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FROM THE

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1. The Transactions shall be published in numbers, at short intervals, under the direction of the Committee of Publication.

2. Every communication to the Society, which may be considered as intended for a place in the Transactions, shall immediately be referred to a committee to consider and report thereon.

3. If the committee shall report in favour of publishing the communication, they shall make such corrections therein as they may judge necessary to fit it for the press; or if they shall judge the publication of an abstract or extracts from the paper to be most eligible, they shall accompany their report with such abstract or extracts. But if the author do not approve of the corrections, abstract, or extracts, reported by the committee, he shall be at liberty to withdraw his paper.

4. The order in which papers are read before the Society shall determine their places in the Transactions, priority of date giving priority of location.

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TRANSACTIONS

OF

THE AMERICAN PHILOSOPHICAL SOCIETY.

ARTICLE I.

Description of New Freshwater and Land Shells. By Isaac Lea. Read December 19, 1834.

ANODONTA GIGANTEA. Plate I. fig. 1.

Testâ ovatâ, inflatâ, antice latissimâ, postice angulatâ, inæquilaterali; valvulis crassis; natibus prominentibus; margaritâ albâ.

Shell ovate, inflated, broad before, angular behind, inequilateral; valves thick; beaks prominent; nacre pearly white.

Hab. near Port Gibson. T. W. Robeson.
My Cabinet.

Diam. 3·3, Length 4·8, Breadth 7·8 inches.

Shell ovate, inflated, broad before, angular behind, inequilateral; substance of the shell thick; beaks prominent, granulate at tip; epidermis dark brown, smooth; anterior and posterior cicatrices both confluent; dorsal cicatrices near the margin anterior to the beaks; cavity of the shell very deep; cavity of the beaks deep; nacre white and richly pearly.

Remarks.—A single valve only of this species could be obtained, and that many years ago. Several attempts to procure more have proved abortive, and I now venture from it to establish the species. This valve has a greater area than any of the *Naïades* which I have yet seen, and its capacity is also greater. It differs in outline, as well as in size, from any species yet described, being broader before and more angular behind.

Anodonta ovata. Plate II. fig. 2.

Testâ ovatâ, subcompressâ, transversâ, inæquilaterali; valvulis subtenuibus; natibus prominulis; margaritâ albâ.

Shell ovate, somewhat compressed, transverse, inequilateral; valves rather thin; beaks somewhat prominent; nacre white.

Hab. near Marietta, Ohio. Dr Hildreth.
My Cabinet.
Cabinet of Mr Hyde.

Diam. 1·5, Length 2·2, Breadth 4 inches.

Shell ovate, somewhat compressed, transverse, inequilateral; substance of the shell rather thin; beaks somewhat prominent and granulate at tip; ligament rather short; epidermis greenish brown, wrinkled, apparently without rays; anterior and posterior cicatrices both confluent; dorsal cicatrices placed in the centre of the cavity of the beaks; cavity of the shell deep; cavity of the beaks shallow; nacre white, sometimes bluish.

Remarks.—Very recently this shell has been sent to me by Dr Hildreth. I presume it is from the vicinity of Marietta, where he resides. It is certainly distinct from any species with which I am acquainted. It perhaps most resembles the *cataracta* (Say), but differs in being more elliptical. It also differs in the beaks, the *cataracta* being undulated, while this shell is rather granulate at tip.

Unio bengalensis. Plate II. fig. 3.

Testâ ellipticâ, transversâ, inæquilaterali, inflatâ; valvulis tenuissimis; natibus minuté undulatis; dentibus cardinalibus tenuibus et laminatis; lateralibus sublongis, linearibusque; margaritâ purpureâ.

Shell elliptical, transverse, inequilateral, inflated; valves very thin; beaks minutely undulated; cardinal teeth thin and lamellar; lateral teeth rather long and linear; nacre purple.

Hab. Bengal. Dr Burrough.
Cabinet of Dr Burrough.

Diam. ·8, Length 1·3, Breadth 2·2 inches.

Shell elliptical, transverse, inequilateral, inflated about the umbones; substance of the shell very thin; beaks somewhat inflated, beautifully and minutely undulated, the undulations being parallel and oblique to the plane of the disk, and angular on the umbonial slope; ligament thin and straight; epidermis reddish brown and obscurely rayed; cardinal teeth very small, thin, lamellar, and single in both valves; lateral teeth rather long, linear, slightly divided in the left valve; anterior and posterior cicatrices indistinct, and both confluent; dorsal cicatrices small, and placed in the centre of the cavity of the beaks; palleal impression scarcely perceptible, and remote from the border; cavity of the shell deep; cavity of the beaks rounded; nacre very thin and purple.

Remarks.—Among the numerous rare and beautiful shells brought by Dr Burrough from his last voyage, was the single specimen described above. It was purchased in Calcutta, and Dr B. thinks it inhabits the Ganges. It is a very distinct species, and differs in the teeth from all those with which I am acquainted. Without a close examination it might be taken for an *Anodonta*, the teeth being very small and almost linear. In these it resembles somewhat the *Symphynota discoidea* (nobis) and *S. bi-alata* (nobis), but the curve differs, and the lateral tooth of the left valve is distinctly cleft. In the teeth there is certainly a strong approximation to that group which possesses teeth with a simple curve line. In the beaks it is remarkable for the close, parallel undulations, which extend some distance from their apex, and make, by being reflected, quite an acute angle on the umbonial slope.

Unio venustus. Plate II. fig. 4.

Testâ ellipticâ, transversâ, subcompressâ, luteâ, inæquilaterali; valvulis subtenuibus; natibus vix prominentibus; dentibus cardinalibus parvis; lateralibus subcurvis; margaritâ albâ et iridescente.

Shell elliptical, transverse, somewhat compressed, yellowish, inequilateral; valves somewhat thick; beaks scarcely prominent; cardinal teeth small; lateral teeth rather curved; nacre pearly white and iridescent.

Hab. Potosi, Missouri. John Perry, Esq.
Cincinnati, Ohio. T. G. Lea.
My Cabinet.

Diam. ·5, Length 1, Breadth 1·7 inches.

Shell elliptical, transverse, somewhat compressed, yellowish, inequilateral; substance of the shell somewhat thick; beaks scarcely prominent, pointed at tip, and furnished with very minute undulations; ligament rather short; epidermis yellow, with green, somewhat sinuous rays; cardinal teeth small, elevated, deeply cleft in the left valve; lateral teeth somewhat long, rather curved and enlarged at the posterior end; anterior cicatrices distinct; posterior cicatrices confluent; dorsal cicatrices placed in the centre of the cavity of the beaks; cavity of the shell rather shallow; cavity of the beak small and angular; nacre thin behind, pearly white and iridescent.

Remarks.—The specimen here figured was sent to me some years since by John Perry, Esq., who obtained it near the lead mines of Potosi, in Missouri. Subsequently my brother, T. G. Lea, has found the species near Cincinnati. As it very strongly resembles a young *U. crassus* (Say), it may very properly be placed in the group of which that species may be considered the type.

Unio Vaughanianus. Plate III. fig. 5.

Testâ obovatâ, transversâ, subinflatâ, posticé subemarginatâ, inæquilaterali; valvulis tenuibus; natibus vix prominentibus; dentibus cardinalibus parvis erectisque; lateralibus rectis; margaritâ salmonis colore tinctâ.

Shell obovate, transverse, somewhat inflated, subemarginate behind, inequilateral; valves thin; beaks scarcely prominent; cardinal teeth small and erect; lateral teeth straight; nacre salmon colour.

Hab. Sawney's Creek, near Camden, S. C. Professor Ravenel.
My Cabinet.
Cabinet of Professor Ravenel.
Cabinet of Dr Blanding.
*Unio Carolinensis.** Professor Ravenel's Letter.

Diam. ·7, Length 1·2, Breadth 2 inches.

Shell obovate, transverse, somewhat inflated, enlarged towards the posterior basal margin, behind which it is subemarginate, slightly depressed before the umbonial slope, inequilateral; substance of the shell thin and iridescent behind, thicker and salmon coloured before; ligament rather thin and short; epidermis almost black, and obscurely rayed posteriorly; cardinal teeth double in both valves, small, compressed and erect; lateral teeth straight; anterior cicatrices distinct; posterior cicatrices confluent and scarcely visible; dorsal cicatrices placed in the centre of the cavity of the beaks; cavity of the shell deep; cavity of the beaks shallow and angular; nacre salmon coloured and beautifully iridescent.

Remarks.—Professor Ravenel very kindly sent me specimens of this shell nearly two years ago, and I owe to Dr Blanding the possession subsequently of others. This species distinctly appertains to that group of which the *U. nasutus* (Say) may be considered the type. It is rayed like that shell, but may at once be distinguished by the

* This name being preoccupied by Bosc for a shell of this genus, I have considered it necessary to give it another, and propose that of the worthy treasurer of this society, John Vaughan, Esq.

bluntness of the posterior portion of the shell, as well as by its enlargement towards the basal margin.

Unio pulcher. Plate III. fig. 6.

Testâ ellipticâ, transversâ, subcompressâ, inæquilaterali; valvulis subcrassis; natibus irregulariter undulatis; epidermide luteâ, radiis tenebroso-viridibus; dentibus cardinalibus erectis; lateralibus prope eorum fines majoribus; margaritâ colore caryophylli tinctâ.

Shell elliptical, transverse, somewhat compressed, inequilateral; valves rather thick; beaks irregularly undulated; epidermis yellow, with dark green rays; cardinal teeth erect; lateral teeth enlarged near their termination; nacre pink coloured.

Hab. near Nashville, Tenn. Professor Troost.
Cabinet of Professor Troost.

Diam. ·8, Length 1·3, Breadth 2·2 inches.

Shell elliptical, transverse, somewhat compressed, inequilateral; substance of the shell rather thick; beaks rather elevated and irregularly undulated; ligament rather long and straight; epidermis yellow; rays dark green, numerous, diverging from the point of the beak over the whole disk; cardinal teeth large, erect, and disposed to be double in both valves, in the left widely cleft; lateral teeth rather long, somewhat curved, enlarged near their termination; anterior cicatrices distinct; posterior cicatrices confluent; dorsal cicatrices placed in the centre of the cavity of the beaks; palleal impression rather indistinct: nacre beautifully pearly and pink coloured.

Remarks.—This species belongs to that group of *Uniones* of which the *crassus* of Say is the type. It differs from the *crassus* in being a smaller species, in the undulations of the beaks and in the rays. The pink colour, which is more intense at the region of the teeth, is strikingly beautiful. The rays of this specimen are very dark, and more defined than in any species I have remarked. I am indebted to the great kindness of Professor Troost for the loan of this shell, to describe and figure.

Unio obscurus. Plate III. fig. 7.

Testâ ellipticâ, transversâ, inæquilaterali, subinflatâ; valvulis subcrassis; natibus irregulariter undulatis; dentibus cardinalibus elevatis; lateralibus prope eorum fines majoribus; margaritâ albâ et purpureâ.

Shell elliptical, transverse, inequilateral, somewhat inflated; valves rather thick; beaks irregularly undulated; cardinal teeth elevated; lateral teeth larger near their termination; nacre purple and white.

Hab. near Nashville, Tenn. Professor Troost.
Cabinet of Professor Troost.
Cabinet of Mr Hyde. (White nacre.)

Diam. ·8, Length 1·1, Breadth 2 inches.

Shell elliptical, transverse, inequilateral, somewhat inflated; substance of the shell rather thick; beaks slightly elevated and irregularly undulated; ligament rather short; epidermis yellowish brown; rays placed on the posterior part, and somewhat linear; cardinal teeth double in both valves, erect, crenulate, widely cleft in the left; lateral teeth rather long, straight, and enlarged near their termination; anterior cicatrices distinct; posterior cicatrices confluent; dorsal cicatrices placed on the inferior part of the lateral teeth; palleal impression distinct; nacre white anteriorly, purple posteriorly.

Remarks.—I owe to Professor Troost the opportunity of describing this shell. There are no very striking characters in it, but it cannot be classed with propriety with any species which I know. It seems to possess a resemblance to *U. Nashvillianus* (nobis), and to *U. glans* (nobis), two very different species. It is however distinct, and should not be confounded with either. The single specimen here noticed is the only one, I believe, yet found. When more are observed, characters somewhat different may be noticed.

UNIO FISHERIANUS. Plate IV. fig. 8.

Testâ scaleniâ, obliquo-transversâ, compressâ, valde inæquilaterali; valvulis tenuibus; natibus compressis; dentibus cardinalibus lamelliformibus; lateralibus longis subcurvisque; margaritâ purpureâ.

Shell scaleniform, obliquely transverse, compressed, very inequilateral; valves thin; beaks compressed; cardinal teeth lamellar; lateral teeth long and somewhat curved; nacre purple.

Hab. Head of Chester River, Md. Mr Thomas Fisher.
My Cabinet.

Diam. ·6, Length 1·1, Breadth 2·7 inches.

Shell rounded before and acutely angular behind, obliquely transverse, compressed, very inequilateral; substance of the shell thin; beaks flattened and placed near the anterior margin; umbones flattened; umbonial slope elevated; ligament thin and short; epidermis dark brown, smooth; cardinal teeth lamelliform, rather conical, widely cleft in the left valve; lateral teeth long and somewhat curved; anterior cicatrices distinct; posterior cicatrices confluent; dorsal cicatrices placed in the centre of the cavity of the beaks; palleal impression imperceptible; cavity of the shell very shallow; cavity of the beaks very small; nacre purple.

Remarks.—This belongs to that group of Uniones of which the *nasutus* (Say) is the type. It differs from that species in being more compressed, in being more angular posteriorly and in being apparently without rays. In outline it approaches the *Grayanus* and *Shepardianus* (nobis), but cannot be confounded with either of them.

I owe this species to Mr Thomas Fisher, who brought it from Chester River five or six years ago.

Unio jejunus. Plate IV. fig. 9.

Testâ suboblongâ, valde transversâ, compressâ, inæquilaterali; valvulis subtenuibus; natibus compressis; dentibus cardinalibus parvis; lateralibus longis rectisque; margaritâ vel purpureâ vel albâ.

Shell somewhat oblong, very transverse, compressed, inequilateral; valves rather thin; beaks compressed; cardinal teeth small; lateral teeth long and straight; nacre purple or white.

Hab. Roanoke.
Also, near Camden, S. C. Dr Blanding.
My Cabinet.
Cabinet of Dr Blanding.

Diam. ·5, Length 1·2, Breadth 2·5 inches.

Shell somewhat oblong, very transverse, compressed, inequilateral; flattened on the sides; subbiangular behind; substance of the shell rather thin; beaks compressed, scarcely prominent; ligament thin and long; epidermis very dark brown and much wrinkled; cardinal teeth small, double in the left and single in the right valve; lateral teeth long, straight, and enlarged at the posterior end; anterior cicatrices distinct; posterior cicatrices confluent; dorsal cicatrices placed in the centre of the cavity of the beaks; cavity of the shell very shallow; cavity of the beaks very small; nacre purple or white.

Remarks.—In crossing the Roanoke on the mail-route between Winton and Tarborough in 1827, I found a few imperfect specimens of this shell. Last year Dr Blanding had the kindness to give me a more perfect specimen from near Camden, S. C., which confirmed me in my previous impression of its being distinct from any described species. In its general outline and appearance it strongly resembles the *U. complanatus* (Soland.), but is more compressed, and is disposed to be biangular behind.

Unio arctior. Plate IV. fig. 10.

Testâ angulato-ellipticâ, valde transversâ, compressâ; valvulis subtenuibus; natibus compressis et undulatis; dentibus cardinalibus parvis; lateralibus longis; margaritâ albâ et salmonis colore tinctâ.

Shell narrow-elliptical, very transverse, compressed; valves rather thin; beaks compressed and undulated; cardinal teeth small; lateral teeth long; nacre white and salmon colour.

Hab. Ohio River, near Cincinnati. T. G. Lea.
My Cabinet.
Cabinet of P. H. Nicklin.
Cabinet of Professor Vanuxem.
Cabinet of William Hyde.

Diam. ·7, Length 1·1, Breadth 2·3 inches.

Shell narrow, elliptical, very transverse, subangular behind, flattened on the sides; substance of the shell rather thin; beaks compressed, undulated; ligament rather long and slender; epidermis dark brown, wrinkled; cardinal teeth very small; lateral teeth long, straight, and enlarged at posterior end; anterior cicatrices distinct; posterior cicatrices confluent; dorsal cicatrices situated on the plate between the cardinal and lateral teeth; cavity of the shell very shallow; cavity of the beak shallow and subangular; nacre white, salmon colour, and sometimes purple.

Remarks.—I have for some years been in doubt if this should be separated from the *gibbosus* of Barnes, of which it has generally been considered a variety. After proper examination, believing it to be distinct, I propose to separate it from that species. It certainly very closely resembles the *gibbosus*, but may at once be distinguished by its being a smaller shell, and possessing much less substance. The *gibbosus* is generally purple; this species is usually white or salmon colour, but sometimes purple.

UNIO TURGIDUS. Plate V. fig. 11.

Testâ subrotundâ, inflatâ, tuberculatâ, subæquilaterali; valvulis crassis; natibus elevatis; dentibus cardinalibus grandibus compressisque; lateralibus brevibus subrectisque; margaritâ albâ et iridescente.

Shell subrotund, inflated, tuberculated, nearly equilateral; valves thick; beaks elevated; cardinal teeth large and compressed; lateral teeth short and nearly straight; nacre white and iridescent.

Hab. near New Orleans. Mr Barabino.
My Cabinet.

Diam. 1, Length 1·3, Breadth 1·6 inches.

Shell nearly round, inflated, tuberculated, nearly equilateral, subangular behind; substance of the shell thick; beaks thick and elevated; umbonial slope scarcely elevated; ligament short and thick; epidermis dark brown; tubercles small, crowded on the umbones, and sparse towards the margin; cardinal teeth very large, compressed, the anterior section being much elevated and much enlarged; lateral teeth short and nearly straight; anterior cicatrices deeply impressed and distinct; posterior cicatrices distinct, the smaller being scarcely visible; dorsal cicatrices placed on the inferior part of the cardinal tooth; palleal impression deep; cavity of the shell rounded; cavity of the beaks deep and angular; nacre pearly white and iridescent.

Remarks.—For several specimens of this species I am indebted to the kindness of the late Mr Barabino. It has more resemblance to the *U. pustulosus* (nobis) than any shell with which I am acquainted, but differs in being more inflated, in the number, size and position of the tubercles. In the *pustulosus* these are large and more frequent towards the basal margin, the beaks being nearly devoid of them, while in the *turgidus* they are numerous on the umbones and towards the beaks. In the cardinal teeth there is a still greater disparity. In the former species these are spread out, while in the latter they are compressed, and present a very remarkable character in the great elevation of the anterior section. The large ray, so generally found on the *pustulosus*, is not found on the specimens which I have seen of *turgidus*. This or more may perhaps be found on perfect or young individuals.

Unio coccineus. Plate V. fig. 12.

Testâ subtriangulari, obliquâ et subcompressâ; valvulis antice crassioribus; natibus subelevatis retusisque; dentibus cardinalibus crassis; lateralibus crassis et subcurvis; margaritâ coccineâ.

Shell subtriangular, oblique and somewhat compressed; valves thicker anteriorly; beaks rather elevated and retuse; cardinal teeth thick; lateral teeth thick and somewhat curved; nacre bright red.

Hab. Ohio River, near Marietta. Dr Hildreth.
Mahoning river, Ohio. Dr Kirtland.
Near Columbus, Ohio. Mr Lapham.
My Cabinet.
Cabinet of P. H. Nicklin.
Cabinet of W. Hyde.
Cabinet of Professor Vanuxem.
Unio coccineus. Dr Hildreth's letter.

Diam. 1·7, Length 2, Breadth 2·2 inches.

Shell subtriangular, oblique, somewhat compressed; substance of the shell thick anteriorly and thinner posteriorly; beaks rather elevated, retuse, and possessed of one or two undulations at the apex; ligament rather long and curved; epidermis dark reddish brown, with regular distinct marks of growth; cardinal teeth large, crenate, and deeply cleft in the left valve, and emerging from a pit in the right; lateral teeth rather long, thick, and somewhat curved; anterior cicatrices distinct, the great one forming a deep pit; posterior cicatrices distinct, the smaller one being placed at the end of the lateral tooth; dorsal cicatrices situated on the inferior part of the cardinal tooth; cavity of the shell shallow; cavity of the beaks rather deep and angular; nacre bright red, sometimes salmon, rarely white.

Remarks.—About eighteen months since, Dr Hildreth sent me a single specimen of this species, which he communicated under the name of *coccineus.* I have since received from Dr Kirtland some fine suites from Poland, Ohio, where they seem to be common. In the interior it resembles *U. pyramidatus* (nobis). It is, however, easily distinguished by its being more compressed, less inflated on the umbones, and in the beaks being less elevated.

UNIO SOLIDUS. Plate V. fig. 13.

Testâ obliquâ, inflatâque; valvulis crassissimis; natibus elevatis retusisque; epidermide rufo-viridi; dentibus cardinalibus crassis; lateralibus obliquis, brevibusque; margaritâ albâ.

Shell oblique, inflated; valves very thick; beaks elevated and retuse; epidermis rusty-green; cardinal teeth thick; lateral teeth oblique and short; nacre white.

Hab. Ohio River, at Cincinnati. T. G. Lea.
Mahoning River, Ohio. Dr Kirtland.
My Cabinet.

Diam. 1·1, Length 1·7, Breadth 1·8 inches.

Shell oblique, inflated, much enlarged at the umbones; substance of the shell very thick; beaks very much elevated, retuse, and possessed of one or two undulations at the apex; ligament rather short and thick; epidermis rusty-green, and sometimes obscurely rayed; cardinal teeth thick, crenate, and deeply cleft in the left, and emerging from a pit in the right valve; lateral teeth thick, slightly curved and nearly parallel with the line of the cardinal teeth; anterior cicatrices distinct, the great one forming a deep pit; posterior cicatrices distinct, the smaller one being placed at the end of the lateral teeth; dorsal cicatrices situated on the interior of the plate between the cardinal and lateral teeth; cavity of the shell shallow; cavity of the beaks rather deep and angular; nacre pearly white.

Remarks.—This species has a strong resemblance to the *U. undatus* (Barnes), and I have only now, after having had several specimens for some years in my possession, satisfied myself, by examining complete suites, of its being specifically different. It may be distinguished by its being more rounded at the basal margin, by its more elevated beaks, by its colour being more green, and, when the rays exist, in their being more capillary. In the elevation and retuseness of the beaks it resembles the *U. pyramidatus* (nobis), but differs in the depression before the umbonial slope in that shell, and in being white in the nacre, while that species is red. The undulations of the beaks can only be observed when the shell is perfect there, and I have observed it so but in very young individuals.

Unio Hydianus. Plate VI. fig. 14.

Testâ ellipticâ, transversâ, radiatâ, valde inæquilaterali, subinflatâ; valvulis subcrassis; dentibus cardinalibus elevatis; lateralibus longis, à cardinalibus separatis; margaritâ albâ et iridescente.

Shell elliptical, transverse, rayed, very inequilateral, somewhat inflated; valves rather thick; cardinal teeth elevated; lateral teeth long and separated from the cardinal teeth; nacre pearly white and iridescent.

Hab. Teche River, Louisiana. W. M. Stewart.
Vicinity of New Orleans. Mr Barabino.
My Cabinet.
Cabinet of Mr Stewart.
Cabinet of Mr Hyde.

Diam. 1·1, Length 1·4, Breadth 2·5 inches.

Shell elliptical, transverse, usually beautifully rayed, very inequilateral, somewhat inflated; substance of the shell rather thick; beaks placed near the anterior margin; ligament rather long; epidermis yellow; rays dark green and extending over the disk; cardinal teeth double in both valves, erect, conical; lateral teeth rather long, slightly curved; anterior cicatrices distinct; posterior cicatrices confluent; dorsal cicatrices placed in the centre of the cavity of the beaks; palleal impression indistinct; cavity of the shell deep; cavity of the beaks subangular; nacre beautifully pearly white and iridescent.

Remarks. The beautiful specimen figured here I owe to the kindness of Mr W. M. Stewart, who brought it from Louisiana about three years ago. It belongs to the group which contains *Unio radiata*

(Gmel.) and *luteola* (Lam.), (*siliquoideus*, Barnes). It perhaps most resembles the latter, but differs in being a smaller shell, in being more pearly, and in having the beaks nearer to the anterior margin. It is generally found rayed, but in some individuals the rays are wanting; none of my specimens have perfect beaks. I have great pleasure in naming it after one of our most experienced conchologists and most assiduous students of this branch of zoology, Mr William Hyde.

Unio interruptus. Plate VI. fig. 15.

Testâ ellipticâ, compressâ, transversâ, inæquilaterali; valvulis subcrassis; radiis interruptis; natibus compressis; dentibus cardinalibus parvis; lateralibus longis subcurvisque; margaritâ albâ.

Shell elliptical, compressed, transverse; inequilateral; valves somewhat thick; rays interrupted; beaks compressed; cardinal teeth small; lateral teeth rather long and curved; nacre white.

Hab. Harpeth River, Ten. Professor Troost.
My Cabinet.
Cabinet of Professor Troost.

Diam. ·9, Length 1·5, Breadth 2·6 inches.

Shell elliptical, compressed, transverse, inequilateral, subemarginate on the posterior dorsal margin; substance of the shell somewhat thick; beaks rather prominent, somewhat compressed, undulated about the tip; umbones flattened; ligament rather short; epidermis yellow, rather smooth; rays green, broad, interrupted, radiating to all parts of the margin; cardinal teeth small, conical, deeply cleft in the left valve; lateral teeth long, and somewhat curved, enlarged at posterior end; anterior cicatrices distinct; posterior cicatrices confluent; dorsal cicatrices placed in the centre of the cavity of the beaks; cavity of the shell rather shallow; cavity of the beaks small and subangular; nacre pearly white.

Remarks.—Two specimens of this beautiful species were sent to me about three years ago, by Professor Troost, of Nashville. Expecting to receive other specimens from him, I deferred making a description, least they should prove only a variety of *U. crassus* (Say), the young and perfect of which they strongly resemble in many of their characters. The *interruptus* differs in the rays, in the flatness of its sides, and particularly in the undulations of the beaks. The broad interrupted rays of this species are striking, and between them may be usually observed those which are quite capillary. It may be distinguished at once from the *pulcher* (herein described) by its rays, the latter being smaller and not interrupted.

Ampullaria Pealiana. Plate XXIII. fig. 77.

Testâ subglobosâ, lœvi, solidâ, imperforatâ, luteâ, faciatâ ; spirâ acutâ ; anfractibus quinis ; aperturâ subovatâ, fasciatâ.

Shell subglobose, smooth, solid, imperforate, yellow, banded ; spire acute ; whorls five ; aperture subovate, banded.

Operculum horny.

Hab. Turbaco, Colombia, South America. T. R. Peale.
My Cabinet.
Philadelphia Museum.

Diam. 1·1, Length 1·3 inches.

Remarks.—Among the fine collection of rare and beautiful objects in natural history, obtained by Mr Peale during his late journey into Colombia, was this fine *Ampullaria.* The yellow ground of the shell is distinctly marked with rich brown bands, which are visible within. In being imperforate, it resembles the *A. crassa* (Swainson), but differs in being larger, in being more globose, and in having a more effuse outer lip. I dedicate with peculiar pleasure this shell to the discoverer, one of the most enthusiastic and successful cultivators of natural history in our country. Mr Peale found this species in the dry bed of a brook which is devoid of water during half the year.

Paludina hyalina. Plate XXIII. fig. 81.

Testâ obtuso-conicâ, carinatâ, pellucidâ, infrà complanatâ; anfractibus quaternis; suturis valde impressis; aperturâ latè rotundatâ.

Shell obtusely conical, carinate, diaphanous, flattened below; whorls four; sutures very much impressed; aperture widely rounded.

Hab. near Poland, Ohio. Dr Kirtland.

Cabinet of Mr Hyde.

Diam. ·2, Length ·2 of an inch nearly.

Remarks.—Dr Kirtland sent the only specimen of this shell I have seen to Mr Hyde, under the impression that it was a deformed specimen of *Planorbis.* Mr Hyde communicated it to me as a new species, of which there cannot, I think, be a doubt. It is very remarkable for the flatness of the inferior portion of the last whorl, and for the carina on the periphery which this causes. It is perhaps thinner and more transparent than any species yet described.

Melania inflata. Plate XXIII. fig. 98.

Testâ conicâ, inflatâ, tenebroso-corneâ; apice obtuso; anfractibus quinis, subconvexis; columella notatâ; labro valdè expanso.

Shell conical, inflated, dark horn-colour; apex obtuse; whorls five, rather convex; columella marked; outer lip spread out.

Hab. Indian Creek, Vir., West of Alleghany Mountains. P. H. Nicklin.

My Cabinet.
Cabinet of P. H. Nicklin.

Diam. ·4, Length ·6 inches.

