarities, before it assumes its own prominent and permanent features. The Turbinolian stage I have had no opportunity of observing in Meandrina. This genus seems to grow more rapidly than other Astræans, and it was with difficulty I secured the earlier Astræan and Fungian stages of its growth.

Zoölogists are so accustomed to consider the *Oculinidæ* and *Madreporaidæ* as branching corals, that they may be surprised at the announcement that these families, like the Astræans, have their spreading Fungian-like stage of growth, — and yet I have before me a complete series of Oculina stocks, among which small clusters of individuals in simple juxtaposition exhibit the earliest condition thus far observed ; others consist of flat spreading disks, several inches in diameter, without a vertical branch ; while in others the branches seem to rise as small knobs and then begin to assume the ramified forms under which the Oculinas are generally represented in our museums. Even our most branching Madrepores, such as *Madrepora prolifera* and *cervicornis*, form spreading disks before they rise into branching stocks. *Madrepora palmata* is, as it were, an overgrown embryonic condition of the ramified species.

This summary of the facts concerning the growth of our coral-stocks can leave no doubt respecting the correspondence of the phases of growth of the Polyps and the gradation which may be recognized in full-grown communities of these animals. If we extend these comparisons to the representation of the class in earlier geological periods, down to the present time, we cannot fail to perceive that the series exhibiting their succession in time coincides also with that of their relative standing and that of their growth. In order to make this plain it would be necessary to enter into a discussion upon the real affinities of corals, for which this is not the place. I would state, however, that the knowledge I have acquired of the Fungian affinities of Siderastræa leaves no doubt in my mind that a large number of corals, among the representatives of the Oölithic series generally referred to the family of Astræans, are genuine Fungians; thus showing a preponderance of the Fungian type at a period anterior to that in which the Astræans became more numerous. That the genuine Madreporians are of still later date in geological history has long been known. I would state also that from an examination of the soft parts of several representatives of the family of *Eupsammidæ*, I have satisfied myself that they are not allied to the true Madrepores, as Milne Edwards and Haime supposed, but belong in the neighborhood of the Turbinolians. If we now remember that the Acalephian affinities of the *Tabulata* are unquestionable, and that, with them, the *Rugosa* must be removed from the class of Polyps and referred to that of the Acalephs; and if we further take into consideration the fact that *Palæodiscus* belongs to the type of Rugosa, and not to the family of Fungians, it becomes evident that in their order of succession from the Mesozoic era, in which they make their first appearance, the great types of the class of Polyps have succeeded one another in the following order: first Turbinolians, next Fungians, next Astræans, and last Madrepores; in exactly the sequence in which these types stand to one another, as far as their structural gradation is concerned, and in exactly the same order in which, during their growth, these corals pass from one stage to another.

If we now turn our attention to the distribution of these animals in the ocean at different depths, it is equally unquestionable that the lowest types — Turbinolians and Eupsammidæ — range in the greatest depths, and form there the principal feature of the coral population. It is equally apparent, from the facts ascertained by the dredgings of M. Pourtales, that the various types of Astræans, including Stylaster, Oculina, and Parasmilia, appear next, the Stylasterians and Oculinians as the lowest ranging deepest, and that Astræa proper, Manicina, Meandrina, and Colpophylia, with Porites, are already types of shallower waters, while the Madrepores are, of all the genuine corals, those which have the most limited bathymetric range. I have not yet sufficient data upon the relative standing of the different types of Halcyonaria to extend this comparison to that order of Polyps. The results enumerated above are, however, already sufficient to show that, in the relations animals exhibit among themselves and to the elements in which they live, there are other connections to be traced besides those arising from descent or the struggle for existence.

I have reasons for supposing that the investigation of the Gulf Stream, as presented in former Reports of the Coast Survey, has not yet reached its easternmost boundary. It was natural that the earlier explorations should have stopped where the great current no longer exhibits its characteristic peculiarities, and that its eastern range should have been traced with less minuteness than its alternate streaks of warm and cold water nearer shore. But now that the influence of the Gulf Stream upon the geographical distribution of organized beings appears distinctly as one of its most characteristic, though least suspected features, it will be necessary to extend the survey farther out into the Atlantic Ocean.

For the present I would suggest the following lines for soundings and dredgings: —

1°. One line from the Atlantic coast in Georgia or South Carolina to deep water, outside the range of the Gulf Stream, chiefly with a view of tracing the northern limits of the fauna of Florida.

2°. One line from the Atlantic coast in North Carolina or Virginia to the Bermudas and beyond; with the special view of connecting the deep-water fauna of the Gulf Stream with the shore fauna of these islands and that of our own coast, upon which Cape Hatteras marks the limits between two natural zoölogical littoral provinces.

3°. One line from Cape Cod or from the coast of Maine, in a south-east direction, across the Gulf Stream, with the special view of ascertaining the boundaries between the shore fauna and that of the Gulf Stream at this latitude. This line would afford the means of extensive comparisons with our Acadian fauna, which has already been carefully explored as far as Grand Manan by Dr. Stimpson, Prof. Verrill, and myself. Shorter lines from Sandy Hook to the trough of the Gulf Stream would add much value to the results obtained by dredgings from the coast of Massachusetts or Maine across the Gulf Stream.

I would also recommend one line across the Caribbean Sea, from Cumana or LaGuayra to Porto Rico, and one outside of the Small Antilles from the mouth of the Orinoco to Antigua; with the special view of ascertaining the area over which the mud deposits of the Orinoco spread, and how far they affect the Caribbean Sea.

But the most important line beyond our immediate shores, connected with the past history of the Gulf Stream, would be one from Panama westward into the deepest waters of the Pacific; for dredgings in that direction may prove that the deep-sea fauna is identical on both sides of the Isthmus, and that therefore, at a comparatively recent epoch, the great equatorial current of the Atlantic extended without serious obstructions over parts of Central America to the Pacific Ocean.

CAMBRIDGE, November 16, 1869.