Remarks.—I am indebted to Mr Nicklin for this new species, having been found by him in Indian Creek, between the Salt and Red Sulphur Springs. The sinus is so small, that at first view it may easily escape observation. The aperture is large, and in this it has some resemblance to a *Paludina*. Near the base of the columella a purple spot may be usually observed. It resembles most in outline the *M. tuberculata* (nobis), but differs in not being angulated, and being entirely without tubercles. In colour it differs entirely. Some individuals have three coloured purple bands in the interior, while others are devoid of them.

PHYSA AUREA. Plate XXIII. fig. 106.

Testâ sinistrosâ, subinflatâ, aureâ, pellucidâ; spirâ breviusculâ; anfractibus quaternis; labro marginato; aperturâ subinflatâ.

Shell sinister, rather inflated, golden colour, pellucid, shining; spire rather short; whorls four; outer lip margined; aperture somewhat inflated.

Hab. Hot Spring, Bath county, Virginia. P. H. Nicklin.
My Cabinet.
Cabinet of P. H. Nicklin.

Diam. ·3, Length ·5 inches.

Remarks.—Mr Nicklin informed me that he found the *Physa aurea* in a little water-course, by which a hot and a cold spring discharge their mingled waters. The former exhibits a temperature of 106 degrees, and the latter of about 56 degrees of the scale of Fahrenheit.

Near the meeting of the waters, one side of the little stream is cold and the other side hot; and multitudes of these beautiful *Physæ* are to be found on both sides of the line of junction, availing themselves of the power which the locality affords them, of changing their climate according to their fancy.

Continuation of Mr Lea's Paper. Read, January 2d, 1835.

UNIO LAMELLATUS. Plate VI. fig. 16.

Testâ subovatâ, transversâ, subinflatâ, nitidâ; valvulis tennuissimis; natibus vix prominulis, undulatis; dentibus cardinalibus longis, tenuibus et laminatis; lateralibus longis, tenuibus subrectisque; margaritâ cæruleâ.

Shell subovate, transverse, somewhat inflated, shining; valves very thin; beaks scarcely prominent, undulated; cardinal teeth long, thin and lamellar; lateral teeth long, thin and nearly straight; nacre bluish.

Hab. Bengal. Captain Lang.

My Cabinet.

Diam. 1, Length 1·5, Breadth 2·6 inches.

Shell subovate, transverse, somewhat inflated, carinate behind; dorsal line nearly straight; substance of the shell very thin; beaks somewhat prominent, with minute undulations following the umbonial slope; umbonial slope furnished with two capillary raised lines, running nearly parallel; ligament rather short; epidermis dark brown and finely polished; rays none; cardinal teeth long, thin, lamellar, single in the *left* valve and double in the *right;* lateral teeth long, thin, and nearly straight; anterior cicatrices distinct; posterior cicatrices confluent; dorsal cicatrices situated nearly in the cavity of the beaks; cavity of the shell somewhat deep; cavity of the beak shallow; nacre bluish.

Remarks.—Several specimens of this shell, with the animal, were brought by Captain Lang in his late voyage to Calcutta. In the conformation of the animal I could perceive no difference from that of our common species. It may be considered to be most nearly allied to *U. Corrianus* (nobis). It differs from that shell in its most remarkable character, its cardinal teeth, which are longer and more lamelliform than in any species I am acquainted with. The teeth of this species are the more interesting, as they present a link approaching those *Naïades* which have a single line under the dorsal margin, and which are connected with this species through the *Symphynota Bengalensis* (nobis). Intervening species may be discovered to make the "nuance" complete.

Melania plicata. Plate XXIII. fig. 95.

Testâ subturritâ, plicatâ, castaneâ, tuberculatâ, fasciatâ; suturis impressis; aperturâ ovatâ.

Shell somewhat turrited, folded, chesnut coloured, tuberculated, banded; sutures impressed; aperture ovate.

Hab. Bengal?

My Cabinet.

Diam. ·8, Length 2 inches.

Remarks.—Among numerous freshwater shells brought by Captain Lang from Calcutta, I obtained a single specimen of this species. About one-third the distance below the suture it is furnished with a row of tubercles, each of which terminates a somewhat oblique fold. Inferior to this there is a disposition to carination. The tubercles give the shell slightly the aspect of *M. amarula* (Lam.), but it cannot be mistaken for that species, as its spire is quite elevated. The individual above described being decollated, it is impossible to give the number of whorls, or the character of the apex.

Continuation of Mr Lea's Paper. Read, September 18th, 1835.

GENUS MEGASPIRA.

Testâ clavatâ; aperturâ subovatâ, infernè rotundatâ; marginibus reflexis, supernè disjunctis; columellâ pluriplicatâ, basi integrâ, non effusâ.

Shell clavate; aperture nearly oval, below rounded; margins reflected, above disjoined; columella many-folded, below entire, not effuse.

Remarks.—The genus *Megaspira** is proposed for a single species. It is a most curious and interesting shell, and although it is closely analogous to the genera *Bulimus*, *Pupa* and *Auricula* in some of its characters, cannot be with propriety placed in either of them. Unfortunately we know nothing of the animal; but if we may judge from the peculiar form of the shell, it will doubtless be found to differ much from these genera.

Megaspira Ruschenbergiana. Plate XXIII. fig. 101.

Testâ cylindraceo-turritâ, valdè striatâ, subfuscâ, maculis longitudinalibus rufo-fuscis ornatâ, apice consolidatâ; anfractibus tribus et viginti, subplanulatis; spirâ ad apicem obtusiusculâ; columellâ quadruplicatâ; labro reflexo.

Shell subcylindrical, turrited, thickly striate, brownish, furnished with longitudinal reddish-brown spots, having a solid apex; whorls twenty-three, rather flattened; spire obtuse at the apex; columella with four folds; outer lip reflected.

Hab. Brazil? W. S. W. Ruschenberger, M.D.
My Cabinet.

Diam. ·5, Length 2·5 inches.

* μεγας, magnus, and σπεῖρα, spira.

Remarks.—I owe to the kindness of Dr Ruschenberger, of the United States navy, the interesting and curious specimen above described. It was purchased by him in Rio de Janeiro, its exact habitat being unknown to him, having been kept perfectly secret by the person from whom he obtained it. The remarkable elevation of this shell eminently distinguishes it from any species with which I am acquainted. The lower portion of the mouth is slightly thrown back, and where the lip joins the bottom of the columella, it is reflected on the whorl, forming a false umbilicus. From this point three connected folds pass into the interior of the cavity of the shell, and half way up the columella a larger and better defined fold is placed, which in the front aspect has the appearance of a tooth. The whorls are slightly curved, and the aperture is about one-sixth the length of the shell.

PALUDINA PALLIDA. Plate XXIII. fig. 104.

Testâ ventricosâ, tenui, pallidâ, lævi; suturis impressis; anfractibus quaternis, convexis; aperturâ subrotundâ.

Shell ventricose, thin, light horn-colour, smooth; sutures impressed; whorls four, convex; aperture nearly round.

Hab. near Cincinnati, Ohio. T. G. Lea.
My Cabinet.

Diam. ·3, Length ·4 of an inch.

Remarks. This shell has been recently found by my brother, and I believe has not before been observed. It might at first be mistaken for a young shell, on account of its pale yellow colour and translucency. In form, however, it differs from any species I have examined, the last whorl being very much enlarged, and the aperture being very large.

Continuation of Mr Lea's Paper. Read, February 5th, 1836.

UNIO PUMILUS. Plate VII. fig. 17.

Testâ subtriangulari, inæquilaterali, posticè subbiangulatâ; valvulis subtenuibus; natibus prominulis; epidermide tenebroso-fuscâ; dentibus cardinalibus grandibus; lateralibus brevibus rectisque; margaritâ albâ.

Shell subtriangular, inequilateral, behind subbiangular; valves rather thin; beaks somewhat prominent; epidermis dark brown; cardinal teeth large; lateral teeth short and straight; nacre white.

Hab. Black River, North Carolina.

My Cabinet.

Diam. ·5, Length ·8, Breadth 1·1 inches.

Shell subtriangular, inequilateral, behind subbiangular, somewhat carinate; substance of the shell rather thin; beaks somewhat prominent; ligament short; epidermis dark brown, and apparently without rays; cardinal teeth large, and deeply cleft in the left valve; lateral teeth short and straight; anterior cicatrices distinct; posterior cicatrices distinct; dorsal cicatrices situated on the under part of the cardinal teeth; cavity of the shell rather deep; cavity of the beaks angular; nacre bluish white.

Remarks.—A single individual of this species was found by me in 1827, in crossing the Black River, on the road to Fayetteville from Smithfield. The publication of it has been delayed, in the hope of other specimens being found. Although it has every appearance of an adult shell, it may be found larger. Nevertheless, I have no doubt but that it is among the smallest of the genus. It approaches in most of its characters the *modestus* (Fer.), from Brazil, but it is not so thick a shell, and is rather smaller.

Unio tampicoensis. Plate VII. fig. 18.

Testâ ovatâ, inflatâ, transversâ, subcarinatâ, inæquilaterali; valvulis crassis; natibus subprominulis; epidermide nigricante; dentibus cardinalibus magnis; lateralibus longis, subrectis magnisque; margaritâ albá et iridescente, raró roseâ.

Shell ovate, inflated, transverse, subcarinate, inequilateral; valves thick; beaks somewhat prominent; epidermis blackish; cardinal teeth large; lateral teeth long, rather straight and large; nacre white and iridescent, rarely rose coloured.

Hab. River Tampico, Mexico.
River Medellin, Mexico. Dr Burrough.
My Cabinet.
Cabinet of Dr Burrough.
Cabinet of Academy of Natural Sciences.

Diam. 1·7, Length 2·8, Breadth 4·3 inches.

Shell ovate, inflated, transverse, subcarinate, inequilateral; substance of the shell thick, thinner behind; beaks somewhat prominent; ligament large and long; epidermis nearly black, and apparently without rays; cardinal teeth large, and deeply cleft in the left valve; lateral teeth long, rather straight, and large; anterior cicatrices distinct; posterior cicatrices confluent; dorsal cicatrices placed across the cavity of the beak, and on the inferior part of the cardinal teeth; cavity of the shell large; cavity of the beaks somewhat deep and angular; nacre white and iridescent, rarely rose colour.

Remarks.—The specimen figured here, I owe to the kindness of Richard Ronaldson, Esq., who procured it from the commander of a vessel trading to Tampico. It was brought from some distance above that city. Dr Burrough subsequently procured the same species from the river Medellin, ten miles south of Vera Cruz. It is a fine shell, and has not much resemblance to any one of ours. It perhaps, in outline and in form of the teeth, most resembles *U. crassus* (Say). In the older specimen, the epidermis is almost black—in the younger, it is of a yellow brown, and in this stage indistinct rays may occasionally be observed. The general colour of the nacre seems to be white, with a disposition to pinkish in the teeth. Sometimes this colour extends over the whole of the thick parts of the nacre, which is very pearly; a tint of salmon colour, in some individuals, may be observed in the cavity of the shell and beaks. The dorsal line in the specimen before me, is slightly tuberculated in an irregular manner.

Unio Cumberlandicus. Plate VII. fig. 19.

Testâ ellipticâ, transversâ, inæquilaterali; valvulis tenuibus; natibus prominulis; epidermide luteâ, radiatâ; dentibus cardinalibus parvis; lateralibus longis rectisque; margaritâ albâ et iridescente.

Shell elliptical, transverse, inequilateral; valves thin; beaks somewhat prominent; epidermis yellow, radiated; cardinal teeth small; lateral teeth long and straight; nacre white and iridescent.

Hab. Cumberland River, Ten. Professor Troost.
My Cabinet.
Cabinet of Professor Troost.

Diam. ·5, Length ·8, Breadth 1·5 inches.

Shell elliptical, transverse, inequilateral, umbonial slope rounded; substance of the shell thin, thicker before; beaks somewhat prominent; ligament short; epidermis yellow, with numerous nearly equidistant rays; cardinal teeth small, double in the left valve, and disposed to be bifid in the right; lateral teeth long and straight; anterior cicatrices distinct; posterior cicatrices confluent; dorsal cicatrices placed in the centre of the cavity of the beaks; cavity of the shell rather shallow; cavity of the beaks small; nacre white, and very iridescent behind.

Remarks.—I owe this shell to the kindness of Professor Troost. It most resembles *U. iris* (nobis), and may easily be mistaken for that species. It differs in being less transverse, in being more yellow and in having fewer rays.

Unio simus. Plate VIII. fig. 20.

Testâ ovatâ, transversâ, compressâ, inæquilaterali, postice subangulatâ ; valvulis subcrassis ; natibus prominulis ; epidermide luteolâ, radiatâ ; dentibus cardinalibus parvis ; lateralibus longis crassisque ; margaritâ albâ et iridescente.

Shell ovate, transverse, compressed, inequilateral, subangular behind ; valves somewhat thick ; beaks somewhat prominent ; epidermis somewhat yellow, radiated ; cardinal teeth small ; lateral teeth long and thick ; nacre white and iridescent.

Hab. Cumberland River, Ten. Professor Troost.
My Cabinet.
Cabinet of Professor Troost.

Diam. ·6, Length 1, Breadth 1.7 inches.

Shell ovate, transverse, inequilateral, compressed, subangular behind ; substance of the shell somewhat thick, thinner behind ; beaks somewhat prominent ; ligament rather short ; epidermis somewhat yellow, indistinctly rayed ; cardinal teeth small, double in the left and single in the right valve ; lateral teeth long, thickened towards the posterior end ; anterior cicatrices distinct ; posterior cicatrices confluent ; dorsal cicatrices placed in the centre of the cavity of the beaks ; cavity of the shell shallow ; cavity of the beaks angular ; nacre white and iridescent behind.

Remarks.—This shell was procured by Professor Troost from the Cumberland River, but whether near Nashville or not, I am not informed. It resembles the *Cumberlandicus* (nobis), but is a thicker and heavier shell.

Unio Roanokensis. Plate VIII. fig. 21.

Testâ suboblongâ, transversâ, inæquilaterali, posticè biangulatâ, compressâ; valvulis crassis; natibus prominulis; epidermide terebroso-fuscâ; dentibus cardinalibus parvis; lateralibus longissimis subcurvisque; margaritâ albâ.

Shell somewhat oblong, transverse, inequilateral, biangular behind, compressed; valves thick; beaks somewhat prominent; epidermis dark brown; cardinal teeth small; lateral teeth long and rather curved; nacre white.

Hab. Roanoke River, North Carolina.
Altamaha, Geo. Professor Nuttall and Major Leconte.
My Cabinet.
Cabinet of Major Leconte.

Diam. 1·2, Length 2·2, Breadth 4·7 inches.

Shell somewhat oblong, transverse, inequilateral, biangular behind, compressed, flattened on the umbonial slope; substance of the shell thick; beaks somewhat prominent; ligament very large and long; epidermis dark brown, apparently without rays; cardinal teeth small and striate; lateral teeth long, large, and somewhat curved; anterior cicatrices distinct; posterior cicatrices confluent; dorsal cicatrices on the superior part of the cavity of the beaks; cavity of the shell small; cavity of the beak very small; nacre white.

Remarks.—In crossing the Roanoke some years ago, between Norfolk and Tarborough, I picked up a few specimens of this shell. Since that, Professor Nuttall gave me a single valve from the *Altamaha*, and more recently some large specimens have been brought from the same river by Major Leconte. I found at Tarborough several specimens, which I presume to be the young of this species. This shell strongly resembles a gigantic *complanatus*, and may be considered to belong to that group. The nacre of all the specimens, however, which I have seen is white, and filled with deposite of epidermal matter in a clouded manner. It may perhaps be found sometimes purple.

Unio notatus. Plate VIII. fig. 22.

Testâ ellipticâ, compressâ, transversâ, inæquilaterali, postice subbiangulatâ; valvulis tenuibus; natibus subprominulis; epidermide rufo-fuscâ, vittatâ; dentibus cardinalibus parvis; lateralibus longis subcurvisque; margaritâ salmonis colore tinctâ et iridescente.

Shell elliptical, compressed, transverse, inequilateral, behind subbiangular; valves thin; beaks rather prominent; epidermis reddish brown, spotted; cardinal teeth small; lateral teeth long and slightly curved; nacre salmon colour and iridescent.

Hab. Cumberland River. Professor Troost.
Cabinet of Professor Troost.

Diam. ·6, Length 1, Breadth 1·8 inches.

Shell elliptical, compressed, transverse, inequilateral, subbiangular behind; substance of the shell thin; beaks somewhat prominent; ligament rather short; epidermis reddish brown, with spotted rays over the whole disk; cardinal teeth small, pointed, and deeply cleft in the left valve; lateral teeth long and slightly curved; anterior cicatrices distinct; posterior cicatrices confluent; dorsal cicatrices placed in the centre of the cavity of the beaks; cavity of the shell rather shallow; cavity of the beaks angular; nacre salmon colour and very iridescent.

Remarks.—Another of the fine shells sent by Professor Troost from Tennessee. In outline it resembles *U. Vanuxemensis* herein described, but is not so thick a shell, and differs in having rays (interrupted), while the other has none. It is also much smaller in the teeth. The individual before me not being perfect in the beaks, I cannot say if the undulations be the same.

Unio Jayensis. Plate IX. fig. 23.

Testâ angusto-ellipticâ, transversâ, valdè inæquilaterali, posticè subangulatâ; valvulis tenuibus; natibus prominulis; epidermide fuscâ; dentibus cardinalibus compressis; lateralibus longis rectisque; margaritâ purpureâ.

Shell narrow-elliptical, transverse, very inequilateral, subangular behind; valves thin; beaks somewhat prominent; epidermis brown; cardinal teeth compressed; lateral teeth long and straight; nacre purple.

Hab. Florida. J. C. Jay, M.D.
My Cabinet.

Diam. ·8, Length 1·2, Breadth 2·5 inches.

Shell narrow-elliptical, transverse, very inequilateral, subangular behind; subcarinate; substance of the shell thin; beaks somewhat prominent; ligament rather long; epidermis brown, and apparently without rays; cardinal teeth compressed, in the left valve deeply cleft and elevated; lateral teeth long and straight; anterior cicatrices distinct; posterior cicatrices confluent; dorsal cicatrices situated in the centre of the cavity of the beaks; cavity of the shell small; cavity of the beaks small; nacre purple and iridescent.

Remarks.—Among other shells for which I am indebted to Dr Jay, were single opposed valves of two individuals of nearly the same size, and for which I propose the name of *Jayensis*. I do not know from what part of Florida they came. This species strongly resembles the *nasutus* (Say), but is not quite so transverse a shell, approaching the *complanatus*. The nacre of both the individuals is of a light purple, bordering on a pinkish tint. In young specimens, it may perhaps be found to possess rays.

UNIO HOPETONENSIS. Plate IX. fig. 24.

Testâ suboblongâ, transversâ, inæquilaterali, compressâ, posticè biangulatâ, ad latus planulatâ; valvulis subcrassis; natibus prominulis, ad apices undulatis; epidermide tenebroso-fuscâ; dentibus cardinalibus parvis; lateralibus longis curvisque; margaritâ purpureâ et iridescente.

Shell somewhat oblong, transverse, inequilateral, compressed, biangular behind, flattened at the sides; valves somewhat thick; beaks scarcely prominent, undulated at the tip; epidermis dark brown; cardinal teeth small; lateral teeth long and curved; nacre purple and iridescent.

Hab. Hopeton, near Darien. Professor Shepard.

My Cabinet.
Cabinet of Professor Shepard.

Diam. ·9, Length 1·7, Breadth 3·4 inches.

Shell somewhat oblong, transverse, inequilateral, compressed, biangular behind, flattened at the umbones and sides, carinate; substance of the shell rather thick; beaks scarcely prominent, undulated at the tip; ligament thin, long and straight; epidermis dark brown and obscurely rayed; cardinal teeth small; lateral teeth very long, curved and enlarged at the posterior end; anterior cicatrices distinct; posterior cicatrices confluent; dorsal cicatrices in the centre of the cavity of the beaks; cavity of the shell rather small; cavity of the beaks small; nacre purple and iridescent.

Remarks.—This shell was procured by Professor Shepard from his friend J. H. Cowper, Esq., with several other fine species. They were found in the canals of the rice fields, where they seem to exist in great perfection.

The *Hopetonensis* very closely resembles some of the varieties of *complanatus.* It differs from it in the teeth, in the carina, and in the possession of a dark border round the inferior part of the margin. In the nacre it appears to be the same, and probably, like the *complanatus*, varies into white and salmon colour.

UNIO LUGUBRIS. Plate IX. fig. 25.

Testâ ellipticâ, transversâ, subinflatâ, inæquilaterali, posticè biangulatâ; valvulis subcrassis; natibus prominulis; epidermide nigricante; dentibus cardinalibus compressis; lateralibus sublongis subcurvisque; margaritâ purpureâ.

Shell elliptical, transverse, somewhat inflated, inequilateral, biangular behind; valves somewhat thick; beaks rather prominent; epidermis nearly black; cardinal teeth compressed; lateral teeth rather long and somewhat curved; nacre purple.

Hab. Hopeton, near Darien. Professor Shepard.
My Cabinet.
Cabinet of Professor Shepard.

Diam. ·9, Length 1·3, Breadth 2·5 inches.

Shell elliptical, transverse, somewhat inflated, inequilateral, biangular behind and rounded before; substance of the shell somewhat thick; beaks rather prominent; ligament rather short and thin; epidermis nearly black, and apparently without rays; cardinal teeth compressed, single in the right and double in the left valve; lateral teeth rather long and somewhat curved; anterior cicatrices distinct; posterior cicatrices confluent; dorsal cicatrices placed in the centre of the cavity of the beaks; cavity of the shell deep; cavity of the beak rather small; nacre purple and iridescent.

Remarks.—This was among the shells procured by Professor Shepard, from near Darien, and may be considered to be between the *complanatus* (Soland.) and *confertus* (nobis). It is disposed to be more cylindrical than the former, and has a less elevated umbonial slope than the latter. The curve of the basal margin is greater than either. Possessing but a single specimen, I am unable to determine if the colour of the nacre varies in this species as it does in most of those allied to *complanatus*.

Unio Barnesianus. Plate X. fig. 26.

Testâ subtriangulari, compressâ, inæquilaterali; valvulis crassis; natibus subprominulis; dentibus cardinalibus parvis; lateralibus subrectis; margaritâ albâ et iridescente.

Shell subtriangular, compressed, inequilateral; valves thick; beaks rather prominent; cardinal teeth small; lateral teeth nearly straight; nacre white and iridescent.

Hab. Cumberland River, Ten. Professor Troost.

Cabinet of Professor Troost.

Diam. ·6, Length 1, Breadth 1·4 inches.

Shell subtriangular, compressed, inequilateral; substance of the shell thick; beaks rather prominent, short; epidermis chestnut brown, with interrupted rays and strong marks of growth; cardinal teeth small, somewhat compressed; lateral teeth nearly straight, and enlarged at the posterior end; anterior cicatrices distinct; posterior cicatrices distinct; dorsal cicatrices placed on the interior part of the plate between the cardinal and lateral teeth; cavity of the shell small; cavity of the beaks small and angular; nacre pearly white and iridescent.

Remarks.—This pretty little species is one of those for which I am indebted to Professor Troost. In its outline it very closely resembles *U. rubiginosus* (nobis). It differs from it, however, entirely in the form and size of its cardinal teeth, and in having green interrupted rays. A single specimen only has come under my observation.

Unio Zeiglerianus. Plate X. fig. 27.

Testá ellipticá, transversâ, inæquilaterali, glabrâ; valvulis subcrassis; natibus subprominulis; undulatis; epidermide luteâ, radiatâ; dentibus cardinalibus parvis; lateralibus parvis subrectisque; margaritâ purpureâ et iridescente.

Shell elliptical, transverse, inequilateral, smooth; valves rather thick; beaks somewhat prominent, undulated; epidermis yellow, radiated; cardinal teeth small; lateral teeth small and nearly straight; nacre purple and iridescent.

Hab. Cumberland River, Ten. Professor Troost.
My Cabinet.
Cabinet of Professor Troost.

Diam. ·6, Length 1, Breadth 1·6 inches.

Shell elliptical, transverse, inequilateral, smooth, rounded in the umbonial slope; substance of the shell rather thick; beaks somewhat prominent, with fine undulations at the tip; ligament rather short; epidermis yellow, with fine green rays on the posterior portion; cardinal teeth small, deeply cleft in the left valve; lateral teeth small and nearly straight; anterior cicatrices distinct; posterior cicatrices confluent; dorsal cicatrices placed in the centre of the cavity of the beaks; cavity of the shell rather shallow; cavity of the beaks angular; nacre purple and iridescent.

Remarks.—This shell resembles the *U. Muhlfeldianus*, herein described, but may be distinguished at once by its being much smaller, by being more regularly elliptical, and being smoother and polished. The nacre of *Zeiglerianus*, in several specimens before me, is purple and salmon, some having a white margin. I presume the dominant colour to be purple. I have pleasure in dedicating this shell to F. Zeigler, a distinguished zoologist of Vienna.

UNIO CREPERUS. Plate X. fig. 28.

Testâ subellipticâ, transversissimâ, valdè inæquilaterali; valvulis subcrassis; natibus prominulis, undulatis; epidermide viride; dentibus cardinalibus parvis; lateralibus vix cernendis; margaritâ albâ.

Shell subelliptical, very transverse, very inequilateral; valves somewhat thick; beaks rather prominent and undulated at tip; epidermis greenish; cardinal teeth small; lateral teeth obscure; nacre white.

Hab. Tennessee. Professor Troost.
My Cabinet.

Diam. 1, Length 1·4, Breadth 2·7 inches.

Shell subelliptical, subemarginate at base, very transverse, very inequilateral, somewhat flattened over the umbones; substance of the shell thick anteriorly, thin and iridescent posteriorly; beaks rather elevated, retuse, and finely undulate at tip; ligament long; epidermis dark green and obscurely rayed; cardinal teeth small and elevated; lateral teeth obscure, being perceptible only at the termination; anterior cicatrices distinct; posterior cicatrices confluent; dorsal cicatrices in the centre of the cavity of the beaks; cavity of the shell deep; cavity of the beak small; nacre white.

Remarks.—I owe to the kindness of Professor Troost the single valve which I possess of this species. It has some resemblance to the *U. emarginatus* (nobis), but perhaps resembles more the *U. iris* (nobis). In the structure of the teeth, particularly in the lateral tooth, the character is obscure. In this it resembles the *U. calceolus* (nobis). At the termination of the ligament there is, however, in my specimen, a well defined terminal point of the lateral tooth, and in other specimens this may be found to be more developed. The anterior lobe of the cardinal tooth is conical.

Unio glaber. Plate X. fig. 29.

Testâ ellipticâ, transversâ, compressâ, glabrâ, inæquilaterali; valvulis tenuibus; natibus subprominulis, undulatis; epidermide luteâ, radiatâ; dentibus cardinalibus parvis, elevatis; lateralibus longis; margaritâ albâ.

Shell elliptical, transverse, compressed, smooth and shining, inequilateral; valves thin; beaks somewhat prominent and undulated; epidermis yellow, radiated; cardinal teeth small and elevated; lateral teeth long; nacre white.

Hab. Holston River, Ten. Professor Troost.
My Cabinet.
Cabinet of Professor Troost.

Diam. ·5, Length ·8, Breadth 1·5 inches.

Shell elliptical, transverse, compressed, polished, somewhat compressed behind, inequilateral, substance of the shell thin, somewhat thicker before; beaks somewhat prominent, with fine, nearly parallel undulations at the tip; ligament short; epidermis smooth, yellow, with numerous fine rays nearly over the whole disk; cardinal teeth small, rather compressed, elevated; lateral teeth long; anterior cicatrices distinct; posterior cicatrices confluent; dorsal cicatrices placed in the centre of the cavity of the beaks and under the cardinal tooth; cavity of the shell shallow; cavity of the beaks small, angular; nacre white and iridescent.

Remarks.—Among the shells brought by Professor Troost from his geological exploration of the eastern part of Tennessee, was this one from the Holston. It is allied to *U. iris* (nobis), but is not so transverse. It differs also somewhat in the rays and beaks, and the epidermis is more yellow. The epidermis is smooth and polished; in these respects it resembles the young of *U. luteola* (Lam.), *siliquoideus* (Bar.).

UNIO GIBBER. Plate X. fig. 30.

Testâ triangulatâ, compressâ, inæquilaterali, posticè subbiangulatâ; valvulis subcrassis; natibus prominulis; epidermide tenebroso-fuscâ; dentibus cardinalibus parvis; lateralibus declivibus; margaritâ salmonis colore tinctâ.

Shell triangular, compressed, inequilateral, behind subbiangular; valves rather thick; beaks somewhat prominent; epidermis dark brown; cardinal teeth small; lateral teeth inclined; nacre salmon colour.

Hab. Carryfork River, Ten. Professor Troost.
My Cabinet.
Cabinet of Professor Troost.

Diam. ·7, Length 1, Breadth 1·8 inches.

Shell triangular, compressed, inequilateral, behind somewhat biangular, elevated on the dorsal margin; substance of the shell rather thick, thinner behind; beaks somewhat prominent; ligament short; epidermis dark brown, apparently without rays; cardinal teeth small and deeply cleft in the left valve; lateral teeth inclining towards the posterior angle; anterior cicatrices nearly distinct; posterior cicatrices distinct; dorsal cicatrices in the centre of the cavity of the beaks; cavity of the shell very shallow; cavity of the beaks angular; nacre salmon colour and iridescent behind.

Remarks.—Among the numerous interesting species sent to me by Professor Troost, is this species from Carryfork river. In its general character it approaches the *U. crassidens* (Lam.), (*cuneatus*, Bar.). It is, however, a very much smaller shell and more triangular. All the specimens submitted to me (five) were of a fine salmon colour. It may, however, be found to vary, like the *crassidens* and *complanatus*.

Unio Vanuxemensis. Plate XI. fig. 31.

Testâ ellipticâ, compressâ, transversâ, inæquilaterali; valvulis crassis; natibus subprominulis; epidermide tenebroso-fuscâ; dentibus cardinalibus magnis; lateralibus longis subcurvisque; margaritâ salmonis colore tinctâ, et iridescente.

Shell elliptical, compressed, transverse, inequilateral; valves thick; beaks somewhat prominent; epidermis dark brown; cardinal teeth large; lateral teeth long and somewhat curved; nacre salmon colour and iridescent.

Hab. Cumberland River, Ten. Professor Troost.
Cabinet of Professor Troost.

Diam. ·7, Length 1.2, Breadth 1.9 inches.

Shell elliptical, compressed, transverse, inequilateral; substance of the shell thick, thinner behind; beaks somewhat prominent, and minutely undulated at the tip; ligament rather short; epidermis dark brown, apparently without rays; cardinal teeth large and deeply cleft in the left valve; lateral teeth long and somewhat curved; anterior cicatrices distinct; posterior cicatrices confluent; dorsal cicatrices placed across the centre of the cavity of the beaks; cavity of the shell shallow; cavity of the beaks angular; nacre salmon colour and very iridescent behind.

Remarks.—This beautiful shell is another of the fine ones obtained by Professor Troost from Cumberland River. I have peculiar pleasure in calling it after my friend Professor Vanuxem. In its general characters it perhaps most resembles the *U. Nashvillianus* (nobis), but is more compressed, less transverse, and darker coloured exteriorly. In the nacre, however, the specimen from which this description is made, differs very much, being of an intense salmon colour. In other specimens this character may be found to differ, as colour of nacre is usually in this family very uncertain.

UNIO CARBONARIUS. Plate XI. fig. 32.

Testâ subtriangulatâ, tumidâ, transversâ, inæquilaterali, subemarginatâ; valvulis crassis; natibus subprominulis; epidermide nigrâ; dentibus cardinalibus grandiusculis; lateralibus parvis subcurvisque; margaritâ purpureâ et iridescente.

Shell subtriangular, swollen, transverse, inequilateral, subemarginate; valves thick; beaks rather prominent; epidermis black; cardinal teeth rather large; lateral teeth small and somewhat curved; nacre purple and iridescent.

Hab. River Medellin, Mexico. Dr Burrough.
My Cabinet.
Cabinet of Dr Burrough.

Diam. 1·1, Length 1·4, Breadth 2·4 inches.

Shell subtriangular, swollen, transverse, inequilateral, subemarginate at the base; substance of the shell thick, thinner behind; beaks rather prominent; epidermis black, apparently without rays; ligament rather long; cardinal teeth rather large, double in the left valve; lateral teeth rather short, and widely separated from the cardinal teeth; anterior cicatrices distinct; posterior cicatrices distinct; dorsal cicatrices placed across the inferior part of the cardinal teeth; cavity of the shell rather deep; cavity of the beaks deep and angular; nacre purple and iridescent behind.

Remarks.—The two individuals which I have before me were kindly sent by Dr Burrough, now resident United States consul at Vera Cruz. Ever prompt to promote the study of natural history, in the various climes he visits, he has sent numerous objects from Vera Cruz, with the view of increasing our cabinets and our knowledge.

The *carbonarius* has a stronger affinity to *U. crassidens* (Lam.) than any other species I am acquainted with. It is, however, a smaller shell, with more proportional diameter, and a more intense purple than I have seen in that species. The colour in the only two specimens I have seen, is almost a chocolate, and may be said to resemble the nacre of the *gibbosus* (Bar.). The black exterior and the dark interior, give the shell a very sombre aspect—hence its name.

Unio folliculatus. Plate XI. fig. 33.

Testâ angusto-ellipticâ, transversissimâ, valdè inæquilaterâ, posticè subbiangulatâ; anticè rotundatâ; ad latera planulatâ; valvulis subtenuibus; natibus vix prominulis; epidermide tenebroso-fuscâ; dentibus cardinalibus parvis; lateralibus longis subcurvisque; margaritâ purpureâ et iridescente.

Shell narrow-elliptical, very transverse, very inequilateral, behind subbiangular, before rounded, flattened at the side; valves rather thin; beaks scarcely prominent; epidermis dark brown; cardinal teeth small; lateral teeth long and somewhat curved; nacre purple and iridescent.

Hab. Savannah River. Major Leconte.
My Cabinet.
Cabinet of Major Leconte.

Diam. ·5, Length ·8, Breadth 2·4 inches.

Shell narrow-elliptical, very transverse, very inequilateral, subbiangular behind, rounded before, rather compressed, flattened at the side; substance of the shell rather thin; beaks scarcely prominent; ligament long and curved; epidermis very dark brown; cardinal teeth small and lobed; lateral teeth long and somewhat curved; anterior cicatrices distinct; posterior cicatrices confluent; dorsal cicatrices in the centre of the cavity of the beaks; cavity of the shell small; cavity of the beak very small; nacre purple and iridescent.

Remarks.—I owe the possession of this species to Major Leconte, whose active researches in the rivers of Georgia have produced us several new *Uniones.*

The *folliculatus* is a remarkably transverse shell, and seems to belong to that group of which the *complanatus* (Soland.) may be considered the type. It diverges towards the *Shepardianus* (nobis), but is by no means so transverse a species. The only two specimens which I have seen, are purple inside, which may be considered its general colour. Like the *complanatus*, it may perhaps be found white and salmon coloured.

Unio medellinus. Plate XII. fig. 34.

Testâ ellipticâ, transversâ, subcompressâ, inæquilaterali; valvulis subtenuibus; natibus subprominulis; epidermide luteolâ, radiatâ; dentibus cardinalibus parvis; lateralibus longis subcurvisque; margaritâ albâ et iridescente.

Shell elliptical, transverse, rather compressed, inequilateral; valves somewhat thin; beaks rather prominent; epidermis yellowish, radiated; cardinal teeth small; lateral teeth long and somewhat curved; nacre white and iridescent.

Hab. River Medellin, near Vera Cruz. Dr Burrough.
My Cabinet.
Cabinet of Dr Burrough.

Diam. ·7, Length 1·3, Breadth 2·3 inches.

Shell elliptical, transverse; rather compressed, subemarginate at base, inequilateral; substance of the shell rather thin; beaks rather prominent; ligament rather long and slender; epidermis yellowish, with numerous green rays over the whole disk; anterior cicatrices distinct; posterior cicatrices confluent; dorsal cicatrices placed in the centre of the cavity of the beaks; cavity of the shell shallow; cavity of the beaks very shallow; nacre white and iridescent.

Remarks.—This species was among those sent by Dr Burrough from Vera Cruz. One of the two specimens received is apparently only half grown. The very strong resemblance these specimens bear to *U. radiatus* (Gmelin), has caused me to hesitate in considering the species distinct. The younger individual is more transverse than any specimen of *radiatus* I have seen, and the emargination is a character which that shell does not possess.

Unio Lecontianus. Plate XII. fig. 35.

Testâ ellipticâ, transversâ, inœquilaterali, subinflatâ; valvulis crassis; dentibus cardinalibus parvis; lateralibus longis, à cardinalibus separatis; margaritâ salmonis colore tinctâ.

Shell elliptical, transverse, inequilateral, somewhat inflated; valves thick; cardinal teeth small; lateral teeth long, being separated from the cardinal teeth; nacre salmon colour.

Hab. Conoochee River, Georgia. Major Leconte.
My Cabinet.
Cabinet of Major Leconte.

Diam. 1·2, Length 1·7, Breadth 2·8 inches.

Shell elliptical, transverse, inequilateral, subbiangular behind, somewhat inflated; substance of the shell thick; beaks slightly elevated; ligament rather short; epidermis yellowish brown and obscurely rayed; cardinal teeth small and deeply cleft in the left valve; lateral teeth long, enlarged at the posterior end, and separated from the cardinal teeth; anterior cicatrices distinct; posterior cicatrices confluent; dorsal cicatrices situated on the plate between the cardinal and lateral teeth; cavity of the shell somewhat deep and rounded; cavity of the beak small; nacre salmon colour, approaching to white.

Remarks.—Among many other shells from Georgia, which I owe to the kindness of my friend, Major Leconte, I found this species, which I believe has not been before described. It is with great pleasure I dedicate it to him. The *Lecontianus* perhaps most resembles the *crassidens* (Lam.), *cuneatus* (Barnes). It is not so large a shell, and the beak is more medial. The young specimens have distinct rays, and their epidermis is quite yellow. In this state they resemble somewhat the young of *crassus* (Say). The nacre of all the specimens I have seen is salmon colour, and salmon running into white or purple. None of the beaks were sufficiently perfect to observe the form of undulations.

Unio Muhlfeldianus. Plate XII. fig. 36.

Testâ ellipticâ, subcompressâ, transversâ, inæquilaterali; valvulis subcrassis; natibus subprominulis, undulatis; epidermide luteolâ radiatâ; dentibus cardinalibus subparvis erectisque; lateralibus longis rectisque; margaritâ albâ et iridescente.

Shell elliptical, rather compressed, transverse, inequilateral; valves rather thick; beaks somewhat prominent, undulated; epidermis yellowish, radiated; cardinal teeth rather small and erect; lateral teeth long and straight; nacre white and iridescent.

Hab. Cumberland River, Ten. Professor Troost.
Cabinet of Professor Troost.

Diam. ·8, Length 1·3, Breadth 2·3 inches.

Shell elliptical, rather compressed, transverse, inequilateral, rounded before and behind, flattened on the umbonial slope; substance of the shell rather thick before, thinner behind; beaks somewhat prominent, with fine undulations at the tip; ligament long; epidermis yellowish, with dark green rays on the posterior portion; cardinal teeth rather small, erect, and deeply cleft in the left valve; lateral teeth long and straight; anterior cicatrices distinct; posterior cicatrices confluent; dorsal cicatrices placed in the centre of the cavity of the beaks; cavity of the shell rather deep; cavity of the beaks angular; nacre white and very iridescent behind.

Remarks.—The specimen before me was brought from the Cumberland River by Professor Troost, but I do not know from what part of it. It seems to be more closely allied to *U. iris* (nobis) than any species I have seen, but differs in being less transverse, more flattened out behind, and in having the rays more distinct on the posterior portion. I dedicate it to the distinguished custos of the Imperial Museum at Vienna.

A single valve closely resembling this species was sent to me sometime since by my brother, T. G. Lea, from Cincinnati, but it is not sufficiently perfect to decide on its being the same.

Margaritana Holstonia. Plate XIII. fig. 37.

Testâ subarcuatâ, subinflatâ, transversâ, valde inæquilaterali; ad latus planulatâ; valvulis subtenuibus; natibus subprominulis, undulatis; epidermide fuscâ; dentibus cardinalibus magnis; margaritâ albâ et iridescente.

Shell subarcuate, somewhat inflated, transverse, very inequilateral, flattened on the side; valves rather thin; beaks somewhat prominent, undulated; epidermis brown; cardinal teeth large; nacre white and iridescent.

Hab. Holston River. Professor Troost.
Cabinet of Professor Troost.

Diam. ·8, Length 1·2, Breadth 2·4 inches.

Shell subarcuate, somewhat inflated, transverse, very inequilateral, flattened on the side, rounded on the umbonial slope; valves rather thin, thicker before; beaks somewhat prominent, irregularly and finely undulated at the tip; ligament rather long; epidermis brown, wrinkled, and apparently without rays; cardinal teeth large, and elevated into three points in the left valve, smaller in the right valve, and elevated into a single point; anterior cicatrices confluent; posterior cicatrices confluent; dorsal cicatrices placed on the inferior portion of the cardinal teeth; cavity of the shell rather deep; cavity of the beak shallow and angular; nacre white and iridescent.

Remarks.—This species is the production of Holston River, but I am not aware from what part it was procured by Professor Troost, to whose kindness I owe the privilege of describing it. It is more nearly allied to the *M. Raveneliana* (nobis) than any other species of this genus. It may be distinguished from it by its being more compressed, in the form of its teeth, and in being without rays. The last character must, however, be received with some doubt, as specimens may be found with rays. The single specimen before me having no rays, does not prohibit their occurrence in others. The teeth of the left valve are remarkable in being elevated into three distinct points, the two posterior ones clasping into the cavity of the beak of the other valve.

MARGARITANA DELTOIDEA. Plate XIII. fig. 38.

Testâ triangulatâ, compressâ, inæquilaterali; valvulis tenuibus; natibus prominentibus, ad apices undulatis; epidermide luteâ, radiatâ; dentibus cardinalibus erectis; margaritâ albâ et iridescente.

Shell triangular, compressed, inequilateral; valves thin; beaks prominent, undulated at the tip; epidermis yellow, radiated; cardinal teeth erect; nacre white and iridescent.

Hab. Ohio River, near Cincinnati. T. G. Lea.
Scioto. Dr Kirtland.

My Cabinet.
Cabinet of T. G. Lea.
Cabinet of Dr Kirtland.

Diam. ·6, Length ·9, Breadth 1·4 inches.

Shell triangular, compressed, inequilateral, subemarginate at base; substance of the shell thin behind, thicker before; beaks prominent and strongly undulated at the tip; ligament short and thin; epidermis yellow, with numerous green rays, which are deficient at the beaks; cardinal teeth erect, double in the left valve, single and conical in the right; lateral teeth obsolete; anterior cicatrices confluent; posterior cicatrices confluent; dorsal cicatrices in the centre of the cavity of the beaks; cavity of the shell not deep; cavity of the beaks rather deep and angular; nacre white and iridescent.

Remarks.—This little shell has engaged my attention for some time, having considered it, with a good deal of doubt, a variety of *U. calceolus* (nobis). Like that shell it has a very imperfectly formed lateral tooth; in most individuals it cannot be perceived. In comparison with the *calceolus*, it is more triangular and flattened, and the undulations of the beaks are unbroken. The beaks are of a darker colour, and the anterior lobe of the cardinal teeth seems to be larger in this, while in the other the posterior seems to be the larger. The *deltoidea* is also a smaller shell.

Margaritana fabula. Plate XIII. fig. 39.

Testâ suboblongâ, transversâ, inæquilaterali, ad basim emarginatâ, ad latus planulatâ; valvulis subcrassis; natibus prominulis; epidermide subviridi; dentibus cardinalibus parvis erectisque; margaritâ salmonis colore tinctâ.

Shell somewhat oblong, transverse, inequilateral, emarginate at base, flattened on the side; valves somewhat thick; beaks rather prominent; epidermis greenish; cardinal teeth small and erect; nacre salmon colour.

Hab. Cumberland River, Ten. Professor Troost.
My Cabinet.
Cabinet of Professor Troost.

Diam. ·4, Length ·5, Breadth ·8 of an inch.

Shell somewhat oblong, transverse, inequilateral, somewhat inflated, emarginate at base, flattened on the side, raised at the umbonial slope; substance of the shell rather thick, thinner behind; beaks rather prominent; epidermis greenish, with indistinct rays; ligament short; cardinal teeth small and erect; anterior cicatrices confluent; posterior cicatrices distinct; dorsal cicatrices placed on the under part of the cardinal tooth; cavity of the shell deep; cavity of the beaks angular; nacre salmon colour, lighter before.

Remarks.—This curious and interesting shell I owe, with many others, to my friend Professor Troost. It is much smaller than any species which has been heretofore described, and does not seem to approach very closely any other species in its general characters. The two specimens which are now before me, the only ones I have seen, are much eroded. This prevents my knowing if the beaks be, in a perfect state, furnished with undulations.

ANODONTA CYLINDRACEA. Plate XIII. fig. 40.

Testâ cylindraceâ, inflatâ, valdè transversâ, inæquilaterali; valvulis tenuibus; natibus subprominulis; epidermide tenebroso-fuscâ, radiatâ; margaritâ cæruleâ.

Shell cylindrical, inflated, very transverse, inequilateral; valves thin; beaks somewhat prominent; epidermis dark brown, radiated; nacre blue.

Hab. River Medellin, near Vera Cruz. Dr Burrough.
My Cabinet.
Cabinet of Dr Burrough.

Diam. ·9, Length 1·3, Breadth 2·3 inches.

Shell cylindrical, inflated, very transverse, inequilateral, flattened on the umbones, subbiangular behind; umbonial slope rounded; substance of the shell thin; beaks somewhat prominent; ligament long and slender; epidermis dark brown, with numerous capillary rays over the whole disk; anterior cicatrices confluent; posterior cicatrices confluent; dorsal cicatrices not perceptible; cavity of the shell large; cavity of the beaks small; nacre blue and iridescent.

Remarks.—Two specimens only of this were sent by Dr Burrough. The one figured appears to be mature and in a good state; the other is young and imperfect. In outline it differs from any species within my knowledge. In the nacre it somewhat resembles the *A. tenebricosa* (nobis), but is a much thinner and more transverse shell. The deposit of epidermal matter in the interior, gives it a very clouded appearance. It is highly iridescent on the posterior portion of the nacre.

ANODONTA SALMONIA. Plate XIV. fig. 41.

Testâ ellipticâ, transversâ, inflatâ, valdè inæquilaterali; valvulis tenuibus; natibus prominulis; epidermide tenebroso-fuscâ; margaritâ colore salmonis tinctâ, infernè cæruleâ.

Shell elliptical, transverse, inflated, very inequilateral; valves thin; beaks somewhat prominent; epidermis dark brown; nacre salmon colour, bluish along the base.

Hab. near Poland, Ohio. J. P. Kirtland, M.D.
My Cabinet.
Cabinet of Dr Kirtland.
Cabinet of Mr Hyde.

Diam. 1·1, Length 1·4, Breadth 2·7 inches.

Shell elliptical, transverse, inflated, very inequilateral, within salmon colour and usually very rough; substance of the shell thin; beaks somewhat prominent and slightly undulated at the tip; ligament rather short; epidermis dark brown, sometimes with yellow bands; anterior cicatrices confluent; posterior cicatrices confluent; dorsal cicatrices indistinct; cavity of the shell deep; cavity of the beaks shallow; nacre bluish along the inferior margin, the interior being usually rough and of a deep salmon colour.

Remarks.—I am indebted to Dr Kirtland, of Poland, Ohio, for several specimens of this singular *Anodonta.* It is remarkably characterized in the nacre by the rough or tuberculous deposit of a deep salmon colour. In my specimens this roughness is exhibited most strongly about the anterior cicatrices. In form it most resembles the *A. Ferussaciana* (nobis), but is not quite so cylindrical, and differs altogether in the interior.

Anodonta Wardiana. Plate XIV. fig. 42.

Testâ ellipticâ, transversâ, subinflatâ, inæquilaterali; clivo umboniali rotundato; valvulis tenuibus; natibus prominentibus, ad apices undulatis; epidermide viridi, radiatâ; margaritâ subcæruleâ.

Shell elliptical, transverse, somewhat inflated, inequilateral; umbonial slope rounded; valves thin; beaks prominent, undulated at the tip; epidermis green, rayed; nacre bluish.

Hab. near Chilicothe, Ohio. J. C. Ward, M.D.
My Cabinet.
Cabinet of Dr Ward.

Diam. 1·2, Length 1·7, Breadth 3 inches.

Shell elliptical, transverse, somewhat inflated, inequilateral, at the base subemarginate, dorsal margin curved under the beak; umbonial slope rounded; substance of the shell thin; beaks prominent, concentrically undulated at the tip; ligament rather short; epidermis green, disposed to be yellow on the posterior slope and the beaks; anterior cicatrices confluent; posterior cicatrices confluent; dorsal cicatrices indistinct; cavity of the shell large; cavity of the beaks angular; nacre bluish.

Remarks.—I have from time to time received specimens of this species from Ohio, but I owe the perfect ones, now before me, to Dr Ward, of Chilicothe. Aware of its resemblance to *An. Ferussaciana* (nobis), and *An. areolatus* (Swainson), that gentleman gave particular attention to its habits, and in his letter to me, comparing it to the latter, which it most resembles, he says: "It more nearly resembles a variety of *areolatus* than any other species. It, like that shell, has the strong bend under the beak, which in the *areolatus* is almost a tooth. In habit, it totally differs from *areolatus*. It pierces deeply in the clay and gravel banks, in which it resembles the *An. incerta*, while the *areolatus* is only found in the deep bed of the stream, and is partially uncovered." In the undulations of the beaks, it more resembles the *Ferussaciana*, these being larger in the *areolatus*.

Anodonta Buchanensis. Plate XIV. fig. 43.

Testâ transversâ, inflatâ inæquilaterali, infernè emarginatâ, ad latus planulatâ; clivo umboniali elevato; valvulis tenuibus; natibus prominulis; apicibus undulatis; epidermide subviridi; margaritâ albâ.

Shell transverse, inflated, inequilateral, emarginate at base; flattened on the side; umbonial slope elevated; valves thin; beaks somewhat prominent, undulated at the tip; epidermis greenish; nacre white.

Hab. Buck Creek, Ohio. R. Buchanan, Esq.
My Cabinet.

Cabinet of Mr Buchanan.

Diam. 1·1, Length 1·3, Breadth 3 inches.

Shell transverse, inflated, subcylindrical, inequilateral, emarginate at the basal margin, flattened on the sides; umbonial slope elevated and rounded; substance of the shell thin; beaks somewhat prominent and minutely undulated at the tip; ligament rather short and thin; epidermis greenish, darker on the posterior slope; anterior cicatrices confluent; posterior cicatrices confluent; dorsal cicatrices indistinct; cavity of the shell deep; cavity of the beaks shallow; nacre white, bluish on the posterior part.

Remarks.—I owe to the kindness of R. Buchanan, Esq., a single specimen of this shell. It approaches the *A. Ferussaciana* more nearly than any other of our *Anodontæ* with which I am acquainted. In this individual the beaks are of a bright rusty colour.

Continuation of Mr Lea's Paper. Read, July 15*th*, 1837.

Having for some years given much attention to the anatomical structure of the *Naïades*, I have arrived at some results which may be deemed important enough to attract the further attention of zoologists, and be of sufficient interest to merit a place in our Transactions.

It is a source of congratulation to those interested in the study of this branch of natural history, to find that a number of naturalists are giving their time to examinations in localities peculiarly and fortunately situated in regard to the number of species, as well as their size, which circumstances tend greatly to facilitate investigations.

Believing that the oviducts would present to us the means of discrimination in some of the species, having found them to be so very different in the *Unio irroratus*,* my attention had been particularly addressed to these organs in the few and small species of our vicinity.

While engaged in this investigation, I received a communication from Dr Kirtland of Poland, Ohio, an ardent and intelligent student of natural history, in which he informed me of his conviction of being able to distinguish the female and male shells of the same species, without recourse to the included animal. Very shortly after this, his conclusive article on this subject appeared in the American Journal of Science and Arts, Vol. XXVI. It had been a matter of common observation, that individuals of the same species differ very much in the outline of the posterior portion of the shell. In some cases this has been the sole cause of making species, and *apparently* with reason.

It has generally been believed by European naturalists, as well as those of our own country, that these animals were androgynous, a principle so repugnant to nature, that it ought to have excited stronger doubts where the animal structure was so high in the scale of nature, as is the *Naïades*.

My attention now became more addressed to sexual characters, and a very short series of examination satisfied me fully as to the establishment of the difference of sexes.

The female sustaining her very large burden, naturally requires more space within the valves—hence we generally find an enlargement of the posterior portion of the shell, differing in its form in various species.

In the *U. cariosus*, *ochraceus*, *radiatus*, *luteolus*, *occidens*, *purpuratus*, *&c.*, the female is less transverse than the male, being somewhat truncate at the posterior margin, and the greatest diameter is near this portion of the shell. In the species having this distinction, the oviducts will be found to be placed in the posterior portion of the branchiæ. (See Pl. XV., fig. 44, 45, representing the oviducts of *cariosus* and *ochraceus*.) On reference to the figure of *cariosus* (Say), in Nich. Ency. (Am. Edit.) art. Conch. Pl. III., fig. 2, the female character is evident. The *occidens* (nobis), Trans. Am. Phil. Soc., Vol. III. Pl. X., is female; and *purpuratus* (Lam.), *ater* (nobis), Vol. III. Pl.

* See Vol. III., p. 269.

VII., is undoubtedly such. It may be observed, in each of these figures, that there is an enlargement at the posterior basal margin. This, so far as my knowledge extends, is always indicative of the female character in this form of shells, and this enlargement of the valve corresponds with the position of the charged oviducts. In the *cariosus* I have observed frequently, that the oviducts were so full as to be protruded when the animal was at rest, and when disturbed it retracted them with sluggishness. In a single case of a female *radiatus* which I touched in the river, the oviducts were visibly outside of the line of the shell, and the sudden alarm caused so rapid a closing of the valves as to cut off several of the sacks, which floated away.

There are a few species very remarkable in the shell for a character, which I refer to sex entirely, but never having had the advantage of examining the anatomy of the included animals, I do not present it as an undoubted fact. In my description of *U. arcæformis*, Trans. Am. Phil. Soc., Vol. IV., page 116, I noticed the enlargement and dentate appearance of the posterior margin. In this species, the *brevidens, sulcatus,** *capillaris*, and *triangularis*,† we find an enlargement to commence at a middle age before or along the umbonial slope, and each mark of growth on this enlargement is disposed to be dentate. In the *brevidens* it is so abrupt as to resemble a large cord on the inferior portion of the valves. In the *arcæformis* it is somewhat flattened and but slightly influences the plane of the margin. In the *capillaris* it is more spread out, but the enlargement and dentition are still very perceptible. One of my specimens of the *sulcatus* presents the dentitions more complete than I have observed in any other species. In all the species where this enlargement takes place, a corresponding groove may be observed in the interior part of the valve. In corroboration of my conclusion, that these are female shells, we have specimens of full growth of undoubtedly the same species which have not the least appearance of an enlargement; and all those which have not attained more than one-third or half their growth never in any case present it.

* See my remarks, Vol. III., p. 431.

† The male differing so much in form in the posterior part, induced me to think it to be a distinct species, and as such, I described it in Vol. IV., p. 111, under the name of *formosus*. See Plate XVI., fig. 41.

On examining the peculiarity of this structure, we are led to the conclusion, that these grooves are adapted to the enlargement of the oviducts, and I have no hesitation in believing, that when the animal shall be examined, it will be found to be adapted to this structure. In a former memoir, Vol. III. p. 271, I have described the very curious conformation of the oviducts of the *irroratus*. No species which has come under my notice since, presents any thing resembling it. The situation of the oviduct being about the centre of the valve, we do not find that the form of the margin is changed by its sexual character. The *phaseolus* (Hildreth) presents a very peculiar arrangement of the oviducts, resembling no other species which I have examined. The line of the branchiæ being very long, a continued folding of the whole length seems to be necessary. This is accurately represented in Mr Say's "American Conchology," plate 22. In the few female specimens of this species which I have examined, I have not been able to notice a difference of form in the shell from the male.

The females of the *U. perplexus* and *capsæformis*, are distinguished by a remarkable spreading out and extension of the whole of the posterior part of the shell. This very naturally has been taken for a deformity.

So far as I have been able to examine the *Anodontæ*, I have found them to differ in their structure as regards the oviducts. They do not appear to be divided into sacks like the *U. ochraceus*, *cariosus*, *&c.*, but to present an even mass from the anterior to the posterior part. I have examined numerous individuals of the two species, *An. fluviatilis** and *undulata* (Say), which exist in our vicinity, and several *Ferussaciana* (nobis), of the western waters which have been sent to me by my brother, T. G. Lea, in a preserved state. The whole lobe of the superior *branchiæ* being charged with ova, I presume that the *Anodontæ* produce more young than the *Uniones*. In October 1834, I examined a large number of our two species from the Schuylkill, and found the females very much advanced in gestation. The specimens of *fluviatilis* (see Plate XV. fig. 46), apparently, were ready to discharge their burdens. By the pressure of the finger on the side of the oviducts,

* *Myt. fluviatilis* (Soland.); *An. cataracta* (Say).

the young and perfect shells, lying as closely as possible, came from the orifices at the inferior part of the lobe. This I considered conclusive as regards this species, but I have not been able to decide so satisfactorily as to the mode of the *Uniones* discharging their young. I have been in the habit of keeping many living specimens in water, that I might observe them at convenience, and have placed them so near the surface of the water, in basins, as to examine their oviducts with a good lens. In one case, only, have I seen any discharge, and this was in a good sized *complanatus*, which sent out, while I watched it, perhaps a dozen sacciform oviducts in quite a quick succession. My draughtsman, Mr Drayton, happened to be in my room at the time, and witnessed this operation. Frequently, since that period, I have endeavoured to obtain the same result, but in no case has it recurred. I have, therefore, had my doubts (although I then considered it conclusive) whether it might not have been the effect of accident arising from the unnatural position of the animal—perhaps weakness or approaching dissolution. The *An. undulata* (see Plate XV. fig. 47) seemed nearly ready to spawn. The following observations were made on one which was kept, and opened December 21. The mass of the lobes in this species differs from the *fluviatilis*, in presenting a darker appearance and a very curious arrangement of the oviducts. The ova are placed in a kind of sack which lie across the lobe, presenting one end to the stomach and the other to the mantle of the animal. They lie so close together, as to take the form, on the exterior, like the cells of the honeycomb. This is, of course, caused by pressure. Some of these sacks, when carefully removed, were found to contain as many as twelve ova, each with a perfect living shell in it, having a brownish epidermis.

Fig. *a*, represents a sack with its ova.

Fig. *b*, represents the ovum with its perfect young shell included.

Fig. *c*, represents the honeycomb appearance, and is eight times magnified.

Among the species which I had under examination, were numerous specimens of *U. radiatus*, and, very much to my surprise, I found the females putting on two quite different forms as regards the inferior posterior portion of the mantle.

Plate XV., fig. 48, represents a female, with the parts protruded, as she lay at the bottom of a basin of water. The inferior portion of both sides of the sacciform branchiæ are visible, and bordered with black. The fringe of the mantle bordering this portion is furnished with brownish palpi, of one-eighth to three-eighths of an inch long, the two longest being the anterior ones, and opposed to each other. This part of the mantle is in frequent motion, as if in the action of throwing the water on the oviducts.

Plate XV., fig. 49, exhibits a very different apparatus for this part of the mantle. In the place of the palpi, we have a gray, spotted, fleshy ciliate prolongation of the mantle, which terminates in two long flexible feelers, nearly an inch long. At the posterior end of this portion there is a remarkable black spot on each side, surrounded by a white ring, presenting an extraordinary resemblance to an eye.

The difference between these two forms of the same portion of the mantle of the *radiatus* is truly curious. It seems difficult to believe it possible that they should not differ specifically. In the characters of the shells, however, I can find no difference whatever, and no one has, I believe, thought of dividing the *radiatus* of our rivers. Further investigation may throw some light on this apparent deviation in nature, and I trust the attention of the observant naturalist will be given to it. Circumstances have prevented me from following up these examinations, but it is my intention to resume them again.

I had commenced with the examination for sexual character with a good deal of ardour, and intended to have carried this through every month of the year, so far as the seasons permitted. The circumstances alluded to above, prevented the execution of this being as complete as I desired, and I propose to give extracts from my notes, rather than at present to draw conclusions.

Oct. 12, 1834.—I opened a large number of shells from the Schuylkill.

Twenty-five *U. complanatus.* These were all found to be without charged oviducts!!

Eleven *U. nasutus.* Four were found to be females, seven males.

Twenty-four *U. cariosus.* Ten were found to be females, fourteen males.

Twenty-four *U. ochraceus.* Ten were found to be females, fourteen males.

Six *Margaritana undulata.* One was found to be a female, five males.

One *Margaritana marginata.* Sex female.

Four *Anodonta undulata.* One was found to be a female, three males.

Six *Anodonta fluviatilis.* Three proved to be females, three males.

Oct. 23, 1834.—Opened a fine specimen of *Marg. marginata* and found the oviducts forming a lobe like the *An. fluviatilis*, there being no apparent sacks, but the whole mass was largely distended. The foot and surrounding portions were found to be of a salmon colour, as well as the edge of the mantle, which diminishes in intenseness as it approaches the sides and back. The perfect shells could be observed, but they were not so far advanced as to be yet brown.

Opened five specimens of *Marg. undulata.* Only one had charged oviducts, which were found to be similar to the above, but not quite so far advanced. Termination of the foot slightly salmon colour.

Opened two *U. ochraceus.* One male, the other female. The latter fully charged.

Nov. 16, 1834.—Examined three specimens of *U. cariosus*, all obtuse at posterior end.—Found them all fully charged.

Two *U. ochraceus.* Obtuse. Fully charged.

One *U. radiatus.* Obtuse. Fully charged.

One *U. nasutus.* Obtuse. Just commenced to swell on the border of the branchiæ.

Two *U. complanatus.* Both males.

Two *M. undulata.* Both males.

Two *An. fluviatilis.* One male, one female.

Dec. 24, 1834.—Opened the following shells, which had been kept in water some four, some twelve weeks, in the house.

Four *U. cariosus.* One female, three males.

Three *U. complanatus.* All without charged oviducts.

Two *M. marginata.* Without charged oviducts.

Two *M. undulata.* Without charged oviducts.

One *An. undulata*, with reddish charged oviducts, displaying, in a beautiful manner, the honeycomb appearance.

Jan. 18, 1835.—Re-examined a keg of *Naïades*, received from T. G. Lea, two years since. Found *An. Ferussaciana* to be charged in its oviducts like *An. undulata.* One *U. calceolus* partly charged, and one fully charged. One *U. parvus*, thickened along the edge of the oviduct, but did not appear to be perfectly developed. One *An. edentula* was found charged like *An. undulata.*

Jan. 25, 1835.—Opened a large keg from T. G. Lea, taken near Cincinnati. *U. cornutus* was found to differ in its form of the oviducts from other species, the sacks being inclined, and lying parallel to each other, and pendent to the posterior part of the branchiæ only. *U. trigonus*, animal of a deep nearly red colour. *U. Æsopus*, orange colour. *U. cylindricus*, colour pale orange with a blackish line along the lower part of the foot. *U. securis* was found with the oviducts like *cariosus. Sym. complanata*, colour fine orange. *U. ovatus*, very like to *cariosus* in the oviducts. *Sym. gracilis*, oviducts like *cariosus*, but much finer and closer. *U. triangularis*, oviducts small and somewhat like *cariosus*, but more oblong and bent in. *U. foliatus* had small oviducts.

U. clavus,* found the animal to be orange colour.

U. retusus, has oviducts on the posterior part of the branchiæ only; they resemble those of *cariosus*, but are smaller.

U. ellipsis. The oviducts are like *retusus.*

U. orbiculatus, has oviducts like *cariosus.*

U. rectus, has oviducts close to the posterior end.

March, April, May 1835.—During these months numerous specimens were examined, which confirmed my previous observations.

May 26.—I opened a keg containing various species, from Cincinnati the preceding autumn.

Twenty *An. Ferussaciana.* Seventeen had charged oviducts.

Four *An. incerta* were apparently all males.

* *Scalenius?* (Rafinesque).

Three *An. edentula.* All had charged oviducts.
Four *Unio calceolus.* All had charged oviducts.
One *Unio planulatus.* Oviducts charged.
Four *Unio luteolus.* Two with charged oviducts.
Several *Unio crassus.* Only one with charged oviducts.

A few specimens of *multiplicatus*, *tuberculatus*, *asperrimus*, *crassidens*, *alatus*, *gracilis*, &c., proved to be without oviducts; doubtless all being male.

July 1835.—During this month examined some fifty or sixty specimens of various species, in none of which did I find the oviducts charged.

Aug. 11, 1835.—Received three fine specimens of *U. heterodon* from Mr Clark, of Manayunk. One of these was found to be charged nearly the whole length of the branchiæ with ova. These were so small as to require the microscope to make them out.

Sept. 6, 1835.—Opened a specimen of *U. heterodon*, found a few days since in the Schuylkill. The oviducts were charged nearly the whole length of the branchiæ, and the ova very perceptible with the microscope.

Sept. 11, 1835.—Examined another *U. heterodon*, and found it similar to the last mentioned.

Sept. 13, 1835.—Opened a number of various species. Found three *An. undulata*, with their oviducts charged, being sufficiently forward to exhibit very plainly their singular position across the lobe of the branchiæ. Also four *Marg. undulata*, with charged oviducts, but by no means in a forward state.

Dec. 13, 1835.—Examined a large *Marg. margaritifera*, which proved to be without oviducts. Had a strong dorsal muscular attachment. The palpi along the fringe of the mantle were more grouped than those which I have observed on the *Uniones*. On the branchiæ were spots of a nankin yellow colour, quite consistent, but yielding to the pressure of the knife.

Also a large *Marg. marginata*, nearly three inches in width. This had oviducts filled with minute ova, just perceptible with the microscope. These two fine specimens were taken for me in Crum Creek.

by Dr Griffith. Also examined a *U. radiatus*, with enlarged oviducts, but not sufficiently advanced to observe any ova with a common microscope. Several others examined proved to be males.

June 5, 1836.—Opened an obtuse *U. ochraceus*, with large and full oviducts. The ova only so far progressed as to be visible with the microscope.

Unio spinosus. Plate XVI. fig. 50.

Testâ spinosâ, subtriangulari, inflatâ, inæquilaterali, posticè acuto-angulatâ; valvulis subcrassibus; clivo umboniali carinato; natibus vix prominentibus; epidermide atro-fuscâ, glabrâ; dentibus cardinalibus deorsum inclinantibus; lateralibus subgrandibus subcurvisque; margaritâ purpureâ.

Shell spinous, subtriangular, inflated, inequilateral, acutely angular behind; valves rather thick; umbonial slope carinate; beaks scarcely prominent; epidermis dark brown, shining; cardinal teeth inclining downwards; lateral teeth rather large and curved; nacre purple.

Hab. Altamaha, Hopeton, near Darien, Geo. James Hamilton Cowper, Esq.

Hab. Altamaha, Liberty County, Geo. Lewis Leconte, Esq.

My Cabinet.

Cabinet of Professor Shepard.

Cabinet of Professor Ravenel.

Cabinet of Major Leconte.

Diam. 1·2, Length 1·8, Breadth 3·3 inches.

From tip to tip of fourth pair of spines, 2·6 inches.

Shell spinous, subtriangular, inflated, inequilateral, acutely angular behind; arcuate on the dorsal margin; substance of the shell rather thick, thinner behind; spines erect, opposed in each valve, placed in a row before the umbonial slope and nearly parallel thereto; umbonial slope carinate; beaks scarcely prominent; ligament short and thick; epidermis dark brown, shining, finely wrinkled; cardinal teeth inclining downwards, single in the right and double in the left valve, enlarged and truncate at the anterior end; lateral teeth rather large, thickened and curved in the inferior portion; anterior cicatrices distinct; posterior cicatrices confluent; dorsal cicatrices placed in the inferior part of the cardinal teeth; cavity of the shell deep; cavity of the beaks angular; nacre purple.

Remarks.—The genus *Unio* has particularly attracted the attention of naturalists, in the fact of its presenting specimens which resemble many of the genera and species of other families. Thus we have them to resemble an *Arca*, a *Venus*, a *Solen*, a *Modiolus*, &c. The shell described above resembles that which I never expected to see in the *Naïades*, viz. the *Cytherea Dione!* The *Unio spinosus* is certainly the most extraordinary species of this genus which has come under my notice. Having seen but a single specimen, I am not prepared to say that the number of spines is uniform. There are apparently four pairs. I say apparently, for I find no antagonist spine on the right valve opposed to that nearest the tip of the beak. The beak being slightly eroded there, may account for its absence. That which remains on the left valve, nearly a quarter of an inch from the tip of the beak, is only one-tenth of an inch long, but, being fractured, may have been originally much larger. This I call the first pair.

The second pair is placed nearly half an inch from the same point, and the spines directly opposite to each other. That on the left valve is half an inch long, but, being fractured at the apex, most likely was, in a perfect state, one-tenth of an inch longer. At the base it is nearly one-tenth of an inch thick, at the top one-twentieth. That of the right valve is about four-tenths of an inch long, and bifurcates two-thirds of the way up, at an angle of nearly forty degrees, the apex of each branch being fractured.

The spines of the third pair are not exactly opposed to each other, but this I attribute to accidental causes in this specimen. In the left valve the spine is placed nearer to the umbonial slope than those which are next to it, while that of the right valve is further removed from it; consequently neither stand exactly in the line of the row of the whole on each valve. That of the left valve is broken off three-tenths of an inch from its base; that of the right valve is six-tenths of an inch, and presents the only perfect apex of a spine. This apex is rounded, perfectly smooth, and covered over with epidermal matter.

The fourth pair is nearly three-fourths of an inch from the third, and the spines are much thicker and stronger, and are both rather over half an inch long; that of the left valve bifurcates near the top, and a little lower down there is the rudiment of a third branch; that of the left valve presents no bifurcation, but has the rudiment of a branch at the same height as that of the other valve. All the spines are flattened, the greater diameter being transverse—their upper sides are wrinkled, and particularly those of the inferior pair—their lower sides flattened and smooth. This is exactly what we might expect in the formation of these spines. They are constructed like the tubercles on the nodulous shells and the horns on the *cornutus*. The border of the mantle having deposited the calcareous matter, and the epidermal matter over it, outside of the plane of the shell, where the base of the spine is placed, continues to do this until the apex of the spine is reached. We would then have the larger longitudinal part finished, with its epidermis complete, and the centre would form a kind of channel to the apex. This being reached, the mantle forms the same operation, descending in the lower side, filling up the channel, and covering the deposit with epidermis, and presenting somewhat the appearance of a cicatrix. All the spines which are broken display the remains of the channel, and at first view might be thought to be perforate. This, however, is not the case; the interior of the valves indicating no appearance of the position of the spines, except a little roughness below the last pair.

The teeth of this shell differ in some of their characters from any *Unio* with which I am acquainted. The highest part of the dorsal curve is equidistant from the extreme ends of the two teeth. The cardinal teeth are remarkable for their form and position, being very much enlarged at the anterior end, and pointing to the anterior margin. The lateral teeth are lamellar, and unusually enlarged on the inferior portion—thus forming an inverted curve, the inferior portion of the double lamellar tooth being very much larger than the superior one.

The nacre of the shell is purple, approaching a rose colour, and is very beautiful. The beaks being slightly eroded, renders it unable to determine if there be any undulations there. I doubt when perfect specimens are found, if there will be any observed.

The above description and observations being made under the disadvantage of the examination of a single specimen only, it is proper to mention that they may not apply to all. It is very probable that some individuals may have no bifurcation of the spines, while others may have all the spines possessing that character. The colour of the nacre may also vary. Professor Shepard informs me that two other specimens, now in the cabinet of Professor Ravenel, were quite imperfect. "One of them had but two (nearly obliterated) pairs of spines, and the other but a single pair. The shells being eroded in the vicinity of the spines, all traces of them had disappeared. The largest specimen was one-third larger than that now sent."

The existence of this curious species was first communicated to me by Major Leconte, in 1830 or 1831, and he then very kindly promised to procure it for me through his brother. In a letter recently received from him, he says, "I first heard of, and in fact saw, a fragment of the *Unio spinosus* in the year 1830, as being found, along with several other species (of which single valves were given to me), in the Altamaha River. Since then my brother (Lewis Leconte) has repeatedly endeavoured to obtain specimens of it, without success, until last winter. He once went to the situation where they are most plentifully found (a distance of fifty miles, and in an almost uninhabited country), but failed in procuring any."* About two years after Major Leconte first called my attention to this shell, I found that it had been observed by Bartram in his "Travels." In the summer of 1777 he seems to have observed it in the Mississippi. If it be not the same species, it must be very like it. He says, "The next morning I set off for Point Coupé; passed under the high pointed cliffs, and then set our course across the Mississippi, which is here near two miles over; touched at a large island near the middle of the river, being led there,

* Since the above was written, I have a letter from Major Leconte, of New York, (June 13, 1836), in which he mentions having just received his specimens of this curious *Unio*, with some others which are very interesting, and he has kindly promised to place a specimen in my cabinet.

a little out of our way, in pursuit of a bear crossing from the main. After resting a while, we re-embarked, and continued on our voyage, coasting the east shore of the island to the upper end; here we landed again, on an extended projecting point of clean sand and pebbles, where were to be seen pieces of coal sticking in the gravel and sand, together with other fragments of the fossil kingdom, brought down by inundations and lodged there. We observed a large kind of muscle in the sand; the shell of an oval form, having horns or protuberances near half an inch in length, and as thick as a crow-quill, which I suppose serve the purpose of grapnels to hold their ground against the current. Embarked again, doubled the point of the island, and arrived at Point Coupé in the evening."—*Travels, p.* 431.

I have several times endeavoured to procure the shell mentioned by Bartram, but have not been fortunate enough to succeed. The specimen figured here belongs to Professor Shepard, to whom I am indebted for several other fine species from the same locality. Professor Shepard informs me that he received three individuals from his friend Mr Cowper, with the remark that they were obtained with difficulty during the last summer from a bar in the Altamaha. Two of these specimens were given to Professor Ravenel, to whose kindness I am indebted for the promise of one of them.

Unio pliciferus. Plate XVII. fig. 53.

Testâ ellipticâ, inæquilaterali, subinflatâ, posticè undulatâ; valvulis anticè crassioribus; natibus prominulis; epidermide atro-viridi; dentibus cardinalibus submagnis; lateralibus rectis; margaritâ purpureâ.

Shell elliptical, inequilateral, somewhat inflated, undulated behind; valves thicker before; beaks rather prominent; epidermis blackish green; cardinal teeth rather large; lateral teeth straight; nacre purple.

Hab. Mexico. Dr Burrough.

My Cabinet.

Cabinet of Dr Burrough.

Cabinet of Academy of Natural Sciences.

Diam. ·8, Length 1·2, Breadth 2·1 inches.

Shell elliptical, inequilateral, somewhat inflated, furnished with numerous small folds on the posterior slope and side; substance of the shell thick before, and thinner behind; beaks rather prominent; ligament short and light horn-coloured; epidermis very dark green; cardinal teeth rather large, single in the right valve and double in the left; lateral teeth rather short and straight; anterior cicatrices distinct; posterior cicatrices confluent; dorsal cicatrices situated on the base of the cardinal teeth; cavity of the shell rather deep; cavity of the beak angular; nacre purple, rarely white.

Remarks.—Among the shells recently sent by Dr Burrough from Mexico, were many specimens of this species, which I believe not to have been before described. It is remarkable for the numerous small folds on the posterior slope, and these in some individuals extend over the umbonial slope and posterior half of the side. In the old specimens the posterior margin is disposed to be biangular, and the epidermis is quite black—in the younger it is dark green, and obscure rays may sometimes be observed. Among the specimens examined, two were white in the nacre, and one of these salmon-coloured within the beaks. The lateral teeth, where the beaks are eroded, are somewhat curved.

Unio Tappanianus. Plate XVII. fig. 55.

Testâ obovatâ, subinflatâ, inæquilaterali, posticè dilatatâ; valvulis tenuibus; natibus subprominentibus, undulatisque; epidermide fulvo-fuscâ; dentibus cardinalibus compressis curvisque; lateralibus tenuis; margaritâ subsalmoniâ.

Shell obovate, rather inflated, inequilateral, dilated behind; valves thin; beaks somewhat prominent and undulated; epidermis yellowish brown; cardinal teeth compressed and curved; lateral teeth thin; nacre somewhat salmon.

U. viridis (Conrad), not Rafinesque.
Hab. Juniata, near Hollidaysburg. Dr. Kirtland.
Schuylkill, and a small stream near Lancaster. Mr Hyde.

My Cabinet.
Cabinet of Dr Kirtland.
Cabinet of Judge Tappan.
Cabinet of Mr Hyde.

Diam. ·7, Length 1·1, Breadth 2 inches.

Shell obovate, rather inflated, inequilateral, dilated behind, subalate; umbonial slope rounded, inflated; substance of the shell thin and transparent behind, opaque and thicker before; beaks somewhat prominent, furnished with double undulations; ligament rather short and slender; epidermis yellowish brown, with dark rays, more numerous on the portion behind the umbonial slope; cardinal teeth lamellar, curved outward, single in the right and double in the left valve; lateral teeth acicular; single in both valves, and nearly straight; anterior cicatrices distinct; posterior cicatrices confluent; dorsal cicatrices placed on the base of the cardinal teeth; cavity of the shell deep and rounded; cavity of the beak small and angular; nacre somewhat salmon coloured.

Remarks.—Dr Kirtland found this shell near Hollidaysburg, on the Juniata, where he obtained it last autumn; and to his kindness I owe the specimen in my cabinet. In outline it resembles *U. modioliformis* (nobis), but cannot be easily confounded with that shell, being less inflated, less obovate, and more carinate. In the teeth it differs also, and is peculiar. The specimens which have come under my notice have the lateral teeth single in both valves; in the left valve there is a slight disposition in one of the specimens to duplication. The nacre of the shell is very iridescent and satin-like, the border dark ochre brown: this causes the stages of growth to be distinct.

It is remarkable that, being an inhabitant of the Schuylkill, there should have been but a single specimen taken, that river having been almost daily searched by so many active zoologists.

I name it after my friend, Judge Tappan, of Ohio.

ANODONTA DECORA. Plate XX. fig. 63.

Testâ ellipticâ, inæquilaterali, valdè inflatâ; valvulis tenuibus; natibus prominulis, ad apices undulatis; epidermide glabrâ, unâ vittatâ; margaritâ albâ, salmonis colore tinctâ.

Shell elliptical, inequilateral, very much inflated; valves thin; beaks somewhat prominent and undulated at the tip; epidermis smooth and single banded; nacre white and salmon colour.

Hab. Canal near Cincinnati, Ohio. T. G. Lea.
Canal near Chilicothe, Ohio. Dr Ward.
My Cabinet.
Cabinet of T. G. Lea.
Cabinet of Dr Ward.
Cabinet of Mr Hyde.

Diam. 1·8, Length 2·5, Breadth 3·9 inches.

Shell elliptical, nearly straight on the dorsal margin, subangular behind, inequilateral, very much inflated; substance of the shell thin; beaks rather prominent, and undulated in a double series at the tip; ligament rather long and straight; epidermis smooth and shining, furnished with green rays beyond the dark transverse band situated about the middle of the valve; posterior slope dark, with three rays on each valve; anterior cicatrices confluent; posterior cicatrices confluent; dorsal cicatrices situated in the centre of the cavity of the beaks; cavity of the shell deep; cavity of the beaks rather small; nacre slightly salmon-coloured in the cavity, and white on the remaining portion.

Remarks.—My brother, T. G. Lea, called my attention some years ago to this shell. It, however, so nearly resembled *A. plana* (nobis), that I was disposed to consider it only a variety of that species. A remarkably fine suite, however, recently received from Dr Ward, has satisfied me that it ought to be separated from it. Indeed these specimens are so much inflated, as to have induced Dr Ward to suppose they might belong to *An. Stewartiana* (nobis). The broad and distinct band which in adults transversely crosses the valve about half way between the beak and the margin, is very remarkable in this species. This band defines the extent, in the interior, of the tint of salmon colour. Beyond this the epidermis is usually of a fine green and rayed, while the umbones and beaks are almost without rays.

BULIMUS LACTEUS. Plate XXIII. fig. 100.

Testâ ovato-conicâ, imperforatâ, nitidâ, lacteâ, tenui, subdiaphanâ, minutissimè transversim striatâ, infernè bruneo vittatâ; anfractibus senis; aperturâ subparvâ; labro acuto.

Shell ovately conical, imperforate, shining, milky, thin, somewhat transparent, transversely and minutely striate, base with a brown band; whorls six; aperture rather small; outer lip acute.

Hab. about one hundred miles up the Magdalena River, Colombia. T. R. Peale.

My Cabinet.
Philadelphia Museum.

Diam. ·4, Length ·7 of an inch.

Remarks.—This is one of the new shells brought by Mr Peale from his scientific expedition into Colombia. It may be distinguished by the brown band, which immediately surrounds the base of the columella. One of the individuals under my inspection is more transparent and less white than the other.

BULIMUS PEALIANUS. Plate XXIII. fig. 105.

Testâ ovato-conicâ, imperforatâ, lævi, nitidâ, cittereâ, subcrassâ; flammulis purpureis longitudinalibus pictâ; anfractibus senis; aperturâ patulâ, purpureâ; labro acuto, reflexo.

Shell ovately conical, imperforate, smooth, shining, ash coloured, rather thick; furnished with longitudinal purple spots; whorls six; aperture widened out, purple; outer lip acute, reflected.

Hab. near the Rapids of Angostura, Colombia. T. R. Peale.

Philadelphia Museum.

Diam. ·4, Length 1·1 inches.

Remarks.—During Mr Peale's travels in Colombia, he found a single specimen of this beautiful species, and I am indebted to his kindness for the privilege of describing it. In this individual the longitunal spots are more numerous on the whorl next to the body-whorl, there being none on that part near to the outer lip.

Bulimus Colombianus. Plate XXIII. fig. 110.

Testâ elongato-turritâ, perforatâ, nitidâ, albâ, tenui, minutissimè transversim striatâ; apice aureâ; anfractibus septenis; aperturâ subparvâ; labro acuto.

Shell elongately turrited, perforate, shining, white, thin, transversely and minutely striate; apex golden colour; whorls seven; aperture rather small; outer lip acute.

Hab. about one hundred miles up the Magdalena River, Colombia. T. R. Peale.

Philadelphia Museum.

Diam. ·5, Length 1·2 inches.

Remarks.—The spire is long, and the aperture about one-third the length of the shell. It is nearly milk white, and so thin as to be somewhat translucent.

Bulimus corneus. Plate XXIII. fig. 111.

Testâ ovato-conicâ, umbilicatâ, corneâ, tenui, pellucidâ; anfractibus septenis; aperturâ parvâ; labro acuto.

Shell ovately conical, umbilicate, horn-colour, thin, pellucid; whorls seven; aperture small; outer lip acute.

Hab. Buenavista, Colombia. T. R. Peale.

My Cabinet.
Philadelphia Museum.

Diam. ·3, Length ·7 of an inch.

Remarks.—In form and size this resembles the *B. lactea*, herein described, but may be distinguished at once by its colour, its umbilicus, and the absence of a band. Owing, apparently, to the roughness of the epidermis, its surface is scarcely shining. I owe this shell to the kindness of Mr Peale.

Helix Wardiana. Plate XXIII. fig. 82.

Testâ orbiculato-convexâ, umbilicatâ, infernè depressâ, nitidâ, corneâ, diaphanâ; anfractibus senis, longitudinaliter striatis; striis confertis; spirâ obtusâ; labro acuto, intus spissatâ.

Shell orbicularly convex, umbilicate, flattened below, shining, horn-coloured, translucent; whorls six, longitudinally striate; striæ close; spire obtuse; outer lip acute, within thickened.

Hab. near Cincinnati, Ohio. T. G. Lea.
near Chilicothe, Ohio. C. J. Ward, M.D.
My Cabinet.
Cabinet of T. G. Lea.
Cabinet of C. J. Ward, M.D.

Diam. ·4, Length ·3 of an inch.

Remarks.—While I had several specimens of this species from my brother, T. G. Lea, holding them somewhat in doubt as to their being distinct from *H. ligera* (Say), I received several fine specimens from Dr Ward, who informed me that "the inhabitant is differently marked from *ligera*." He says, "the base of the foot is *white*, posteriorly acute. Body white, with blackish brown spots over it, and one *large* and two smaller black longitudinal bands extending from the neck to the end of the body."

Cyclostoma maculata. Plate XXIII. fig. 87.

Testâ suborbiculatâ, transversim striatâ, carinatâ, maculatâ, diaphanâ, umbilicatâ; anfractibus quinis; spirâ subbrevi; ultimo anfractu medio carino cincto; labro margine albo, reflexo.

Shell suborbicular, transversely striate, carinate, spotted, transparent, umbilicate; whorls five; spire rather short; carinate on the middle of the last whorl; margin of the lip white and reflected.

Hab. Manilla. W. W. Wood.
Philadelphia Museum.

Diam. ·4, Length ·5 of an inch.

Remarks.—This pretty little species of *Cyclostoma* was sent by Mr Wood to Mr T. R. Peale, to whom I owe the opportunity of describing it. Its transparency and numerous brown spots distinguish it at once from all other species with which I am acquainted. In the individual before me, there is a second obscure carination above that on the middle of the whorl. In others this may be found to be more distinct or entirely wanting.

Planorbis lens. Plate XXIII. fig. 83.

Testâ parvâ, lenticulari, lato-umbilicatâ, ad periphœriam carinatâ, pellucidâ, corneâ; anfractibus ternis; aperturâ magnâ.

Shell small, lenticular, widely umbilicate, carinate on the periphery, pellucid, horn-coloured; whorls three; aperture large.

Hab. near Cincinnati, Ohio. R. Buchanan.
My Cabinet.
Cabinet of R. Buchanan.
Cabinet of T. G. Lea.

Diam. 3-20ths, Length 1-20th of an inch.

Remarks.—This is the smallest of the *Planorbes* which has come under my notice, and may at once be distinguished by its lenticular form. The specimens in my possession I owe to my brother, T. G. Lea. They were first pointed out to him by Mr Buchanan.

NOTE.—I would be glad to be permitted to mention here, that the *Helicina pulcherrima* (Vol. V. page 49), and *Helix purpuragula* (Vol. V. page 51), supposed to be from Java, really inhabit Cuba, having recently received some collected on the mountainous part of that island.

Recently, in examining with a lens a very perfect specimen of *Carocolla spinosa* (See Vol. IV. page 104), I observed a remarkable character which had before escaped me. The superior part, in very perfect specimens, exhibits a crimped epidermis of a peculiar nature, being very irregular in the sizes of the crimps. Beneath the epidermis the shell is striate.

Continuation of Mr Lea's Paper. Read, August 19th, 1836.

GENUS MARGARITA.

SUBGENUS UNIO.

UNIO GRANIFERUS. Plate XIX. fig. 60.

Testâ nodulosâ, subrotundâ, inflatâ, ponderosâ; valvulis crassibus; natibus valdè prominentibus; epidermide atro-fuscâ; dentibus cardinalibus grandibus; lateralibus brevibus subrectisque; margaritâ colore cocao.

Shell nodulous, subrotund, inflated, ponderous; valves thick; beaks very prominent; epidermis dark brown; cardinal teeth large; lateral teeth short and nearly straight; nacre chocolate-colour.

Hab. Ohio River, near Cincinnati. T. G. Lea.
My Cabinet.
Cabinet of T. G. Lea.
Cabinet of Mr Hyde.

Diam. 1·4, Length 1·9, Breadth 1·9 inches.

Shell nodulous, subrotund, emarginate behind, inflated, ponderous, sulcate on the posterior slope; substance of the shell very thick; umbones large; beaks very prominent; tubercles not numerous, rather small, disposed to be erect and transverse; ligament rather short; epidermis dark brown; cardinal teeth large and spread out; lateral teeth short, thick, and nearly straight; anterior cicatrices distinct; posterior cicatrices distinct; dorsal cicatrices situated on the inferior portion of the cardinal teeth; cavity of the shell small; cavity of the beaks deep and angular; nacre chocolate-colour.

Remarks.—This shell is very closely allied to the *verrucosus* (Barnes), and has been, I believe, generally considered as a variety of it. In several of its characters, however, it is quite distinct. It differs in being a smaller shell, in being much more inflated over the umbones, in the granules or tubercles being smaller, more erect and more transverse. In the epidermis it is much darker. In my youngest specimen the beaks are nearly perfect, and at the tip they are very minutely and closely undulated.

Unio splendidus. Plate XIX. fig. 61.

Testâ ellipticâ, valdè inflatâ; valvulis subcrassibus; natibus prominentibus; epidermide valdè radiatâ; dentibus cardinalibus subcompressis; lateralibus remotis lamellatisque; margaritâ splendidâ rosâque.

Shell elliptical, very much inflated; valves rather thick; beaks prominent; epidermis very much rayed; cardinal teeth somewhat compressed; lateral teeth separate and lamellar; nacre splendid rose-colour.

Hab. Altamaha River, near Darien, Geo. James Hamilton Cowper, Esq.

Hab. Altamaha, Liberty County, Geo. Lewis Leconte, Esq.

My Cabinet.

Cabinet of Professor Shepard.

Cabinet of Major Leconte.

Diam. 1·4, Length 1·7, Breadth 2·8 inches.

Shell elliptical, very much inflated; substance of the shell rather thick; umbones large; umbonial slope carinate; posterior slope with three indistinct ribs on each valve; beaks prominent; ligament rather long and somewhat thick; epidermis yellowish, with numerous dark green rays over the whole disk; cardinal teeth somewhat compressed, double in both valves, enlarged at the anterior portion; lateral teeth separated from the cardinal teeth, lamellar, the inferior division of that of the left valve enlarged, and longer than the superior one; anterior cicatrices distinct; posterior cicatrices confluent; dorsal cicatrices within the cavity of the beaks under the cardinal tooth; cavity of the shell deep and angular along the carina of the umbonial slope; cavity of beaks deep and rounded; nacre splendid rose-colour.

Remarks.—I owe this species, which came into my possession some months since, to Professor Shepard, who procured it from his friend Mr Cowper. It very closely resembles the *U. ochraceus* (Say), but may be distinguished from it by its carinate umbonial slope, and its being more inflated. The colour of all the specimens I have examined is, in the nacre, of a rose tint. A single one has a slight salmon colour mixed with it. When more are examined, there may be some found entirely salmon or white.

I owe to the kindness of Major Leconte some very fine specimens from Liberty county, where they were found with the *U. spinosus.*

Subgenus Margaritana.

M. arcula. Plate XXII. fig. 69.

Testâ plicatâ, triangulari, valdè inflatâ; valvulis tenuissimis; clivo umboniali carinato; natibus valdè prominentibus; epidermide atro-viride, radiatâ; dentibus laminatis, irregularibus; margaritâ cœruleâ.

Shell plicate, triangular, very much inflated; valves very thin; umbonial slope carinate; beaks very prominent; epidermis dark green, radiated; teeth lamellar, irregular; nacre bluish.

Hab. Altamaha, Liberty County, Geo. Lewis Leconte, Esq.
My Cabinet.
Cabinet of Major Leconte.

Diam. 1·6, Length 1·7, Breadth 2·2 inches.

Shell plicate, triangular, very much inflated; substance of the shell very thin; umbones very large; umbonial slope acutely carinate; posterior slope very much flattened, having an indistinct furrow along the edge of the carina; folds about eight, large on the beaks, and diminishing along the edge of the carina; ligament small; epidermis dark green, with numerous green rays over the whole disk; teeth lamellar, irregular; anterior cicatrices confluent; posterior cicatrices not perceptible; dorsal cicatrices not perceptible; cavity of the shell very deep, acutely angular under the carina, having two furrows leading from the beak to the posterior margin; cavity of the beak very deep and angular; nacre very thin, bluish, often tinted with pink.

Remarks.—I owe to the kindness of Major Leconte the possession of this very interesting species. It is entirely distinct from any I am acquainted with, and is peculiar for the folds which are placed along the umbonial slope, and lie at right angles with it. It is among the most inflated species of the family, and the substance of the shell is thinner than in any species of its size which I know. The posterior slope is so flat, that the valves when placed on that part will rest there. In the folds it has some resemblance to the *Alas. undulata* (Say), but in this species they are larger and more numerous than in the *undulata*. In outline it resembles *U. triangularis* (Barnes). Taking a posterior view of it, one is reminded, by the outline, of *Cardium cardissa.*

Continuation of Mr Lea's Paper. Read, Nov. 4th, 1836.

UNIO DORFEUILLIANUS. Plate XVII. fig. 54.

Testâ subtriangulari, inflatâ, tuberculatâ, inæquilaterali; valvulis præcrassis; natibus magnis elevatisque; dentibus cardinalibus magnis erectisque; lateralibus brevibus curvisque; margaritâ albâ.

Shell subtriangular, inflated, tuberculate, inequilateral; valves very thick; beaks large and elevated; cardinal teeth large and erect; lateral teeth short and curved; nacre white.

Hab. Ohio River. Mr Dorfeuille, Cincinnati.
My Cabinet.

Diam. 2·2, Length 2·6, Breadth 2·9 inches.

Shell subtriangular, inflated, tuberculate on the umbones; substance of the shell very thick; beaks large, very prominent and recurved; ligament short and thick; epidermis dark brown and transversely striate; cardinal teeth large and erect; lateral teeth short, thick and curved; anterior cicatrices distinct, the great one forming a very deep pit; posterior cicatrices distinct; dorsal cicatrices situated on the inferior part of the cardinal tooth; cavity of the shell deep; cavity of the beaks deep and angular; nacre white.

Remarks.—A single specimen of this species belonged to the Museum of Mr Dorfeuille, who very obligingly presented it to me. I do not know from what part of the Ohio it was obtained, and although a single specimen, and resembling two species, I have considered it proper to propose it as a new species, being unable to class it with any one known to me. In general outline and thickness it resembles *U. trigonus* (nobis), but, having higher beaks and being tuberculated, cannot be classed with that species. In the possession of tubercles it resembles *U. pustulatus* (nobis), but differs from it in having very elevated thick beaks, in having very few tubercles (these are scattered over the central portion of the disk only), and in the outline being subangular.

Unio discus. Plate XVIII. fig. 57.

Testâ ellipticâ, valdè compressâ, inæquilaterali; valvulis crassis; natibus prominentibus; dentibus cardinalibus magnis; lateralibus longis, à cardinalibus separatis; margaritâ purpureâ et iridescente.

Shell elliptical, very much compressed, inequilateral; valves thick; beaks prominent; cardinal teeth large; lateral teeth long, being separated from the cardinal teeth; nacre purple and iridescent.

Hab. India.

My Cabinet.

Diam. 1·4, Length 3·3, Breadth 5·2 inches.

Shell elliptical, very much compressed, biangular behind, inequilateral; substance of the shell thick; beaks prominent; ligament long and thick; cardinal teeth large, regularly sulcate and deeply cleft in the left valve; lateral teeth long, thicker at the posterior end, and separated from the cardinal tooth; anterior cicatrices distinct; posterior cicatrices confluent; dorsal cicatrices placed across the base of the cardinal tooth; cavity of the shell very shallow; cavity of the beaks rather small and subangular; nacre purple and iridescent.

Remarks.—This description is made from a single decorticated valve, procured of Mr B. Tanner, who purchased it in a lot of shells brought from India. When I first saw this specimen it was evident to me that it differed from any known American species; and finding, subsequently, that it was most probably a native of India, I could no longer hesitate as to its being new. It bears some resemblance to *U. crassidens* (Lam.) and *U. alatus* (Say). It differs from the former in being flatter, more spread out, and the substance of the shell being less thick. From the latter it differs in being thicker in the substance of the shell, in being ovate, and being without a wing. It is very much to be regretted that the exterior should be so much deprived of its epidermis as to render it impossible to form a correct opinion as to its appearance in a perfect state.

Unio contradens. Plate XVIII. fig. 58.

Testâ obovatâ, subinflatâ, inæquilaterali; valvulis tenuibus; natibus subprominentibus undulatisque; epidermide subviridi; dentibus cardinalibus lineatis, duplicibus in valvulam dextram; lateralibus tenuibus subcurvisque; margaritâ albâ et iridescente.

Shell obovate, rather inflated, inequilateral; valves thin; beaks rather prominent and undulated; epidermis greenish; cardinal teeth linear, the double one in the right valve; lateral teeth thin and somewhat curved; nacre pearly white and iridescent.

Hab. . . . .

My Cabinet.

Diam. ·7, Length 1·1, Breadth 1·9 inches.

Shell obovate, rather inflated, smooth, inequilateral; substance of the shell thin; beaks somewhat prominent, with numerous small undulations extending on the posterior slope; ligament rather long and thin; epidermis yellowish green over the whole disk, except the posterior slope, which is green; cardinal teeth long, linear, *single in the left and double in the right valve;* lateral teeth long, thin, and somewhat curved; anterior cicatrices confluent; posterior cicatrices confluent; dorsal cicatrices placed in the centre of the cavity of the beaks; cavity of the shell rather deep; cavity of the beaks rather shallow and angular; nacre pearly white and iridescent.

Remarks.—I am not acquainted with the habitat of this shell, having purchased it of a dealer, who did not know from what waters it was obtained. In the exterior and general appearance it resembles *U. Tappanianus* (nobis). The remarkable character of its cardinal teeth will distinguish it from that and all other species with which I am acquainted. The single and double tooth have here changed places, the single being in the left valve. They are thin, and run nearly parallel to the margin. The undulations about the region of the beaks are remarkably fine and beautiful.

Unio Menkianus. Plate XIX. fig. 59.

Testâ ellipticâ, subcompressâ, inæquilaterali, valvulis subtenuibus; natibus subprominentibus undulatisque; epidermide fulvâ et multiradiatâ; dentibus cardinalibus parvis erectisque; lateralibus longis subrectisque; margaritâ albâ et iridescente.

Shell elliptical, rather compressed, inequilateral; valves rather thin; beaks somewhat prominent and undulated; epidermis yellow and much rayed; cardinal teeth small and erect; lateral teeth long and nearly straight; nacre pearly white and iridescent.

Hab. Harpeth River, Ten. Professor Troost.
My Cabinet.
Cabinet of Professor Troost.

Diam. ·9, Length 1·5, Breadth 2·5 inches.

Shell elliptical, rather compressed, inequilateral, radiated over the whole disk; substance of the shell thin behind, thicker before; beaks somewhat prominent and undulated at tip; ligament rather long and thin; epidermis yellow, rather smooth, with numerous rather large, green rays, radiating to all parts of the margin; cardinal teeth small, conical, deeply cleft in the left valve; lateral teeth long and nearly straight; anterior cicatrices distinct; posterior cicatrices confluent; dorsal cicatrices placed in the centre of the cavity of the beaks; cavity of the shell rather shallow; cavity of the beaks rather small and subangular; nacre pearly white and iridescent.

Remarks.—This is another new species of the many I owe to the kindness of Professor Troost. It has some resemblance to *U. interruptus* (nobis), and may be said to connect that shell with *U. crassus* (Say). The two specimens which I have before me are covered with beautiful green rays over the whole disk, they being thicker and darker on the posterior half. The undulations of the beaks are small and numerous. I name it after the able German conchologist, Dr Menke.

ANODONTA NUTTALLIANA. Plate XX. fig. 62.

Testâ alatâ, ellipticâ, compressâ, glabrâ, inæquilaterali; valvulis tenuibus connatisque; natibus compressis, ad apices undulatis; epidermide politâ; margaritâ albâ.

Shell winged, elliptical, compressed, smooth, inequilateral; valves thin and connate; beaks compressed and undulated at the tip; epidermis polished; nacre white.

Hab. Wahlamat, near its junction with the Columbia River. Professor Nuttall.

My Cabinet.
Cabinet of Professor Nuttall.

Diam. ·7, Length 1·5, Breadth 2·3 inches.

Shell winged, elliptical, flattened on the side and enlarged on the umbonial slope, subemarginate at base, smooth, inequilateral; substance of the shell thin, the valves being connate over the ligament; beaks compressed and undulated at the tip; umbonial slope furnished with several impressed lines; epidermis smooth and polished, having a dark broad band at the line of growth near the margin; cicatrices scarcely visible; cavity of the shell very small; cavity of the beaks very small; nacre white.

Remarks.—I am greatly indebted to the learned and enterprising traveller, Professor Nuttall, for this and two other species of *Anodonta*, which come from an entirely new locality. The rivers beyond the Rocky Mountains had not before been examined in regard to their mollusca, and we have now for the first time the pleasure of seeing a specimen of this family from these waters. The Wahlamat is the river known in Lewis and Clark's Travels under the name of Multnoma.

This species has some resemblance to *An. Benedictensis* (nobis), but may be distinguished by its flattened sides and dark band, as well as its polished surface.

Anodonta Wahlamatensis. Plate XX. fig. 64.

Testâ alatâ, triangulari, subinflatâ, inæquilaterali; valvulis tenuibus connatisque; natibus subcompressis, ad apices undulatis; epidermide subfulgidâ; margaritâ albâ.

Shell winged, triangular, somewhat inflated, inequilateral; valves thin and connate; beaks rather compressed and undulated at the tip; epidermis somewhat shining; nacre white.

Hab. Wahlamat, near its junction with the Columbia River. Professor Nuttall.

My Cabinet.
Cabinet of Professor Nuttall.

Diam. ·8, Length 1·8, Breadth 2·5 inches.

Shell winged, triangular, inflated on the lower posterior part, inequilateral; substance of the shell thin, the valves being connate over the ligament; beaks rather compressed, undulated at the tip, and yellow as far as the first stage of growth; epidermis rather smooth and shining, having a small dark band at the line of growth near the margin; cicatrices scarcely visible; cavity of the shell shallow; cavity of the beaks very shallow; nacre white.

Remarks.—This is one of the species brought by Professor Nuttall from his late expedition to the Columbia River, over the Rocky Mountains. It has some resemblance to the *Nuttalliana*, but cannot be easily mistaken for that species, being different in outline and more inflated. In its outline and in the inflation of the lower posterior portion of the shell, it resembles *Alas. complanata* (Barnes). Professor Nuttall also met with this and the above species in Lewis's River, a branch of the Shoshonee.

Anodonta pavonia. Plate XXI. fig. 65.

Testâ ellipticâ, inflatâ, valdè radiatâ, inæquilaterali; valvulis tenuibus; natibus prominulis, ad apices undulatis; epidermide glabrâ; margaritâ cæruleâ.

Shell elliptical, inflated, very much radiated, inequilateral; valves thin; beaks somewhat prominent and undulated at the tip; epidermis smooth; nacre bluish.

Hab. head waters of the Little Beaver, Ohio. J. P. Kirtland, M.D.

My Cabinet.
Cabinet of Dr Kirtland.
Cabinet of Mr Hyde.
Cabinet of Dr Jay.

Diam. 1·1, Length 1·5, Breadth 3 inches.

Shell elliptical, inflated, very much radiated, inequilateral; substance of the shell thin; beaks somewhat prominent and furnished with rather large undulations at the tip; ligament rather short and thin; epidermis smooth, shining and furnished with numerous dark green rays, which diverge to the whole margin, the larger ones being generally about the centre of the valve; anterior cicatrices confluent; posterior cicatrices confluent; dorsal cicatrices placed on the interior of the curve at the point of the beaks; cavity of the shell deep and large; cavity of the beak small and angular; nacre bluish.

Remarks.—I owe to Dr Kirtland this beautiful *Anodonta*, which he has recently discovered in the Little Beaver, in considerable quantities. In the interior it very much resembles *An. Ferussaciana* (nobis) and has, like that shell, an incipient tooth at the immediate point of the beak. In the exterior it is distinguished from all the species with which I am acquainted, by its numerous and very beautiful dark green rays, which so much pervade as to give the disk, in some individuals, almost a black appearance.

Anodonta Newtoniensis. Plate XXI. fig. 66.

Testâ ellipticâ, inflatâ, inæquilaterali; valvulis crassis; natibus subprominentibus, ad apices undulatis; epidermide fulgidâ; margaritâ albâ.

Shell elliptical, inflated, inequilateral; valves thick; beaks rather prominent and undulated at the tip; epidermis shining; nacre white.

Hab. Newtown Creek, New Jersey, near Philadelphia. Wm. Hyde.
Also Schuylkill, at Fair Mount.
My Cabinet.
Cabinet of Mr Hyde.

Diam. 2·1, Length 2·3, Breadth 4·6 inches.

Shell elliptical, inflated, inequilateral; substance of the shell thick; beaks somewhat prominent and rather largely undulated at the tip; ligament rather short; epidermis dark brown, smooth, shining and apparently without rays; anterior cicatrices distinct; posterior cicatrices confluent; dorsal cicatrices obsolete; cavity of the shell deep; cavity of the beaks very small; nacre white, sometimes salmon colour.

Remarks.—The large specimen here figured was found by Mr Hyde in Newtown Creek, nearly opposite to Philadelphia, many years since, and is the only full grown or large one I have seen. Within five or six years, from time to time, I have found near Fair Mount, six individuals, which, although they appeared not to be mature shells, were evidently different from any described *Anodonta*, and I have not hesitated to refer them to this species observed by Mr Hyde. The specimens from Fair Mount are rather thin in the substance of the shell, while that from Newtown Creek is somewhat thick. This may be referred to difference of age. In all the specimens there is an entire absence of rays and the young are possessed of a yellow epidermis. This species differs from the *An. fluviatilis*, (*cataracta*, Say), in being more transverse, in the beaks being more medial and in having the undulations of the beaks larger, while the *fluviatilis* is more granulate.

Anodonta Oregonensis. Plate XXI. fig 67.

Testâ subalatâ, ellipticâ, subinflatâ, inæquilaterali; valvulis tenuibus; natibus vix prominentibus, ad apices undulatis; epidermide subfulgidâ striatâque; margaritâ albâ.

Shell subalate, elliptical, somewhat inflated, inequilateral; valves thin; beaks scarcely prominent, undulated at the tip; epidermis rather shining and striate; nacre white.

Hab. Wahlamat, near its junction with the Columbia River. Professor Nuttall.

My Cabinet.
Cabinet of Professor Nuttall.

Diam. 1, Length 1·8, Breadth 3·2 inches.

Shell somewhat winged, elliptical, rather inflated, inequilateral; substance of the shell thin; beaks scarcely prominent and undulate at tip; epidermis somewhat shining and striate; posterior and anterior cicatrices both confluent; dorsal cicatrices placed in the centre of the cavity of the beaks; cavity of the shell rather deep; cavity of the beak very small; nacre white.

Remarks.—Another species for which I am indebted to Professor Nuttall, procured in his late journey. It has some resemblance to *An. cygnea*, but is still more closely allied to *An. Benedictensis* (nobis).

ANODONTA EXILIS. Plate XXII. fig. 68.

Testâ latâ, valdè compressâ, inæquilaterali; valvulis tenuibus; natibus vix prominulis; epidermide glabrâ; margaritâ ceruleâ et iridescente.

Shell wide, very much compressed, inequilateral; valves very thin; beaks scarcely prominent; epidermis smooth; nacre bluish and iridescent.

Hab. . . . . .

My Cabinet.

Diam. ·8, Length 1·6, Breadth 3·4 inches.

Shell wide, very much compressed, slender, rounded before and angular behind, inequilateral; dorsal and basal margin nearly parallel; substance of the shell very thin; beaks scarcely prominent; ligament long and thin; epidermis smooth, brown, apparently without rays; anterior cicatrices distinct; posterior cicatrices confluent; dorsal cicatrices posterior to and below the cavity of the beaks; cavity of the shell wide and shallow; cavity of the beaks very small; nacre bluish and iridescent.

Remarks.—I procured this remarkably compressed *Anodonta* from Mr Warren, of Boston. Its habitat, unfortunately, was not known. It may be distinguished from all the other species with which I am acquainted by its compressed and slender form.

Iridina cœlestis. Plate XXII. fig. 70.

Testâ latissimâ, subcylindraceâ, lævissimâ, valdè inæquilaterali; valvulis tenuibus; natibus prominulis; epidermide politâ, tenebrosâ; margaritâ cœruleâ et iridescente.

Shell very broad, subcylindrical, very smooth, very inequilateral; valves thin; beaks somewhat prominent; epidermis polished, very dark; nacre bluish and iridescent.

Hab. Africa.

My Cabinet.
Cabinet of Dr Jay.

Diam. ·7, Length 1·1, Breadth 3·4 inches.

Shell very broad, subcylindrical, very smooth, very inequilateral, straight on the dorsal margin, rounded before and angular behind; substance of the shell thin and delicate; beaks somewhat prominent, and apparently without undulations at the tip; epidermis highly polished, nearly black on the anterior, posterior and inferior portion of the valves, obsoletely rayed; cicatrices scarcely visible; cavity of the shell rather deep; cavity of the beaks very small; nacre bluish, with a tint of purple on the anterior portion, very iridescent.

Remarks.—The first specimen of this shell which came under my notice I purchased from a dealer in New York, who informed me it came from Africa. For a second specimen, I am indebted to Dr Jay, who gave me the same habitat. It was sent to him under the impression of its being the "*Mutel*" of Adanson. By a comparison with Adanson's figure, it will be at once observed to differ from it entirely in outline. It cannot easily be confounded with any of the described species of *Iridina*. It is a small species, and may be distinguished at once by its dark ebony epidermis, and beautiful blue and iridescent nacre. In none of the specimens which I have seen, is there the least disposition to crenulation on the dorsal margin. On the carina there is a small line below, and nearly parallel to the dorsal margin.

BULIMUS GLANDIFORMIS. Plate XXIII. fig. 92.

Testâ ovatâ, rugosâ, subinflatâ, imperforatâ, subcrassâ, granosâ, rufo-fuscâ, albo-maculatâ ; anfractibus quaternis, ultimo magno; aperturâ purpureâ, ovatâ, submagnâ ; labro reflexo ; columellâ lævi.

Shell ovate, rugose, somewhat inflated, imperforate, rather thick, granose, reddish brown, white spotted ; whorls four, the last being large ; aperture purple, ovate, rather large ; outer lip reflexed ; columella smooth.

Hab. New Granada, between La Plata and Tocaima. J. H. Gibbon, M.D.

My Cabinet.

Diam. ·7, Length 1·3 inches.

Remarks.—This species is about the size of and somewhat resembles an acorn. Its rugosity is owing to the surface being covered with numerous small pits. The spots are few, and placed nearly at the termination of the last whorl. On the same whorl, further removed from the tip, there are numerous indistinct white marks. The body-whorl is about five-sixths the length of the shell, the superior whorls being lighter, and having a dark indistinct line along the suture. The apex is obtuse, and the reflected lip white and rounded like a cord. I am indebted to Dr Gibbon for this species, obtained during his recent travels in New Granada.

Bulimus parvus. Plate XXIII. fig. 96.

Testâ conicâ, imperforatâ, carinatâ, lacteâ; apice rufo; anfractibus senis, planulatis; aperturâ ovatâ; labro acuto; columellâ lævi, subangulatâ.

Shell conical, imperforate, carinate, milky white; apex reddish; whorls six, flattened; aperture ovate; outer lip acute; columella smooth, subangular.

Hab. near Carthagena, S. A. J. H. Gibbon, M. D.
My Cabinet.

Diam. ·3, Length ·5 of an inch.

Remarks.—A very small species, of which I received from Dr Gibbon only a single specimen. There are some marks on it which induce me to believe that it may sometimes be found banded.

Bulimus virgo. Plate XXIII. fig. 97.

Testâ conico-acutâ, perforatâ, nitidâ, diaphanâ, longitudinaliter striatâ; anfractibus septenis, convexiusculis; aperturâ ovatâ; labro acuto; columellâ angulatâ.

Shell acutely conical, perforate, shining, longitudinally striate, diaphanous; whorls seven, slightly convex; aperture ovate; outer lip acute; columella angular.

Hab. near Carthagena, S. A. J. H. Gibbon, M. D.
My Cabinet.

Diam. ·3, Length ·9 of an inch.

Remarks.—A single specimen only of this was brought by Dr Gibbon. It resembles in size, and some of its characters, the *maculatus* herein described. It may, however, be at once distinguished by its want of spots, the absence of a black apex, and in being perforate.

Bulimus Gibbonius. Plate XXIII. fig. 99.

Testâ ovatâ, ventricosâ, perforatâ, subcrassâ, granosâ, tenebroso-fuscâ, atro-maculatâ; anfractibus quinis, ultimo magno; aperturâ purpureâ, magnâ, obliquâ; labro reflexo; columellâ albidâ.

Shell ovate, ventricose, perforate, somewhat thick, granose, dark brown, black maculate; whorls five, the last being large; aperture purple, large, oblique; outer lip reflexed; columella whitish.

Hab. New Granada, between La Plata and Tocaima. J. H. Gibbon, M. D.

My Cabinet.

Diam. 2·4, Length 3·5 inches.

Remarks.—I owe the possession of this fine shell to the kindness of Dr Gibbon, who obtained it during his expedition to the Pacific Ocean, by Panama; and to him I dedicate it. It is remarkable for its dark colour, the substance of the shell being of a dark purple. The spots are dark, small, irregular and indistinct, and the surface irregularly pitted and minutely granulate. The body-whorl is about five-sixths the length of the shell, the superior whorls being darker, and having a white indistinct line along the suture. The apex is pointed.

Bulimus gracilis. Plate XXIII. fig. 102.

Testâ subfusiformâ, nitidâ, subperforatâ, albidâ, trivittatâ, longitudinaliter striatâ; anfractibus planulatis; aperturâ ovatâ; labro reflexo; columellâ lævi, purpureâ.

Shell subfusiform, shining, subperforate, whitish, with three imperfect bands, longitudinally striate; whorls flattened; aperture ovate; outer lip reflexed; columella smooth and purple.

Hab. near Carthagena, S. A. J. H. Gibbon, M. D.

My Cabinet.

Diam. ·6, Length 1·4 inches.

Remarks.—Among the fine land shells which I owe to Dr Gibbon was a single specimen of this graceful looking species. Other individuals may be more or less coloured. In this one the bands are indistinct, and are of a brownish tint, being more strongly marked in the interior.

Bulimus decoratus. Plate XXIII. fig. 108.

Testâ subturritâ, imperforatâ, nitidâ, croceâ, trifasciatâ; anfractibus senis, convexiusculis; aperturâ ovatâ, caniculatâ; labro subreflexo; columellâ arcuatâ.

Shell somewhat turrited, imperforate, shining, reddish saffron, three-banded; whorls six, somewhat convex; aperture ovate, channeled; outer lip slightly reflexed; columella arched.

Hab. near Carthagena, S. A. J. H. Gibbon, M. D.
My Cabinet.

Diam. ·5, Length 1·2 inches.

Remarks.—A singularly beautiful species, and remarkable for its fine colour, its three yellow bands, and the channel at the base. It is among the finest of the species brought by Dr Gibbon from his late voyage to New Granada.

Bulimus maculatus. Plate XXIII. fig. 112.

Testâ conico-acutâ, imperforatâ, nitidâ, albâ, rufo-maculatâ; apicè nigro; anfractibus septenis, subplanulatis; aperturâ ovatâ; labro acuto; columellâ subangulatâ.

Shell acutely conical, imperforate, shining, white, with reddish spots; apex black; whorls seven, rather flattened; aperture ovate; outer lip sharp; columella somewhat angular.

Hab. near Carthagena, S. A. J. H. Gibbon, M.D.
My Cabinet.

Diam. ·3, Length ·9 of an inch.

Remarks.—A delicate little species, of which I received but a single specimen, and this not entirely perfect in the mouth. The spots are quadrate, and arranged in a double series on the four lower whorls.

HELIX MITCHELLIANA. Plate XXIII. fig. 71.

Testâ supernè obtuso-conicâ, infernè inflatâ, longitudinaliter et subtiliter striatâ, corneâ, diaphanâ, imperforatâ; anfractibus quinis; aperturâ subrotundatâ; labro reflexo; columellâ lævi.

Shell above obtusely conical, below inflated, longitudinally and finely striate; horn-colour, transparent, imperforate; whorls five; aperture nearly round; outer lip reflexed; columella smooth.

Hab. Ohio. J. K. Mitchell, M. D.
My Cabinet.

Diam. ·7, Length ·4 of an inch.

Remarks.—I am indebted to Dr Mitchell for this shell, which was sent to him by a friend from Ohio. It is rather larger than the *H. clausa* (Say) and *H. jejuna* (Say), but in form resembles them. It may be distinguished from the latter in not being perforate, and from the former in having a sharper lip. In its striæ it is distinct from both, in having them larger and much better defined.

HELIX VANCOUVERENSIS. Plate XXIII. fig. 72.

Testâ plano-convexâ, infernè planulatâ, nitidâ, longitudinaliter striatâ, corneâ, latè umbilicatâ; anfractibus quinis, rotundatis; aperturâ subrotundatâ; labro infernè subreflexo, supernè depresso; columellâ brevi, callosâ.

Shell plano-convex, below flattened, shining, longitudinally striate, horn-colour, widely umbilicate; whorls five, rounded; aperture roundish; outer lip below somewhat reflexed, above depressed; columella short, callous.

Hab. Fort Vancouver, Oregon. Professor Nuttall.
My Cabinet.
Cabinet of Professor Nuttall.

Diam. 1·1, Length ·5 inches.

Remarks.—Professor Nuttall informs me that this species is common to the shores of the Columbia River. Young individuals very closely resemble *H. concava* (Say). In the older specimens the lip will at once distinguish it. The depression of the superior part of the outer lip is a remarkable character. In the older specimens the inferior and superior termination of the outer lip are joined by a remarkable callus.

Helix Nuttalliana. Plate XXIII. fig. 74.

Testâ obtuso-conicâ, subtus planulatâ, umbilicatâ, longitudinaliter minutè striatâ, supernè luteâ, infernè tenebroso-fuscâ, propè carinam fasciatâ; anfractibus septenis; aperturâ subrotundatâ, intus fasciatâ; labro subreflexo; columellâ lævi.

Shell obtusely conical, beneath flattened, umbilicate, longitudinally and minutely striate, above yellowish, below dark brown, near the carina banded; whorls seven; aperture nearly round, banded within; lip somewhat reflexed; columella smooth.

Hab. from Fort Vancouver down to the ocean, Oregon. Professor Nuttall.
My Cabinet.
Cabinet of Professor Nuttall.

Diam. 1.3, Length ·8 inches.

Remarks.—This may be considered to be the finest *Helix* found within the territory of the United States. It has little resemblance to any of our species yet known. It most resembles the *H. solilaria*, but is rather larger than that species. I owe to the kindness of Professor Nuttall two specimens—one is darker on the superior part than the other, being brownish. The dark band about the middle of the whorl is remarkable—above it are two indistinct bands.

Helix Columbiana. Plate XXIII. fig. 75.

Testâ obtuso-convexâ, infernè subrotundatâ, nitidâ, longitudinaliter striatâ, corneâ, diaphanâ, umbilicatâ; anfractibus senis, subrotundatis; aperturâ subrotundatâ; labro albo et reflexo, infernè subcalloso; columellâ lævi.

Shell obtusely convex, rounded below, shining, longitudinally striate, horn-coloured, transparent, umbilicate; whorls six, roundish; aperture rather round; outer lip white and reflexed, slightly callous below; columella smooth.

Hab. Fort Vancouver, Oregon. Professor Nuttall.
My Cabinet.
Cabinet of Professor Nuttall.
Diam. ·7, Length ·4 of an inch.

Remarks.—One of the new shells brought by Professor Nuttall from his late expedition. It very closely resembles a small individual of *H. thyroideus* (Say), but may be distinguished by its having the striæ more distant, and in having a more depressed spire.

Helix magnifica. Plate XXIII. fig. 88.

Testâ obtuso-conicâ, subcarinatâ, longitudinaliter striatâ, fasciis flammeis, rubris albisque pictâ, subtus seriebus pluribus punctorum rufescentium ornatâ, latè umbilicatâ; anfractibus quinis, supernè planulatis, infernè subconvexis; aperturâ transversâ; labro sinuoso, reflexo; columellâ lævi.

Shell obtusely conical, subcarinate, longitudinally striate, with white and red flame-shaped bands, beneath furnished with many series of reddish spots, widely umbilicate; whorls five, above flattened, below rather convex; aperture transverse; outer lip sinuous, reflexed; columella smooth.

Hab. New Granada. J. H. Gibbon, M.D.
My Cabinet.
Diam. 2·7, Length 1·2 inches.

Remarks.—This remarkably fine shell was among the collection which I owe to Dr Gibbon. In many respects it very closely resembles the *H. pellis serpentis* (Lam.). It may, however, be at once distinguished from that species by its being striate and not granulate, a character in *pellis serpentis* not noticed by Lamarck, but which exists in all I have examined. It is also a much larger shell, and much more flattened above. The umbilicus is larger, and the area around it white. Beneath these are seven revolving lines, which are red and white spotted.

Paludina sinistrosa. Plate XXIII. fig. 78.

Testâ sinistrosâ, ventricoso-conoideâ, subtenui, tenebroso-corneâ, striatâ, latè umbilicatâ; suturis impressis; anfractibus quinis, valdè convexis; aperturâ subrotundatâ, intus purpurascenti.

Shell sinistral, ventricoso-conoidal, rather thin, dark horn-colour, striate, widely umbilicate; sutures impressed; whorls five, very convex; aperture nearly round, purplish within.

Hab. . . . . East Indies. Miss Hodges.
My Cabinet.
Cabinet of Miss Hodges.

Diam. 1·1, Length 1·3 inches.

Remarks.—This is the only sinistral species of *Paludina* which has come under my notice, and I am indebted to the kindness of Miss Hodges, of Salem, Massachusetts, for one of the two specimens which were in her fine cabinet. This species is so ventricose that it might be almost mistaken for an *Ampullaria*. It cannot, however, be confounded with that from the Nile (*Amp. carinata*, Caill.). The interior is purple brown, being at the edge of the lip bordered with white. Under the lens the longitudinal striæ will be observed to be very close and small.

PALUDINA VIRENS. Plate XXIII. fig. 93.

Testâ obliquâ, crassâ, subgranosâ, viridi; anfractibus subinflatis; aperturâ ovatâ.

Shell oblique, thick, somewhat granose, green; whorls rather inflated; aperture ovate.

Hab. Wahlamat, near its junction with the Columbia river. Professor Nuttall.

My Cabinet.
Cabinet of Professor Nuttall.

Diam. ·2, Length ·4 of an inch.

Remarks.—The apices of all the specimens which Professor Nuttall gave me are destroyed, so that it is impossible to give some of the characters of this species. It is remarkably solid for so small a species.

PALUDINA NUCLEA. Plate XXIII. fig. 103.

Testâ obtusè turritâ, corneâ, lævi; suturis impressis; anfractibus quinis; aperturâ albâ, ovatâ.

Shell obtusely turrited, solid, horn-colour, smooth; sutures impressed; whorls five; aperture white, ovate.

Hab. Wahlamat, near its junction with the Columbia river. Professor Nuttall.

My Cabinet.
Cabinet of Professor Nuttall.

Diam. ·2, Length ·4 of an inch.

Remarks.—This is a small solid species, and is more oblique than *P. decisa* (Say). Like it, the apex is usually cut off. Round the mouth there is a black border, which contrasts with the pale horn-coloured epidermis.

Paludina Nickliniana. Plate XXIII. fig. 109.

Testâ turritâ, viridi, lævi; apice obtuso; anfractibus quaternis, convexis; aperturâ ovatâ.

Shell turrited, green, smooth; apex obtuse; whorls four, convex; aperture ovate.

Hab. Hot Springs, Virginia. P. H. Nicklin.
My Cabinet.
Cabinet of Mr Nicklin.

Diam. 2-20ths, Length 3-20ths of an inch.

Remarks.—This shell, with several other species, was brought by Mr Nicklin from the Hot Springs of Virginia, and kindly placed in my cabinet. It lives in a rivulet, whose channel is supplied by the waters of a hot and a cold spring. The *Physa aurea* inhabits the same stream. It is the smallest species I know in our country, except the *granosa* of Say. It is rather larger, and very much resembles the *viridis* (Lam.). Its habitat, however, is very different, as the *viridis* lives in "cold fountains."

Melania Troostiana. Plate XXIII. fig. 86.

Testâ elevatâ, fuscâ, multistriatâ; apice acuto; anfractibus decem, suprà carinatis; aperturâ ovatâ.

Shell elevated, brown, thickly striated; apex acute; whorls ten, above carinate; aperture oval.

Hab. Mossy Creek, Jefferson County, Ten. Professor Troost.
My Cabinet.
Cabinet of Professor Troost.
Cabinet of Mr Hyde.

Diam. ·5, Length 1·2 inches.

Remarks.—I owe to Professor Troost this interesting species. It differs from any American species with which I am acquainted, in having a sharp carina, which is placed on the inferior part of the superior whorls. In its numerous striæ it resembles the *M. multilineata* (Say), which is now I believe acceded to be only a variety, much striated, of *M. virginica* of the same author. Most of the specimens which have come under my notice are white inside, with a purple spot on the columella, and an indistinct light band along the inferior part of the suture. Some individuals are, however, entirely purple inside, and this gives the epidermis quite a black appearance.

NOTE.—When I described a *Melania* under the name of *tuberculata*, I had not seen Spix's work on the fresh water shells of Brazil. Finding there the same name used for a *Melania*, mine must of course be changed, and I would propose the name of *Spixiana* for it.

MELANIA PLICIFERA. Plate XXIII. fig. 90.

Testâ acuto-turritâ, subcrassâ, tenebrosâ; spirâ pliciferâ; apice truncato; anfractibus convexiusculis, ultimo supernè lævi, infernè striato; aperturâ albâ.

Shell acutely turrited, rather thick, nearly black; spire full of folds; apex truncate; whorls somewhat convex, the last being smooth above and striate below; aperture white.

Hab. Wahlamat, near its junction with the Columbia River. Professor Nuttall.

My Cabinet.
Cabinet of Professor Nuttall.

Diam. ·4, Length 1·1 inches.

Remarks.—Among the fine shells brought by Professor Nuttall from beyond the Rocky Mountains, was this single species of *Melania*. It is remarkable for its numerous folds, or ribs, which fill the superior whorls. The inferior whorl is entirely without these ribs, but the inferior portion is furnished with transverse striæ. I am indebted to Professor Nuttall for many specimens of this shell, all of which are more or less truncate at the apex. The most perfect one, which is small, has nine whorls.

Cyclostoma Popayana. Plate XXIII. fig. 76.

Testâ obtuso-convexâ, albidâ, pellucidâ, longitudinaliter striatâ, latè umbilicatâ, unifasciatâ; anfractibus quaternis; apice acuminato; labro acuto; operculo subcrasso.

Shell obtusely convex, whitish, translucent, longitudinally striate, widely umbilicate, with a single band; whorls four; apex pointed; lip sharp; operculum rather thick.

Hab. New Granada, near Popayan. J. H. Gibbon, M.D.
My Cabinet.
Diam. ·8, Length ·5 of an inch.

Remarks.—Brought by Dr Gibbon from his recent expedition to South America. It very closely resembles *C. striata* (nobis), but may at once be distinguished by its longitudinal striæ, the *striata* being transversely striate. The specimens were generally worn. That which is represented is the only one which had any part of the epidermis remain ng.

Lymnea solida. Plate XXIII. fig. 91.

Testâ elevato-conicâ, solidâ, lævi, corneâ; spirâ subturritâ; anfractibus quinis; columellâ reflexâ; aperturâ subovatâ.

Shell acutely conical, solid, smooth, horn colour; spire rather turrited; whorls five; columella reflected; aperture subovate.

Hab. Wahlamat, near its junction with the Columbia River. Professor Nuttall.
My Cabinet.
Cabinet of Professor Nuttall.
Diam. 5-20ths, Length 8-20ths of an inch.

Remarks.—A single specimen of this species was among the shells given to me by Professor Nuttall. It differs from any species which I know, in being more solid. In this specimen the interior is brownish.

Continuation of Mr Lea's Paper. Read, July 21st, 1837.

UNIO RANGIANUS. Plate XVIII. fig. 56.

Testâ obliquâ, subcompressâ, valdè inæquilaterali; valvulis subcrassis; natibus prominentibus; dentibus cardinalibus parvis; lateralibus longis rectisque; margaritâ albâ.

Shell oblique, somewhat compressed, very inequilateral; valves rather thick; beaks prominent; cardinal teeth small; lateral teeth long and straight; nacre white.

Hab. Ohio River, near Cincinnati. T. G. Lea.
near Poland, Ohio. Dr Kirtland.
My Cabinet.
Cabinet of Mr Hyde.
Cabinet of Dr Kirtland.

Diam. .8, Length 1·2, Breadth 1·8 inch.

Shell oblique, somewhat compressed, flattened before the umbonial slope, very inequilateral; substance of the shell rather thick before, thinner behind; beaks prominent; ligament rather short; epidermis yellowish, covered with numerous green rays; cardinal teeth small; lateral teeth long and straight; anterior cicatrices distinct; posterior cicatrices confluent; dorsal cicatrices placed on the inferior part of the cardinal tooth; cavity of the shell small; cavity of the beaks angular; nacre white.

Remarks.—This shell has been known to our naturalists for some years, and has usually been considered a variety of *U. perplexus* (nobis), without the tubercles. In some of their characters they agree entirely, and the female, in both, has the same spreading out of the posterior inferior portion, which is usually of a darker green. It is a smaller shell than *perplexus*, and may be distinguished at once by its want of tubercles and by its having nearly equidistant distinct marks of growth which are scarcely visible in the other. In some of its characters it resembles *U. capsæformis* (nobis), but that shell is elliptical while this is oblique.

I owe to Dr Kirtland a fine suite of male and female specimens, and it was the examination of these which induced me to assign a distinct place for it among the species.

I name it after an ardent student of the Mollusca, Mons. Sander Rang.

Anodonta Pepinianus. Plate XVI. fig. 51.

Testâ trapezio simili, inqœuilaterali, transversâ; valvulis tenuibus; natibus prominentibus; clivo umboniali subelevato; epidermide striatâ; margaritâ albâ.

Shell trapezoidal, inequilateral, transverse; valves thin; beaks prominent; umbonial slope rather elevated; epidermis striated; nacre white.

Hab. Lake Pepin, Portage County, Ohio. B. Tappan, Esq.
My Cabinet.
Cabinet of Judge Tappan.

Diam. ·7, Length 1·2, Breadth 2 inches.

Shell trapezoidal, rather inflated, flattened on the sides, carinate behind, inequilateral, transverse; substance of the shell thin; beaks prominent; umbonial slope rather elevated and rounded; epidermis transversely striated, with the lines of growth strongly marked and apparently without rays. Anterior and posterior cicatrices both confluent; dorsal cicatrices in the centre of the cavity of the beaks; cavity of the shell rather deep; cavity of the beaks rather deep; nacre white.

Remarks.—I owe this shell to the kindness of my friend, Judge Tappan, who informs me that has observed it only in Lake Pepin. In its colour, and being fragile, it resembles the *An. fragilis* (Lam.). It may be distinguished from any of our species by its trapezoidal outline. The two specimens in my possession, are both in the nacre slightly incrusted with yellow spots. The smaller one being young and having the beaks perfect, exhibits numerous fine undulations at the tip.

The specimen represented is of the largest size which Judge Tappan has seen.

Anodonta angulata. Plate XVI. fig. 52.

Testâ obovatâ, snbinflatâ, valdè inæquilaterali; valvulis subtenuibus, natibus subprominulis; clivo umboniali carinato; epidermide luteolâ, subradiatâ; margaritâ albâ.

Shell obovate, rather inflated, very inequilateral; valves rather thin; beaks somewhat prominent; umbonial slope carinate; epidermis yellow, somewhat radiated; nacre white.

Hab. Lewis's River. Professor Nuttall.
My Cabinet.

Diam. ·8, Length 1·1, Breadth 2·4 inches.

Shell obovate, rather inflated, flattened before and behind the umbonial slope, very inequilateral; substance of the shell rather thin; beaks somewhat prominent; umbonial slope acutely carinate; epidermis yellow, obscurely radiated on the posterior slope dark green; anterior cicatrices distinct; posterior cicatrices confluent; dorsal cicatrices placed in the centre of the cavity of the beaks; cavity of the shell rather deep and angular; cavity of the beaks shallow; nacre white.

Remarks.—A single valve, and that with a small fracture, of this species was brought by Professor Nuttall. It is very peculiar in possessing a carinate umbonial slope, and might, on account of this character, at first sight be mistaken for a wide specimen of *Margaritana marginata.* In this individual the cavity of the beak is salmon colour, but this may not be a permanent character. The anterior margin being small, and the posterior one large, gives it the outline of a *Modiola.*

Among the shells of this family brought from the Columbia River by this distinguished traveller and naturalist, were several specimens of *Margaritana margaritifera.* To find that this species inhabits the waters flowing into the Pacific, is of peculiar interest. Its being common to the European rivers and those of the United States flowing into the Atlantic, gave it an importance in regard to its geographical distribution, which had attracted attention, as it is the only species which has been observed on both continents. Its discovery, now, in the Columbia River, adds much to that interest, as it proves it to exist on a very large portion of the circuit of our globe. It should be remarked that the nacre of these specimens is purple, a character not observed from other localities. In all other characteristics there is not apparently any difference whatever.

Carocolla Hydiana. Plate XXIII. fig. 73.

Testâ orbiculatâ, utrinque convexâ, subfuscâ, minutè granulatâ, latè umbilicatâ; anfractibus quinis; aperturâ subtriangulatâ, plicis quaternis inæqualibus coarctatâ; marginibus connexis, reflexis, subrufis.

Shell orbicular, on both sides convex, brownish, minutely granulated, widely umbilicate; whorls five; aperture subtriangular, contracted, with four unequal folds; margin continuous, reflected, reddish.

Hab. near Porto Cabello, S. A. J. H. Gibbon, M.D.
My Cabinet.
Cabinet of Mr Hyde.

Diam. 1·9, Length ·9 of an inch.

Remarks.—I owe the possession of this fine shell to the kindness of Dr Gibbon. It resembles so closely *C. labyrinthus* (Lam.), that I have had some hesitation in proposing it as a new species. There appears, however, to be a difference in the form of the mouth, in the number of the teeth, and in the surface being minutely granulate. The figure in Wood's Catalogue (*H. plicata, No.* 27), is no doubt intended to represent Lamarck's *labyrinthus*, but the lower part of the mouth seems to be represented by three distinct folds. In some specimens of our shell the fourth tooth is wanting, and I presume this is owing to its immaturity. I have great pleasure in dedicating this species to my friend William Hyde, Esq.

Helix Californiensis. Plate XXIII. fig. 79.

Testâ globosâ, imperforatâ, granosâ, fuscâ, unifasciatâ; anfractibus quinis; aperturâ subrotundatâ; labro reflexo; columellâ lævi.

Shell globose, imperforate, granose, brownish, single banded; whorls five; aperture nearly round; outer lip reflected; columella smooth.

Hab. St Diego, Upper California. Professor Nuttall.

My Cabinet.

Cabinet of Professor Nuttall.

Diam. ·7, Length ·6 of an inch.

Remarks.—This species is remarkable for its globoseness and the single small dark band placed in the middle of a light and broader one immediately above the centre of the whorl.

Helix Townsendiana. Plate XXIII. fig. 80.

Testâ obtuso-conicâ, longitudinaliter striatâ, rugosâ, fuscâ, umbilicatâ; anfractibus quinis; aperturâ subrotundatâ; labro reflexo; columellâ lævi.

Shell obtusely conical, longitudinally striate, rough, brownish, umbilicate; whorls five; aperture nearly round; lip reflected; columella smooth.

Hab. Wahlamat, near its junction with the Columbia River. Professor Nuttall.

My Cabinet.

Cabinet of Professor Nuttall.

Diam. 1, Length ·6 of an inch.

Remarks.—In general form, and nearly in size, this species resembles *H. thyroidus* (Say), but differs from it in being of a darker colour and in being rugose. Under the microscope minute transverse striæ may be observed. The lip is beautifully white, and the last whorl near its termination yellow. I name it after Mr Townsend, who accompanied Professor Nuttall in his travels to the Pacific.

Helix Nickliniana. Plate XXIII. fig. 84.

Testâ subglobosâ, tenuiculâ, albidâ, longitudinaliter striatâ, nubilâ, perforatâ, unifasciatâ; anfractibus quinis; aperturâ rotundatâ; labro subreflexo; columellâ lævi.

Shell subglobose, rather thin, whitish, longitudinally striate, clouded, perforate, single banded; whorls five; aperture round; lip slightly reflected; columella smooth.

Hab. St Diego, Upper Calefornia. Professor Nuttall.

My Cabinet.

Cabinet of Professor Nuttall.

Diam. ·9, Length ·7 of an inch.

Remarks.—This species resembles *H. Caleforniensis* (herein described), but differs in being less globose and in having no broad light band, as well as in being larger. The whole shell, except the apex, is mottled, the inferior part of the whorls being lighter. In the specimens before me the umbilicus is very nearly closed.

Helix Oregonensis. Plate XXIII. fig. 85.

Testâ subcarinatâ, tenui, lævi, rufo-fuscâ, ad carinam bifasciatâ, supernè subconvexâ, infernè subinflatâ.

Shell subcarinate, thin, smooth, reddish brown, double banded on the carina, above slightly convex, below somewhat inflated.

Hab. Wahlamat, near its junction with the Columbia River. Professor Nuttall.

My Cabinet.

Cabinet of Professor Nuttall.

Diam. ·6, Length ·4 of an inch.

Remarks.—It is much to be regretted that Professor Nuttall was unable to procure a mature specimen of this beautiful species. The description being made from a young individual is, of course, defective. It is impossible to say whether it be umbilicate and whether it may possess a reflected lip when mature. It may also acquire a much larger size. It is remarkable for a dark brown and a white band on the carina. That part of the specimen which has the epidermis, presents in it, under the microscope, a remarkable waved appearance.

Succinea aperta. Plate XXIII. fig. 107.

Testâ subrotundâ, tenui, flavescente, lævi; spirâ brevissimâ; anfractibus binis, ultimo grandissimo; aperturâ latissimâ.

Shell subrotund, thin, yellowish, smooth; spire very short; whorls two, the last being very large; aperture very wide.

Hab. Banks of Columbia River. Professor Nuttall.
My Cabinet.
Cabinet of Professor Nuttall.

Diam. ·4, Length ·5 of an inch.

Remarks.—This is one of the interesting shells brought by Mr Nuttall. It is remarkable for its fullness, for the size of the last whorl, and its mammiform apex, which is remarkably small.

Paludina Nuttalliana. Plate XXIII. fig. 89.

Testâ subglobosâ, corneâ, lævi; suturis subimpressis; anfractibus quaternis; aperturâ albâ, subrotundâ.

Shell subglobose, horn-coloured, smooth; sutures rather impressed; whorls four; aperture white, nearly round.

Hab. Wahlamat, near its junction with the Columbia River. Professor Nuttall.

My Cabinet.
Cabinet of Professor Nuttall.

Diam. ·3, Length ·4 of an inch.

Remarks.—There is a very close resemblance between this species and *P. nuclea* (herein described). It is, however, less oblique, larger, and less elevated in the spire.

LYMNEA APICINA. Plate XXIII. fig. 94.

Testâ obtuso-conicâ, subsolidâ, lævi, corneâ; spirâ breviusculâ; anfractibus quaternis; columellâ reflexâ; aperturâ subovatâ.

Shell obtusely conical, rather solid, smooth, horn-coloured; spire rather short; whorls four; columella reflected; aperture subovate.

Hab. Wahlamat, near its junction with the Columbia River. Professor Nuttall.

My Cabinet.
Cabinet of Professor Nuttall.

Diam. ·3, Length ·4 of an inch.

Remarks.—This small species is rather more globose than usual. It is distinguished by a dark apex. Within the outer lip there is a dark brown band.

Continuation of Mr Lea's Paper. Read, January 5th, 1838.

Unio dolabræformis. Plate XXIV. fig. 113.

Testâ ellipticâ, inflatâ, inæquilaterali; valvulis crassis; natibus inflatis prominentibusque; epidermide lævi; dentibus cardinalibus sublamellatis; lateralibus longis lamellatisque; margaritâ albâ et iridescente.

Shell elliptical, inflated, inequilateral; valves thick; beaks inflated and prominent; epidermis smooth; cardinal teeth somewhat lamellar; lateral teeth long and lamellar; nacre white and iridescent.

Hab. Altamaha River, Liberty County, Georgia. Lewis Leconte, Esq.

Hab. Altamaha River, near Darien. Professor Ravenel.

My Cabinet.
Cabinet of Major Leconte.
Cabinet of Professor Ravenel.

Diam. 2·1, Length 3, Breadth 4·5 inches.

Shell elliptical, inflated, inequilateral; substance of the shell thick, thinner on the posterior portion; beaks inflated and prominent; ligament rather short and very thick; epidermis brown, finely wrinkled, polished; umbonial slope somewhat carinate, obscurely rayed; cardinal teeth not very large, compressed; lateral teeth long, lamellar, curved, and separated from the cardinal teeth; anterior cicatrices distinct; posterior cicatrices confluent; dorsal cicatrices very large, and placed on the inside of the plate between the cardinal and lateral teeth; cavity of the shell large and deep; cavity of the beaks large and subangular; nacre pearly white, iridescent, sometimes pinkish in the teeth and cavity of the beaks.

Remarks.—There is a group of *Uniones* to which this belongs, which have a close resemblance to each other in nearly all their characteristics. The *U. ovatus* (Say) may be considered the type of this group, and it has been with some hesitation that I have added another species. The *dolabræformis* stands between *ovatus* (Say) and *occidens* (nobis), and when young I should suppose would resemble *U. globosus* (Lea). This shell was among those sent by Lewis Leconte, Esq. to his brother, to whom I am greatly indebted for the possession of many fine species. The strong resemblance this species bore to the *occidens* (nobis) induced me to defer, when I described the other new ones, the description of this for better specimens to decide upon. The acquisition of several fine ones from Professor Ravenel no longer left any doubt in my mind of the propriety of proposing it as a new species. The female shell, like the *occidens*, is very broad at the posterior margin.

Unio Novi-Eboraci. Plate XXIV. fig. 114.

Testâ ellipticâ, subcompressâ, inæquilaterali; valvulis subcrassis; natibus subprominentibus, ad apices undulatis; epidermide luteolâ, radiatâ; dentibus cardinalibus magnis erectisque; lateralibus longis rectisque; margaritâ albâ et iridescente.

Shell elliptical, somewhat compressed, inequilateral; valves rather thick; beaks somewhat prominent, undulated at the tip; epidermis yellow and radiated; cardinal teeth large and erect; lateral teeth long and straight; nacre white and iridescent.

Hab. Oak Orchard Creek, Orleans County, New York. J. C. Jay, M.D.

My Cabinet.
Cabinet of Dr Jay.

Diam. ·7, Length 1·1, Breadth 2·2 inches.

Shell elliptical, somewhat compressed, inequilateral; substance of the shell rather thick, thinner on the posterior portion; beaks somewhat prominent, and minutely undulated at the tip; epidermis yellow, with green rays nearly over the whole disk; cardinal teeth large, erect and deeply cleft in the left valve; lateral teeth long, straight, and separated from the cardinal teeth; anterior cicatrices distinct; posterior cicatrices confluent; dorsal cicatrices placed in the centre of the cavity of the beaks; cavity of the shell shallow; cavity of the beaks subangular and shallow; nacre white, and very iridescent on the posterior portion.

Remarks.—This species more nearly resembles *U. iris* (nobis) than any other I am acquainted with. It is, however, a thicker shell, more angular behind, and not quite so transverse. The epidermis is more yellow. I am indebted to the kindness of Dr Jay for the specimen in my cabinet, from which the figure is taken.

UNIO CLAIBORNENSIS. Plate XXIV. fig. 115.

Testâ ellipticâ, subinflatâ, inæquilaterali; valvulis crassis; natibus subprominentibus; epidermide luteolâ, lævi; dentibus cardinalibus parvis; lateralibus longis lamellatisque; margaritâ albâ et iridescente.

Shell elliptical, somewhat inflated, inequilateral; valves thick; beaks somewhat prominent; epidermis yellow, smooth; cardinal teeth small; lateral teeth long and lamellar; nacre white and iridescent.

Hab. Alabama River, near Claiborne. Judge Tait.
My Cabinet.

Diam. ·6, Length 1, Breadth 1·7 inches.

Shell elliptical, somewhat inflated, inequilateral; valves thick; beaks somewhat prominent; ligament rather long and thin; epidermis yellow, smooth, with a few obsolete rays; cardinal teeth small and compressed; lateral teeth long, lamellar, and nearly straight; anterior cicatrices distinct; posterior cicatrices confluent; dorsal cicatrices placed in the interior of the cavity of the beaks; cavity of the shell not very deep; cavity of the beaks small; nacre pearly white and iridescent.

Remarks.—Among the number of fine shells sent to me some years since by the late Judge Tait, was one whole specimen and an odd valve of this shell. In hopes of procuring more and better specimens, I delayed bringing it forward as a new species, and regret now to have to figure and describe an individual not mature, the odd valve being considerably larger. It has a strong resemblance to *U. luteolus* (Lam.) and to *U. Hydianus* (nobis), but does not, like them, possess distinct rays.

ANODONTA SUBCYLINDRACEA. Plate XXIV. fig. 117.

Testâ ellipticâ, inflatâ, subcylindraceâ, valdè inæquilaterali; valvulis tenuibus; natibus subprominentibus undulatisque; epidermide fuscâ; margaritâ subcœruleâ et iridescente.

Shell elliptical, inflated, nearly cylindrical, very inequilateral; valves thin; beaks somewhat prominent and undulated; epidermis brown; nacre bluish and iridescent.

Hab. Oak Orchard Creek, Orleans County, New York. J. C. Jay, M. D.

My Cabinet.
Cabinet of Dr Jay.

Diam. ·8, Length 1·1, Breadth 2·2 inches.

Shell elliptical, inflated, rounded at both ends, nearly cylindrical, very inequilateral; substance of the shell very thin; beaks somewhat prominent and minutely undulated at the tip; epidermis brown, and without rays; anterior cicatrices confluent; posterior cicatrices confluent; dorsal cicatrices not perceptible; cavity of the shell deep; cavity of the beaks very shallow; nacre bluish and iridescent.

Remarks.—This *Anodonta* resembles, particularly in an immature state, the *An. Ferussaciana* (nobis). It is not, however, so large a shell, and the beak is more terminal. The undulations of the beaks, which are nearly concentric, are also smaller. Dr Jay very kindly placed the shell above described at my disposal many months since.

POLYGYRA DORFEUILLIANA. Plate XXIV. fig. 118.

Testâ supernè obtuso-conicâ, infernè subinflatâ, nitidâ, corneâ, longitudinaliter striatâ, latè umbilicatâ ; anfractibus senis ; aperturâ lunatâ, tridentatâ.

Shell above obtusely conical, below somewhat inflated, shining, horn-colour ; longitudinally striate, widely umbilicate ; whorls six ; aperture lunate, three-toothed.

Hab. Ohio. Mr Dorfeuille, Cincinnati.
My Cabinet.

Diam. ·3, Length ·2 of an inch.

Remarks.—I adopt Mr Say's genus *Polygyra*, believing the division, though very artificial, quite as good as many made by Lamarck. This species has, like *Polygyra fatigiata* (Say) and *P. plicata* (Say), one large tooth on the left lip and two smaller ones on the right lip. It differs from the first in not being carinate, from the last in being larger and having larger striæ. In the *Dorfeuilliana* the tooth on the left lip is large and square, with an indentation in the centre. The view into the mouth is nearly obstructed by the teeth, leaving, to appearance, three nearly square apertures. The superior part of the shell is striate, while the inferior part is nearly smooth, and exhibits two volutions. I have seen but a single specimen, which I believe is the only one obtained by Mr Dorfeuille, who obligingly sent it to me.

POLYGYRA TROOSTIANA. Plate XXIV. fig. 119.

Testâ supernè subplanulatâ, infernè subinflatâ, corneâ, longitudinaliter striatâ, latè umbilicatâ ; anfractibus senis ; aperturâ lunatâ, tridentatâ.

Shell above nearly flat, below somewhat inflated, horn-coloured, longitudinally striate, widely umbilicate ; whorls six ; aperture lunate, three-toothed.

Hab. Tennessee. Professor Troost.
My Cabinet.
Cabinet of Professor Troost.

Diam. ·4, Length ·2 of an inch.

Remarks.—This species strongly resembles *P. Dorfeuilliana*, herein described, being nearly of the same size, and possessing most of its characters. It differs, however, in the large solid tooth on the left lip being more angular, and in the two teeth on the right lip being somewhat differently placed. In the striæ it differs much, these being larger, much better defined, and passing entirely over the whorls. In the umbilicus it is wider, and shows more of the two whorls. This shell forms the fourth of a group, the form of the apertures of which is exceedingly alike, viz. *P. fatigiata* (Say), *P. plicata* (Say), and *P. Dorfeuilliana* (nobis).

Continuation of Mr Lea's Paper. Read, January 19th, 1838.

Unio Brownianus. Plate XXIV. fig. 116.

Testâ trigonâ, inflatâ, valdè inæquilaterali, alatâ ; valvulis crassis ; natibus prominentibus ; epidermide striatâ ; dentibus cardinalibus subgrandibus ; lateralibus longis ; margaritâ albâ.

Shell triangular, inflated, very inequilateral, winged; valves thick; beaks prominent; epidermis striated; cardinal teeth rather large; lateral teeth long; nacre white.

Hab. River Amazon, South America. Captain George Brown.
My Cabinet.
Cabinet of Captain Brown.

Diam. 1, Length 1, Breadth 2 inches.

Shell triangular, inflated, very inequilateral, winged on the posterior part; substance of the shell thick; beaks prominent; ligament rather long and thin; epidermis dark brown, finely striate, and polished on the umbones; umbones inflated; umbonial slope carinate; cardinal teeth rather large and striate; lateral teeth long and nearly straight; anterior cicatrices distinct, the smaller being situated *above* the large one; posterior cicatrices confluent; dorsal cicatrices very small; cavity of the shell rather deep; cavity of the beaks shallow.

Remarks.—This shell belongs to Lamarck's genus *Hyria*, which, in my proposed arrangement, I have placed among the *Uniones* having one cardinal and one lateral tooth. I am induced to believe in the propriety of this remaining so, until we shall have a better knowledge of the whole family, and of course a natural arrangement. In a previous memoir* I noticed the fact, that in the genus *Hyria* the cicatrix of the extensor muscle was placed over that of the anterior adductor muscle. In the *Brownianus* we find them in the same relative position.

I am indebted to Captain Brown for the examination of three specimens of this species, which he brought from the Amazon, with the other two species already known to exist there. It most resembles *H. syrmatophora*, but differs from it in being more transverse, being less carinate, having a shorter cardinal tooth, which is more striate, and in having a wing much less elevated. The umbones are also more inflated before the umbonial slope. It may be proper to remark here, that in some individuals of the genus *Hyria* an imperfect crenulation of the lateral tooth may be found, somewhat similar to the genus *Castalia* (Lam.), and this is the case with one of the specimens of the species proposed above.

* Vol. IV., p. 67.

SYSTEMATIC INDEX

OF

THE SHELLS DESCRIBED IN MR LEA'S MEMOIR.

Continuation of Mr Lea's Paper.

SYNOPSIS

OF

THE FAMILY OF NAIADES.

THE following table of arrangement and synonymy was undertaken purely with the view and in the hope of clearing away the difficulties which had incumbered one of the most interesting families of the Mollusca. In this attempt the author met, while pursuing his task, with obstructions and difficulties which he little anticipated at its commencement. The want of some of the books of reference, and the confusion which reigned throughout many of them, sometimes presented obstacles which seemed almost insurmountable. In attempting to establish the synonymy, he has endeavoured to render the strictest justice, and if in any case it is found he has failed to do this, it will be a matter of sincere regret to him.

In the following tables there will be found in the family 323 recent species as admitted, 29 unknown to me or doubtful, and 22 fossil; in all 374.

Of the subgenus *Unio*, there are 235 species in a recent state, and 20 which I have not been able to admit as certain; of fossil species 21.

Of the subgenus *Margaritana* there are 20 admitted species, and 2 which are unknown to me.

Of the subgenus *Dipsas* I know of but 2 species, both of which are recent.

Of the subgenus *Anodonta* there are 58 admitted species, and 7 which are unknown to me. Of fossil species there is one which is doubtful.

The subgenus *Iridina* has 2 species, both recent.

The subgenus *Spatha* has 6 species, all recent.

Most of the distinguished authors who have written on the subject of the division of the Family *Naïades* of Lamarck, have acknowledged the extreme difficulty they have encountered in separating it into subdivisions. This difficulty is not peculiar to the *Naïades*. In most of the families where a great number of species have been observed, we find these species so merging, and in some of their characters so fading away into each other, that we scarcely know how, indeed in some instances it is impossible, to make the separation with precision. "Natura non facit saltum." In the vegetable kingdom the same obstructions to a system are encountered. The observations of Lindley* are so just and philosophic, that I cannot refrain from quoting them here:—

"Species are created by Nature herself, and remain always the same, in whatever manner they may be combined: they form the basis of all classification, and are the only part of it which can be considered absolute. For although in a natural system, all other combinations, whether genera, tribes, orders, or by whatever name they may be known, comprehend species agreeing much more with each other than with any thing else, and having a positive general resemblance in the majority of their features, yet no fixed limits can be assigned to any of

* See Introd. to Botany, p. 307.

them; on the contrary, they pass, by means of various intermediate species, into the other genera, tribes, orders, &c., to which they are most nearly allied. For this reason, viz., that no fixed limits can be assigned to orders, genera, &c., we find the ideas about them fluctuating with the degree of our knowledge; which is the true cause of those changes in the limits of genera, &c., which persons unacquainted with the subject are apt to consider arbitrary; but which, in skilful hands, are dependent upon a progressive advance in the knowledge of science."

Blainville, in his "Manuel de Malacologie," divides the *Naïades* (his *Sub-Mytilacea*) into *Anodonta* and *Unio*, but thinks that species will be found which will make these to be united.*

Sowerby says, "the difficulty of ascertaining to which genus of Lamarckian *Naïades* certain species belong, arises from the very general similarity of form," &c.; "in fact, an examination of a sufficient number of species will prove that no dependence can be placed upon the characters by which authors usually attempt to discriminate between these genera, and that the transition from one to another is so gradual in some instances, and so strongly marked in others, that it is not surprising that authors who having only met with certain species, and not being aware of such intermediate links, should have considered them as the types of new genera."† And further, "we think we have already said enough to prove, that unless it be thought wise to elevate each of the peculiar sorts we have mentioned, and many more, into distinct genera, it will be positively necessary to unite them altogether under one generic appellation." Swainson (Zool. Illus., second series) divides this family into *Unio*, *Hyria*, *Iridina*, *Anodon*, and *Alasmodon*, but in describing *An. areolatus* speaks of the genera gliding into each other.

Deshayes, in his edition of Lamarck's "Animaux sans Vertebres," says it is impossible to separate the genera of the *Naïades*. "Nous pourrions prendre pour exemple celui des genres qui est consideré comme l'un des mieux caractérisés. Le genre *Symphynote* est fondé sur ce caractere remarkable que les deux valves sont soudées entre elles le long du bord superieur," etc. "Nous concluons que tout ce grand

* See page 540. † Zool. Journ. Vol. I.

ensemble ne peut et ne doit former qu'un seul genre constituent a lui seul la famille des *Nayades*."*

It might be expected that some attempt of the application of M'Leay's circular system should be made in regard to this family. Swainson says that "the progression of every natural series is in a circle."† In my attempts to verify this, I have not been successful. That the same idea exists in the construction of species is evident through a great number, but that this idea is returned to the point at which it commenced I am not prepared to admit.

To form a systematic, and, so far as possible, a natural arrangement of this family, has long occupied my serious attention.

I was, from my first knowledge of the family, struck with the very different aspect of the winged species, and, taking the hint of Lamarck,‡ I thought that an important division could be made by separating the connate from the free shells, and proposed the name of *Symphynota* for such as were connate. I was not satisfied at that time in separating a genus of this family by a character differing from that of the teeth, but presumed that the family would be taken up by some one, if not by myself, and that the first division of it would be symphynote and non-symphynote *Naïades*. The numerous new species which have been made known since, have satisfied me that this character cannot be so extensively and usefully applied as I then thought it could, and that it is not in fact free from the same objection which pervades so many generic characters as adopted by the most intelligent naturalists, viz. that perfect fading and mingling of character which interferes with all the systems yet formed.

* Vol. VI. p. 526.—I will be excused in taking this opportunity to correct an erroneous impression on the mind of M. Deshayes. He says that I was not able to examine the collection of the Museum of Paris. "Malgré cette imperfection qu'il ne pouvait empêcher, le travail de M. Lea se recommende à l'attention des naturalistes par ces observations judicieuses, des descriptions exactes," etc. It would be strange, indeed, if after spending so many years in the study of this family, that I should neglect, while in Paris, to see the collections from which Lamarck made so many descriptions. I was frequently at the museum, and on one particular occasion, by appointment of MM. Blainville and Ferussac, arranged, in the presence of these and other gentlemen, all the species of the *Naïades* that were in the museum, and named them; and also presented to the museum about fifteen species which were new to that great national institution. I also did the same thing for Baron Ferussac, having designated every specimen in his cabinet belonging to this family.

† Swainson, in Lard. Cycl. Nat. Hist. p. 247.

‡ Vol. VI. p. 76.

Sowerby, after examining into the propriety of dividing the family into genera, came to the conclusion of keeping but one genus, viz. *Unio*: this he divided into A without teeth, B with teeth. These he subdivided into winged and not winged. Another subdivision followed these, on the presence, form, and absence of teeth. There is evidently much merit in this division; but it is not perfect; nor ought we to expect perfection, I believe, in any system. Ferussac informed me, when in Paris, that he proposed to consider the Family *Naïades* to consist of one genus, *Margaritifera*, which genus he divides into the following subgenera: 1. *Anodonta;* 2. *Iridina;* 3. *Dipsas;* 4. *Triquetra;** 5. *Alasmodonta*; 6. *Unio.*

In Vol. 3 of our Trans. p. 398, Mr Nicklin expresses the opinion "that the seven genera, now referred to the family of *Naïades*, are founded in artificial distinctions, and not in nature; and that in fact the family contains but one genus."

After mature reflection, I have come to the conclusion, in forming this systematic arrangement and catalogue, to divide the family into two genera, *Margarita* and *Platiris*, and both of these into *subgenera.* Under this system, the best place for the symphynote shells would be a division of the subgenera into Symphynote and Non-Symphynote.

* Klein. This it would appear Baron F. intended should embrace my genus *Symphynota*, as he included all he knew of them except *S. bialata.*

FAMILY NAIADES.	I. GENUS MARGARITA.	1. Subgenus Unio, Having a cardinal and lateral tooth.	Symphynote—Unio alatus,[a] &c. Non-Symphynote—U. pictorum,[b] &c.
		2. Subgenus Margaritana, Having one tooth (cardinal).	Symphynote—Alas. complanata,[c] &c. Non-Symphynote—Alas. undulata,[d] &c.
		3. Subgenus Dipsas, Having a linear tooth under the dorsal margin.	Symphynote—Dipsas plicatus.[e]
		4. Subgenus Anodonta, Having no teeth.	Symphynote—Sym. magnifica,[f] &c. Non-Symphynote—An. fluviatilis,[g] &c.
	II. GENUS PLATIRIS.	1. Subgenus Iridina, Having a crenulate dorsal margin.	Non-Symphynote—I. exotica.[h]
		2. Subgenus Spatha, Having the dorsal margin non-crenulate.	Non-Symphynote—I. Nilotica.[i]

After the divisions of Symphynote and Non-Symphynote shells, we have what appears to me four very natural subdivisions, viz.

[a] Of Say.
[b] Of Lamarck.
[c] Of Barnes.
[d] Of Say.
[e] Of Leach. Only two species yet known, this and *S. discoidea*, Lea.
[f] Lea.
[g] *Mytilus fluviatilis*, Sol., Dill. &c. *An. cataracta*, Say.
[h] Of Lamarck.
[i] Of Sowerby.

1. Plicate shells.*
2. Nodulous shells.†
3. Spinous shells.‡
4. Smooth shells.§

Each of these subdivisions may be again separated, according to the form of their outline, thus:

1. Quadrate.[a]
2. Triangular.[b]
3. Oblique.[c]
4. Oval.[d]
5. Oblong.[e]
6. Subrotund.[f]
7. Wide.[g]
8. Obovate.[h]
9. Arcuate.[i]

The shell is supposed to be lying on its side with the ligament furthest removed from the observer, and the beak to the right of it. The base will of course be nearest to him, and the anterior margin to his right, while the posterior margin will be to the left. This is my mode of arranging my whole cabinet, which contains over 2100 specimens of this family, each differing in some character or locality.

In attempting to make a complete synopsis of the *Naïades*, much labour has necessarily been expended. I do not present this as a perfect work, but it has been made as much so as the opportunities in my possession permitted. Errors may have arisen from two sources: first, default of judgment; second, from accident, owing to the mass of research necessary to accomplish the object, considering the crude state

* As Unio plicatus. *Lesueur.*

† As Unio pustulosus. *Lea.*

‡ As Unio spinosus. *Lea.*

§ As Unio complanatus. (U. purpureus. *Say.*)

No regard of course is paid in this division to the folds or undulations of the beaks, as all the species are more or less disposed to this character.

a As U. asperrimus. *Lea.*

b As U. triangularis. *Barnes.*

c As U. clavatus. *Lam.*

d As U. crassus. *Say.*

e As U. complanatus. *Solander.*

f As U. circulus. *Lea.*

g As U. rectus. *Lam.*

h As U. modioliformis. *Lea.*

i As M. margaritifera. (Al. arcuata. *Barnes.*)

the subject was in. I shall be most agreeably disappointed if there be not parts pointed out as erroneous which are substantially correct. It will be observed that the works of M. Rafinesque are but little quoted. This has arisen from the utter impossibility of satisfying myself as to his species, causing me at an early period to abandon the task of making out his very imperfect descriptions. His own discrepancy in the names sent to Ferussac,* and those which are attached to specimens here, together with the want of accordance in the tables made out by his friends, have induced me to regard his claims as being too slender to rely upon the decisions, so contradictory, of the several parties, in the absence of the individual specimens noted. In the absence of these specimens, which no naturalist has, I believe, ever seen but the Professor, I feel myself compelled to prefer other authorities, which are now almost universally received by our men of science. I am the more fortified in this conclusion, when I see that his most ardent advocate acknowledges that he has made six species from a single one;† and the absurdity is still stronger when we turn to Professor R.'s monograph, and find that this single species has furnished *several genera*, and is placed in fact in *two different sub-families!!!*

In regard to the Catalogue published last year by Baron Ferussac, in which he gives precedence to many of Professor Rafinesque's names, it must be remembered that this has been done on the authority of others, and not from the inspection of the subjects themselves. Had he known the manner in which these claims had been brought forward, he certainly would have admitted them with doubt.

* "Les erreurs involuntaires qui échappent à M. Rafinesque dans ses envois augmentent aussi la difficulté de reconnaitre ses espèces. Nous avons reçu de lui les mémes coquilles sous différents noms, et d'autres avec les noms évidemment autres que ceux qu'elles portent dans sa Monographie. Il en est résulté une difficulté inextricable pour la détermination de ses espèces, et pour pouvoir établir une synonymie exacte entre lui et les autres qui, depuis, se sont occupés des Mulettes."—*Magasin de Zoologie*, p. 13.

† Conrad's Synoptical Table on New Fresh Water Shells of the United States, p. 72. *U. triangularis*.

FAMILY NAIADES.—*Lamarck.*

GENUS MARGARITA.

I. SUBGENUS UNIO.

SYMPHYNOTE UNIONES.

PLICATE.

TRIANGULAR.

*angulatus. *Lea.*†
- Hyria corrugata.‡ *Lam.* *Sow.*
- Mya angulata. *Wood.*
- Unio corrugata. *Blain.*
- Unio rugosus. *Wagner.*§
- Paxyodon ponderosus. *Schum.*
- Triplodon rugosus. *Spix.*§

gigas. *Lea.*
- Lymnadia gigas. *Swain.*

SMOOTH.

*inflatus. *Lea.*
- Symph. inflata. *Lea,* in Trans. Am. P. S.

*alatus. *Say.*
- Unio alatus. *Say.* *Lam.* *Swain.* *Bar.* *Hild.*
- Mya alata. *Wood.*
- Symph. alata. *Lea,* Trans. Am. P. S.

*syrmatophorus. *Lea.*
- Mya syrmatophora. *Gronovius.* *Gmel.* *Wood.* *Dill.*

SYMPHYNOTE UNIONES.

SMOOTH.

TRIANGULAR.
- Hyria avicularis. *Lam.* *Crouch.*
- Hyria syrmatophora. *Sow.*
- Hyria elongata?|| *Swain.*
- Unio caudatus.§ *Wagner.*
- Prisodon obliquus. *Schum.*
- Prisodon truncatus. *Schum.*
- Diplodon furcatum.§ *Spix.*

*Brownianus. *Lea.*

*lævissimus. *Lea.*
- Symph. lævissima. *Lea,* in Trans. Am. P. S. *Eaton.*
- Unio lævissima. *Deshayes.*

*gracilis. *Barnes.* *Hild.*
- Unio planus. *Barnes.*
- Unio fragilis. *Swain.*
- Symph. gracilis. *Lea,* in Trans. Am. P. S. *Eaton.*

*compressus. *Lea.*
- Symph. compressa. *Lea,* in Trans. Am. P. S.

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* All the species preceded by an * are in my Cabinet. The inner column forms the Synonyms.

† It will be observed, throughout this *Synopsis,* that where any change has been made of generic or specific names, that I have placed my name there. This is not done with a view to claim any merit, but in accordance with that which is usually done. The object is to show the author of the change, and nothing further.

‡ This specific name having been used by the older conchologists, as well as Lamarck, for a shell from India (*Unio corrugata*), it becomes necessary, as I retain that as the older, to change this, which I do to Wood's name.

§ On the authority of Ferussac.

|| Mr Gray thinks this to be a "perfectly distinct species." I have never seen the shell, and feel too much in doubt to insert it as such.

NON-SYMPHYNOTE UNIONES. — PLICATE.

QUADRATE.

*Nicklinianus.† *Lea.*

*cœlatus. *Con.*

*multiplicatus.‡ *Lea.*
Unio heros. *Say,* in Disseminator.
Unio undulatus. *Say,* Am. Conch. No. 2. *Deshayes.*
Unio heros. *Say,* Am. Conch. No. 6.

*undulatus. *Bar. Valen. Hild. Desh.*
Unio costata? *Raf.*
Unio costatus. *Con.*

*plicatus. *Lesueur. Say. Bar. Eat. Hild.*
Unio Peruviana. *Lam.*
Unio rariplicata. *Lam.*
Unio Dombeyanus. *Valen.*
Unio undulata. *Desh.*
Unio multiplicata. *Desh.*

*trapezoides. *Lea.*
Unio crassidens. *Lam. Var. a.*
Unio interruptus.§ *Say.*

TRIANGULAR.

*ambiguus. *Lea.*
Castalia ambigua. *Lam. D'Orb.*
Unio ambigua. *Blain. Desh. Sow.*
Mya ambigua. *Wood.*
Tetraplodon pectinatum. *Spix.*

NON-SYMPHYNOTE UNIONES. — PLICATE.

TRIANGULAR.

Cast. quadrilatera.‖ *D'Orb.*
Cast. inflata. *D'Orb.*

*foliatus.¶ *Hild.*
Unio flexuosa? *Raf.*
Unio flexuosus. *Con.,* in text, Monograph, page 8.
Unio foliatus. *Con.,* in plate 4, Monograph.

OVAL.

*pliciferus. *Lea.*

WIDE.

*multistriatus. *Lea. D'Orb.*
Diplodon ellipticum? *Spix.*

*subtentus. *Say. Con.*

*Conradicus. *Lea.*

*acutissimus. *Lea.*

*Murchisonianus. *Lea.*
Unio Douglasiæ. *Gray.*

*Grayanus. *Lea.*

ARCUATE.

ponderosus. *Lea.*
Mya ponderosa. *Solan. Dill.*
Mya crassa. *Wood.*

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† This distinct and beautiful species was described from a single valve not entirely perfect. When the whole shall be found perfect, I think it likely to prove symphynote.

‡ When I described the *multiplicatus* in 1830, I had had several specimens for two or three years, and was not aware that Mr Say had published a shell under the name of *heros,* which he subsequently abandoned as the *undulatus* of Barnes; but in 1834 reclaimed as *heros.* I consider that Mr Say's abandonment of the species entitles me to it, if my previous claim be not sufficient.

§ Mr Say, in his "Synonymy," claims precedence in this species, although my Memoir bears date May 1830, while his is December 1831. (See Transylvania Journal, Vol. V.) The reader will not after this be surprised to be told that Mr Say does not allow me, in his very incorrect "Synonymy," to be the discoverer of *a single new species* of Unio from our western waters!! I may be allowed also to state, that I do not understand why he gives the same name to two of his different numbers: thus, he calls No. 17, *U. interruptus,* Rafin.; and No. 47, *U. interruptus,* Say. The species are evidently distinct.

‖ I owe to the kindness of M. D'Orbigny specimens of this and *inflata.* I regret, however, that I am compelled to differ in opinion with this distinguished naturalist, believing, as I do, that there has been as yet observed but one species of Lamarck's *Castalia.*

¶ The male of *foliatus* is certainly a triangular shell—the female differs in form very much, having a deep

NON-SYMPHYNOTE UNIONES. NODULOUS.

QUADRATE.

*lacrymosus.† *Lea.*

*asperrimus.‡ *Lea.*
Unio quadrulus. *Say.*

*fragosus.§ *Con.*

Phillipsii. *Con.*

*pustulatus. *Lea.*

*Schoolcraftensis. *Lea.*
Unio prasinus. *Con.*

TRIANGULAR.

*apiculatus. *Say.*

*asper. *Lea.*

*Dorfeuillianus. *Lea.*

*stapes. *Lea.*

*metanever. *Lea.*
Unio metanevra. *Raf.*
Unio nodosus. *Bar.*
Unio rugosus (Flat). *Bar.*
Unio metanevrus. *Con.*

NON-SYMPHYNOTE UNIONES. NODULOUS.

TRIANGULAR.

*cornutus. *Bar.*
Unio reflexa? *Raf.*
Unio reflexus. *Con.*

SUBROTUND.

*pustulosus. *Lea.*
Unio verrucosus. *Bar.* *Var. b.*
Unio verrucosa. *Valen.*
Unio verrucosus albus. *Say;* but not of *Hildreth.*||

*turgidus. *Lea.*
Unio Mortoni. *Con.*

*Cooperianus. *Lea.*

*verrucosus. *Bar.* *Eat.*
Unio tuberculata? *Raf.*
Unio tuberculosa. *Valen.*
Unio verrucosus purpureus. *Hild.*
Unio tuberculatus. *Con.*

*graniferus. *Lea.*

*nodulosus. *Lea.*
Mya nodulosa.¶ *Wood.* *Dill.*

*irroratus. *Lea.* *Eaton.*
Unio verrucosus albus. *Hild.*

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inflection on the posterior basal margin. It may be doubted if this should be considered a plicate shell. I consider that the folds of the growth, particularly in the male shells, require it to be placed here.

† It is a matter of some doubt if this be more than a beautiful variety of *asperrimus* (nobis). Future observation must determine. Ferussac and some other zoologists believe it to be distinct. Dr Ward says they "are certainly distinct."

‡ Mr Say supposed this to be the *rugosus*, Barnes. Two specimens referred to by Mr B. as *rugosus* were under my inspection, and proved to be—the one a flat *metanevra*, Rafin., the other a *plicatus* (Lesueur). Mr B. in his reclamation recognises his *rugosus* as *U. Peruviana*, Lam., which shell is undoubtedly the *plicatus*, (Lesueur and Say).

§ This shell has been considered the female of *asperrimus* (nobis), but I am, after the examination of many specimens, disposed to think it to be distinct. Some of our best western naturalists think it to be the true *rugosus* of Barnes.

|| A specimen sent to me by Dr Hildreth as *Unio verrucosus albus*, proved to be a true *irroratus* (nobis).

¶ This shell, as figured by Wood in his "General Conchology," seems to me to be distinct from the *pustulosus* (nobis), with which it has been confounded. The figure of Wood is longer than any *pustulosus* I have seen, and the epidermis is much darker ("bottle green"). The nodules are more numerous about the beaks, and the lateral tooth is longer and thicker. I doubt if the *nodulosus* be an American species.

NON-SYMPHYNOTE UNIONES.

NODULOUS.

SUBROTUND.

*dromas. *Lea.*

OBLIQUE.

*Æsopus. *Green.*
Unio cicatricosus. *Con.; not of Say.*
Unio varicosus. *Con.; not of Lea.*

*varicosus. *Lea.*
Unio cicatricosus? *Say.*†

*perplexus. *Lea.*
Unio gibbosus? *Raf.*
Unio gibbosus. *Con.*

WIDE.

*Leaii. *Gray.*

*granosus. *Brug. Lam.*

*tuberculatus. *Bar. Eat. Hild.*

Novæ Hollandiæ. *Gray.*

*cylindricus. *Say. Eat. Hild.*
Unio naviformis. *Lam. Blain. Valen.*

NON-SYMPHYNOTE UNIONES.

SPINOUS.

WIDE.

*spinosus. *Lea.*

SMOOTH.

QUADRATE.

*arcæformis. *Lea.*
Unio nexus.‡ *Say.*

TRIANGULAR.

*triangularis. *Bar. Eat. Hild. Say.*
Unio formosus.§ *Lea.* (Male.)
Unio cuneatus. *Swain.*

*elegans.|| *Lea.*

*donaciformis.¶ *Lea.*

*zigzag. *Lea. Eat.*

*heterodon. *Lea.*

*penitus.†† *Con.*

*securis. *Lea. Eat.*
Unio depressa.‡‡ *Raf.; but not of Lam.*

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† Never having seen the specimen described by Mr Say as *cicatricosus*, I am unable to decide if it be the same with *varicosus* (nobis). Two things mentioned by Mr Say induce me to doubt it. He calls his "a common species," and says it is "distinguishable by the single series of transverse elevations on the middle." The latter remark does not apply to *varicosus*, and I have always deemed it a rare shell.

‡ Say and Conrad both commit the error of giving precedence to *nexus*. My description of *arcæformis* is in my memoir, read before the American Philosophical Society May 20, 1831, while Mr Say's was first described in the Transylvania Journal of December 1831. Subsequently he republished it in his American Conchology, No. 6, where he places erroneously the date of 1832 to my memoir.

§ Mr Barnes's description of *triangularis* was made from a female shell, and mine of *formosus* from the male. There being an obvious distinction of the sexes in every specimen, my error was a very natural one, as we were not at the time acquainted with the sexual differences in the *Naïades.*

|| Mr Say thinks that Mr Barnes's *undulatus*, Var. *a*, is the same with *elegans.* I think differently, and would fortify my opinion in the fact, that Mr B. does not mention the zigzag rays which are strikingly singular in the *elegans*, and could not have failed to have elicited his remarks had it been under his eyes.

¶ I have expressed my doubts, Transactions of the American Philosophical Society, Vol. IV., page 84, (page 94 in "Observations on the Genus Unio," &c.,) if this be more than a fine variety of *zigzag* (nobis). Mr Say gives it as a synonym to *nervosus*, Raf., and Mr Conrad as *truncata*, Raf.

†† I received from Judge Tait of Alabama, in 1830, several specimens of this species, but they were not sufficiently perfect to induce me to publish them. Mr Conrad does not mention the rays, a very peculiar character of which is their being dotted somewhat like those of *securis* (nobis), but in a lighter manner.

‡‡ Mr Conrad makes *depressa*, Raf., *ellipsaria*, Raf., and *securis* (nobis), synonymous with *lineolata*,

NON-SYMPHYNOTE UNIONES. — SMOOTH.

TRIANGULAR.

*camelus. *Lea.*

*ovatus. *Say. Lam. Bar. Valen. Eat. Hild. Con.*
Unio ventricosus. *Desh.*
Unio subovatus. *Desh.*
Unio occidens. *Desh.*

*subovatus.† *Lea.*

*crassidens.‡ *Lam.*
Unio cuneatus. *Bar. Eat. Hild.*
Unio niger? *Raf.*
Unio niger. *Con.*

*carbonarius. *Lea.*

*gibber. *Lea.*

*pumilis. *Lea.*

*rubiginosus. *Lea.*

*Barnesianus. *Lea.*

NON-SYMPHYNOTE UNIONES. — SMOOTH.

TRIANGULAR.

*pileus. *Lea.*

*Sowerbianus. *Lea.*

*trigonus. *Lea.*

*solidus. *Lea.*

*obliquus. *Lam.*
Unio undatus. *Bar.*
Unio trigonus.§ *Say* and *Con.;* not of *Lea.*
Unio mytiloides. *Eat.*
Unio undulatus. *Desh.*
Unio cordatus? *Raf.*
Unio cordatus. *Con.*

*pyramidatus. *Lea.*
Unio rubra? *Raf.*
Unio mytiloides. *Con.*

*mytiloides.|| *Raf.*
Mya obliqua. *Wood.*

Raf. Mr Say does the same, with the exception of *ellipsaria,* which he considers distinct; while Mr Rafinesque himself places *lineolata* and *ellipsaria* in different subgenera!!

† Mr Say makes "*ventricosus*, Bar., *occidens* (nobis), *subovatus* (nobis), (var.), and *capax*, Green, (var.)," synonymous with *cardium*, Raf. In my opinion they form at least three, perhaps four distinct species.

‡ *Crassidens*, Var. *a*, Lam., is *trapezoides* (nobis).

§ Say and Conrad both give *trigonus* (nobis) as a synonym to *undatus*, Barnes. It is difficult for me to understand why they should not at once on comparison be recognised as different species. The *trigonus* is always more angular on the umbonial slope, and the undulations at the tips of the beaks differ. This may be observed particularly in the young and perfect specimens. If a doubt could be admitted as to the difference of the form of the shell, the colour of the animal in *trigonus* would at once settle the question. It is peculiar, and differs from all the species I know in being of so deep a colour as to be almost red.

Some years since, when I described this species, I deposited a specimen in the Academy of Natural Sciences of this city, with its proper name appended. Subsequently, I found the Academy had prefixed the name of *undatus*, Barnes, to the label, and I presume this error is still continued there.

|| It is a matter of great doubt if this name ought to be admitted at all in this table. It was applied many years since, by the naturalists of this city, without reference to any particular specimen, but, as it now appears nearly certain, incorrectly. Dr Ward says the description and outline would "equally well apply to six or eight different species." The difficulty of recognising Mr Rafinesque's species is well illustrated in this one. Mr Conrad considers *triangularis*, Raf., as the type, and gives the following names of the same author as synonyms, viz. *lateralis, sintoxia, pachostea, mytiloides,* and *rubra*; thus charging him with making six species of one. But what is still more extraordinary, this single species, (agreeably to Mr Conrad's synonyms) is not only divided by Mr R. into *different subgenera*, but into *different genera*, and even into two DIFFERENT SUB-

NON-SYMPHYNOTE UNIONES.

SMOOTH.

OBLIQUE.

*Troostensis. *Lea.*
Unio trabalis. *Con.*

*Tigris. *Fer.*

*Taitianus. *Lea.*

cor. *Con.*

truncatus. *Swain.*

*decisus. *Lea.* *Con.*

*clavus. *Lam.* *Con.*
Unio scalenia. *Raf.*
Unio modioliformis. *Say;* not of *Lea.*

*patulus. *Lea.*

*Ravenelianus.† *Lea.*

*Rangianus. *Lea.*

*sulcatus. *Lea.* *Eat.* *Say.*
Unio ridibundus. *Say.* *Eat.* (Female.)‡

*Haysianus. *Lea.*

*ellipsis.§ *Lea.* *Eat.*
Unio brevialis? *Sow.*

*castaneus. *Lea.*

NON-SYMPHYNOTE UNIONES.

SMOOTH.

OVAL.

*Tampicoensis. *Lea.*

*Lecontianus. *Lea.*

*perdix. *Lea.*

pectorosus. *Con.*

*ventricosus. *Bar.*

*occidens.‖ *Lea.*
Unio ventricosus. *Say.*

*dolabræformis. *Lea.*

*globosus. *Lea.*
Sym. globosa. *Lea,* Trans. Am. P. S.
Unio capax? *Green.*

*splendidus. *Lea.*

*ochraceus. *Say.* *Con.*
Sym. ochracea. *Lea.* Trans. Am. P. S.

*cariosus. *Say.* *Bar.*
Unio cariosa.¶ *Lam.*
Unio ovata. *Valen.*
Unio luteola. *Con.;* not of *Lam.*

FAMILIES!! See "New Fresh Water Shells of the United States," p. 72, and Mr Rafinesque's "Monographie." In Mr Say's "Synonymy," *triangularis*, Raf., is considered to be the same as *ellipsis* (nobis)!

† Mr Conrad has subsequently published a different species under this name.

‡ For some years I was satisfied that Mr Say's *ridibundus* was only a variety of *sulcatus* (nobis). There can now, however, scarcely be a doubt that it is the female of that species; but it must be remarked, that this serrated shell is usually found smaller than the other; a circumstance not common with the females of other species. Mr S. describes and figures *ridibundus* in No. 1 of "American Conchology," but does not insert it in his "Synonymy" in No. 6.

§ Mr Say in his "American Conchology," refigures this, and recognises my name. Subsequently, in his "Synonymy," he makes it a synonym of *triangularis*, Raf. Mr Conrad says it is *olivarius*, Raf.

‖ This and the preceding shell are so nearly allied, that it is a matter of doubt with me if it would not be preferable to unite them. Dr Ward thinks they are male and female. Subsequent examination may throw sufficient light upon them to decide with certainty. Among Mr Barnes's varieties of *ventricosus*, it is evident there are several distinct species.

¶ *U. cariosa*, Lam. (Var. 2,) is the Alas. *marginata*, Say.

NON-SYMPHYNOTE UNIONES. SMOOTH.

OVAL.

perovatus. *Con.*

altilis. *Con.*

*multiradiatus. *Lea.*
Unio fasciola? *Raf.*
Unio fasciolus. *Con.*
Unio ligamentina. *Desh.*

*Novi-Eboraci. *Lea.*

perovalis. *Con.*

*capsæformis. *Lea.*

Greenii. *Con.*

*pictus. *Lea.*

tæniatus. *Con.*

*interruptus. *Lea.*

*Menkianus. *Lea.*

*venustus. *Lea.*

*crassus. *Say. Bar.*†
Unio ellipticus. *Bar.*
Unio carinatus. *Bar.*
Unio ligamentina. *Lam.*

NON-SYMPHYNOTE UNIONES. SMOOTH.

OVAL.

Mya gravis. *Wood.*
Unio fasciatus. *Con.*‡

*orbiculatus. *Hild.*
Unio abruptus.§ *Say.*
Unio crassus. *Con.*

australis. *Lam.*

*Hydianus. *Lea.*

*Claibornensis. *Lea.*

*luteolus. *Lam.*
Unio siliquoideus.|| *Bar. Con.*
Unio inflatus. *Bar.*

Childreni.¶ *Gray.*

pulcher. *Lea.*

*radiatus. *Lam. Bar. Hild.*
Unio Virginiana. *Lam.*
Mya radiata. *Gmel. Wood. Dill.*
Mya oblongata. *Wood.*
Mya pictorum tenuis. *Chem.*

*Medellinus. *Lea.*

*notatus. *Lea.*

*Vanuxemensis. *Lea.*

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† Mr Barnes made eleven varieties of *crassus;* most of which were no doubt distinct species, some were plicate.

‡ Mr Conrad thinks the *crassus* of Say is *fasciata* of Mr Rafinesque. An examination of his description ought to satisfy any one that the *crassus* of Say could not have been under the eye of the author when he made his description of *fasciata.*

§ The specimen figured by Mr Say in Amer. Conch. No. 2, is a female shell. The male shell is not abrupt at the posterior margin.

|| Mr Say makes *siliquoideus* the same with *viridis,* Raf. Ferussac, in his cabinet, makes it the same with *fasciata,* Raf. Mr Conrad makes it the same with *vittata,* Raf. Ferussac, in his "Observations," states the inextricable difficulty resulting from the confusion caused by Mr Rafinesque. See "Observations," p. 13, in Magazin de Zoologie.

¶ I have never seen this species, but presume, from the figure in Griffith's Cuvier, very poor as it evidently is, that it is a distinct species.

NON-SYMPHYNOTE UNIONES. SMOOTH. OVAL.

*Nashvillianus. *Lea.*

*Zeiglerianus. *Lea.*

lienosus. *Con.*

*obscurus. *Lea.*

*delodontus. *Lam.*
Unio lacteolus. *Lea. D'Orb.*

*charruanus.† *D'Orb.*

*lamellatus. *Lea.*

*Bengalensis. *Lea.*

*cœruleus. *Lea. Ben.*

*olivarius. *Lea. Ben.*

*Batavus. *Lam. Pfeif. Flem.*
Mya pictorum. *Chem. Schröeter. Monta.*
Mya ovalis.‡ *Soland.*
Mya Batava. *Wood. Maton. Dill.*
Mysca Batava. *Turton.*
Unio riparia. *Pfeif.*
Unio pictorum. *Drap.*, pl. 11, fig. 3.
Unio fusculus. *Mühl.*
Unio gibba. *Mühl. Pfeif.*
Unio Labacencis. *Mühl.*
Unio reniformis. *Schmidt.*
Unio fuscus. *Zeig.*
Unio consentaneus. *Zeig.*
Unio amnicus. *Zeig.*
Unio carynthiacus? *Zeig.*
Unio decurvatus. *Rossmaesler.*
Unio sinuatus. *Stud.*
Unio planus. *Stud.*
Unio ater.§ *Nil.*

*Cumberlandianus. *Lea.*

Smithii.|| *Gray.*

vibex. *Con.*

*Mühlfeldianus. *Lea.*

*creperus. *Lea.*

*glaber. *Lea.*

*Hildrethianus.¶ *Lea.*
Al. ambigua? *Say.*

*fabalis.†† *Lea.*

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† The two specimens sent to me by M. D'Orbigny are so like *delodontus*, that I am strongly induced to believe that they will prove to be the young of that species.

‡ On the authority of Dillwyn.

§ On the authority of Ferussac.

|| Never having seen this shell, I place it here on the authority of Mr Gray.—See his figure in Griffith's Cuvier, Vol. XII.

¶ I retain this species among the *Uniones*, although it does not possess a perfect lateral tooth. As it is, however, thickened along the dorsal margin, and puts on the appearance of a tooth, I have concluded that it was better not to remove it to the Sub. Gen. *Margaritana*, to which it has little resemblance in its general characters. These observations may apply to *U. oriens* (nobis), and partially to *U. monodonta*, Say, (*U. soleniformis*, nobis.) Mr Say's description of *ambigua* answers well to *Hildrethianus*, but I am not sure it is the same, as he has given no figure of it. He seems to have abandoned it, as he does not insert it in his "Synonymy." Mr Conrad also avoids the insertion of it in his Synoptical Table.

†† Say and Conrad both in their catalogues give precedence to *lapillus*. *Fabalis* is in my Memoir read before the Am. Philos. Soc., May 7, 1830, and inserted in the Transactions; *capillus* was first inserted in the

NON-SYMPHYNOTE UNIONES.

SMOOTH.

OVAL.

Unio capillus. *Say*, Transylvania Journal, Vol. V.
U. lapillus. *Say*, Am. Conch. No. 5, *Con.*

*parvus. *Bar. Eat.*
Unio parvus. *Con.*

*glans.† *Lea.*

*divaricatus. *Lea.*

*faba. *D'Orb.*

*Burroughianus. *Lea. D'Orb.*

*discus. *Lea.*

*simus. *Lea.*

*corrugatus. *Lam.*
Mya corrugata. *Müller. Chem. Gmel. Wood. Dill.*
Mya rugosa. *Gmel. Wood. Dill.*

NON-SYMPHYNOTE UNIONES.

SMOOTH.

OVAL.

Mya nodosa? *Gmel. Wood. Dill.*
Mya spuria. *Gmel.? Wood.*
Unio spuria. *Lam.*
Unio triradiata. *In "Museum" at Paris.*

*Niloticus. *Fer. Caill.*
Mya pictorum. *Forkaël.*‡

*Egyptiacus.§ *Caill. Fer.*

OBLONG.

*brevidens. *Lea.*

tetralasmus. *Say.*

*camptodon.‖ *Say.*
Unio declivis.¶ *Con.*

*obesus.†† *Lea.*

*Hopetonensis. *Lea.*

*Roanokensis. *Lea.*

December number (1831) of the Transylvania Journal, and subsequently in the "Amer. Conch." No. 5, (Aug. 1832) under the name of *lapillus*. Mr Say does not mention why he changed the name on redescription. I should prefer the first, as a more descriptive name, were I to choose between the two.

† Mr Say doubts if the *glans* be not the same with *parvus*. I do not see how there can be any difficulty in distinguishing them. The *glans* is a much heavier shell, and the nacre of all the specimens I have seen is more or less purple, while that of *parvus* is always, I believe, white. Among many hundred specimens which have come under my notice, I have never seen one of any other colour. The texture of the nacre is also totally different, the latter being more pearly than any other of our *Uniones*. In the epidermis and beaks they also differ essentially.

‡ On the authority of Ferussac.

§ The specimen of this species which I received from M. Caillaud, the traveller, is so much like *Niloticus*, that I certainly would not myself have separated it.

‖ This fine shell, as well as the preceding one, both of which are Mr Say's, seem to have been overlooked in the formation of his catalogue. They are described in his Amer. Conchology. I have never seen the shell he calls *tetralasmus*,—they may possibly prove to be the same.

¶ The shell in the Academy of Nat. Sci., described and figured by Mr Conrad in his "Monography," page 45, as *declivis*, Say, I consider to be a middle aged *camptodon*, Say. This, however, is not the opinion of all our conchologists.

†† Ferussac believes that this is *Carolinianus* of Bosc. Not having seen the specimen described by Bosc, nor having access to his description, I am unable to decide. The fact, however, of Bosc's having visited Carolina some forty years since, renders it highly probable to be so. Ferussac gives his *trapezium* as a synonym to *Carolinianus*. In my table of the Uniones made in 1829, I considered *Carolinianus* as the *complanatus*: in which I was most likely wrong.

NON-SYMPHYNOTE UNIONES. SMOOTH.

OBLONG.

*jejunus. Lea.

*complanatus. *Lea.*
Mya complanata. *Soland. Dill.*
Unio violaceus.† *Spangler.*
Unio purpureus.‡ *Say. Bar.*
Unio rarisulcata. *Lam.*
Unio coarctata. *Lam.*
Unio purpurascens. *Lam.*
Unio rhombula. *Lam.*
Unio carinifera. *Lam.*
Unio Georgina. *Lam.*
Unio glabrata. *Lam.*
Unio sulcidens. *Lam.*
Unio fluviatilis. *Green.*
Mya rigida? *Wood.*

*Griffithianus. *Lea.*

*auratus. *Lea.*
Niäa aurata. *Swain.*
Unio obtusa.§ *Fer.*
Unio depressus.§ *Less.*

*atratus. *Lea.*
Niäa atrata. *Swain.*
Niäa fragilis. *Swain.*

*confertus. *Lea.*

*paliatus. *Ravenel's Letter.*

Watereensis. *Lea.*
Unio Raveneli.‖ *Con.*

NON-SYMPHYNOTE UNIONES. SMOOTH.

OBLONG.

*fulvus. *Lea*
Unio icterinus. *Con.*

*Congaræus. *Lea.*

*declivis. *Say.*
Unio geometricus.¶ *Lea.*

*Blandingianus. *Lea.*

*depressus. *Lam. D'Orb.*

angustus. *Lam.*

*modestus. *Fer.*

*litoralis. *Lam. Pfeif. Des Moul. Grat.*
Unio crassus. *Schr. Retz. Neil. Speng.*
Unio rhomboidea. *Schr.*
Unio brevialis. *Lam.*
Unio semirugata. *Lam.*
Unio nana. *Lam.*
Unio subtetragona. *Mich.*
Unio incurvus. *Lea.*
Unio Pianensis. *Farines.*
Unio granosus. *Schum.*
Mysca ovata. *Turt.*
Mya depressa. *Don.*

SUBROTUND.

*circulus. *Lea. Eat.*
Mya rotunda? *Wood.*

*lens.†† *Lea.*

---

† On the authority of Ferussac.

‡ Mr Conrad is wrong in his "Synoptical Table," in giving Mr Say's name precedence, making *complanatus* a synonym.

§ On the authority of D'Orbigny.

‖ Prof. Ravenel's name being previously used for a *Unio* (Amer. Phil. Soc. Trans., Vol. V.), it becomes necessary to change Mr Conrad's name, which I do, to that of the river in which it was found.

¶ I do not find either of these names in Mr Say's Synonymy. He has, however, priority.

†† I have some doubts whether this should be considered more than a variety of *circulus*. I am not, however, sure, that it is not distinct.

NON-SYMPHYNOTE UNIONES. SMOOTH.

SUBROTUND.

rubellus. *Con.*

Masoni. *Con.*

*rotundatus. *Lam.*
Unio suborbiculata. *Lam. Blain.*
Unio glebulus.† *Say.*
Unio subglobosus. *Lea.*

*Paranensis. *Lea. D'Orb.*
Unio Solisiana. *D'Orb.*

membranacea.‡ *Lea.*
Myt. membranacea. *Mat.*
Myt. Matoniana. *D'Orb.*

variabilis. *Lea.*
Mya variabilis.§ *Mat. Wood. Dill.*
Unio rotundus. *Wag.*

*personatus. *Say.*
Unio capillaris. *Lea.*

*retusus. *Lam. Con.*
Unio torsa. *Raf. Eat.*

*ebenus. *Lea.*
Unio mytiloides. *Con.*; not *Raf.*

maculatus. *Con.*

NON-SYMPHYNOTE UNIONES. SMOOTH.

SUBROTUND.

*Kirklandianus. *Lea.*

*subrotundus. *Lea.*
Unio politus? *Say.*
Unio brevialis? *Crouch.*

infucatus. *Con.*

*coccineus. *Lea.*
Unio coccineus. *Dr Hildreth's Letter.*
Unio coccineus. *Con.*
Unio catillus. *Con.*

WIDE.

*Shepardianus. *Lea.*

*folliculatus. *Lea.*

*rectus. *Lam. Eat.*
Unio prælongus. *Barn. Hild.*
Unio recta. *Valen.*
Unio Sageri?‖ *Con.*
Mya prælonga. *Wood.*

*dehiscens.¶ *Say.*
Unio oriens. *Lea.*

*angustatus. *Lea.*

---

† Although Mr Say had published this shell in the Transylvania Journal, and in his Am. Conchology, he omitted it altogether in his "Synonymy." Other species are inserted from the vicinity of New Orleans.

‡ I formerly placed this with the Anodontæ, but D'Orbigny, who has seen the shell in its native waters, having placed it among the *Uniones*, I follow him, never myself having seen the shell. The figure of Dr Maton (Linn. Trans. Vol. X) is without teeth, and the text says expressly "cardo edentulus." Notwithstanding this, I am inclined to believe that D'Orbigny is right, for the form of the shell is such as I have not seen in the Anodontæ. Not knowing what induced M. D'Orbigny to change Dr Maton's name, I have restored it.

§ The figure of this shell in the Lin. Soc. Trans., Vol. X., although so much smaller a shell than *Paranensis* (nobis), is so much like it, that I should not be surprised if they should prove to be the same.

‖ Mr Conrad's figure so nearly resembles the male specimens of *U. rectus*, from Green Bay, in my cabinet, that I am persuaded the *Sageri* will not prove to be a distinct species. Drs Kirtland and Ward, and Judge Tappan, consider it a variety of *gibbosus* of Barnes.

¶ Mr Say gives Mr Rafinesque's name of *lata* precedence. Mr Eaton says that *An. lata*, Raf., is *Sym. tenuissima*, Lea.

NON-SYMPHYNOTE UNIONES. SMOOTH.

WIDE.

*lanceolatus.† *Lea.*

*Anodontoides. *Lea.*
Unio teres? *Raf.*
Unio teres. *Con.*

*parallelopipedon. *Lea. D'Orb.*

*platyrhynchus.‡ *Rossmaesler.*

*Cailliaudii. *Fer.*

*ovalis. *Flem. Sow.*
Mytilus angustior.§ *List.*
Mya ovalis. *Monta.*
Mya ovata. *Don. Mat. Wood. Dill.*
Mya depressa. *Don.*
Mysca solida. *Turt.*
Unio nodulosa. *Lam.*
Unio tumida. *Retz. Pfeif. Nil.*
Unio Michaudiana? *Des Moul.*
Unio ovata. *Bouil.*
Unio rostrata. *Stud.*
Unio Limagnæ. *Bouil.*

*pictorum. *Lam. Pfeif. Drap. Blain. Crouch. Flem. Des Moul. Grat. Bouil.*
Mya pictorum. *Lin. Poli. Dill. Wood. Mat.*
Mya corrugata Maroccana.‖ *Chem.*
Long thick horse mussel. *Petiv.*

NON-SYMPHYNOTE UNIONES. SMOOTH.

WIDE.

Mya angustata. *Schrœt. Klein.*
Mysca pictorum. *Turt.*
Unio rostrata. *Lam. Pfeif. Mich. Desh. Bouil.*
Unio manca. *Lam.*
Unio elongatula. *Mühl.*
Unio Turtonii. *Payraud.*
Unio Capigliolo. *Payraud.*
Unio Requienii. *Mich.*
Unio Deshayesii. *Mich.*
Unio limosa. *Nil.*
Unio longirostris. *Zeigl.*
Unio Limovianscæ. *Fer.*

*elongatus. *Pfeif.*

productus. *Con.*

*nasutus. *Say. Barn. Swain.*
Unio rostratus. *Valen.*
Mya nasuta. *Wood.*
Unio subrostratus? *Say.*

*Fisherianus. *Lea.*

*Jayensis. *Lea.*

*lugubris. *Lea.*

*marginalis. *Lam.*
Unio anodontina. *Lam.*

---

† M. Deshayes (2d edit. Lamarck) doubts if *lanceolatus* be not the young of *Anodontoides*. The first has been found only in the waters east of the Alleghany mountains, the last only in the western waters. There cannot be a doubt of their being distinct species. In size they differ altogether.

‡ This is a curious and very interesting new species which I recently received from Vienna. Its habitat is Carynthia.

§ On the authority of Fleming.

‖ Chemnitz figures this shell, Vol. VI. table 3, fig. 23 & 24. From the description and outline, I have little doubt of its being a young *pictorum*, more than usually undulated in the region of the beaks. Its being rugose over the whole surface, as mentioned by him, is not evidence against its being such. As the first growth subsequently forms the beak of the shell, it ought of course to be rugose, if that be the character of the shell. The inside view is without teeth, but this is doubtless the fault of the draftsman or engraver, as the author speaks of the hinge being like the common mussel.

NON-SYMPHYNOTE UNIONES. SMOOTH.

WIDE.

*iris.† *Lea.*
Unio nebulosus. *Con.*

*tenuissimus. *Lea.*
Symp. tenuissima. *Lea,* in Trans. Am. P. S.
An. purpurascens. *Swain.*
Unio velum. *Say.*

*bilineatus. *Lea. Ben.*
Symp. bilineata. *Lea,* in Trans. Am. P. S.

*Corrianus. *Lea.*

*phaseolus. *Hild. Eat.*
Unio planulatus. *Lea.*
Unio cuneatus.‡ *Barn.* (White var.)

arcus. *Con.*

arctatus. *Con.*

*gibbosus. *Bar. Eat. Hild.*
Unio mucronatus. *Bar.*
Unio nasuta. *Lam.*
Unio dilatata? *Raf.*
Unio dilatatus. *Con.*

*arctior. *Lea.*

*Patagonicus. *D'Orb.*

NON-SYMPHYNOTE UNIONES. SMOOTH.

WIDE.

*Vaughanianus. *Lea.*
Unio Carolinensis. *Prof. Ravenel's Letter.*

OBOVATE.

*purpuratus. *Lam.*
Mya ventricosa.§ *Solan. Humphreys?*
Unio ater. *Lea.*
Unio lugubris. *Say.*
Unio Poulsoni. *Con.*

rhombeus. *Wag.*
Diplodon rhombeum. *Spix.*

*cuprinus. *Lea.*
Unio metallicus.‖ *Say.*

*modioliformis. *Lea.*
Unio delumbis. *Con.*

*tenerus. *Rav.*
Unio tenebrosus. *Con.*

*Tappanianus. *Lea.*

*contradens. *Lea.*

stramineus. *Con.*

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† Mr Say in his "Synonymy" gives *iris* as a synonym to his *subrostratus.* If they were the same I would be entitled to precedence, as my description bears date March 1829, while his is January 1831. His description, however, of *subrostratus* does not apply to my *iris,* and certainly this shell could not have been under his eye when his description was made. He says that the *subrostratus* "may be said to be the analogue of the *Unio nasutus* (nobis) of the western waters." As the *U. nasutus* inhabits the western waters, a variety of that species may have been described by him for *subrostratus.*

‡ In note to Dr Hildreth's Memoir on the shells in the vicinity of Marietta, Ohio, published in Silliman's Journal.

§ On the authority of Ferussac.

‖ Mr Say in his "Synonymy" claims precedence. My Memoir bears the date of May 7, 1830; his that of January 1, 1831.

NON-SYMPHYNOTE UNIONES. — SMOOTH.

ARCUATE.

*crassissimus. *Fer.* *Des Moul.* *Grat.*
Mya crassissima.† *Klein.*
Unio auricularis.† *Speng.*
Unio margaritacea. *Drap.*
Unio sinuata. *Lam.* *Blain.* *Pfeif.* *Desh.*
Unio rugosa.† *Poir. ?*

*monodontus. *Say.* *Eat.*
Unio soleniformis. *Lea.*

*emarginatus. *Lea.*

Being unacquainted with the following species, I have deemed it best simply to insert a list of them, with the hope of their being determined at a future period:—

Unio rubens. *Menke.*
Unio rugatus. *Menke.*
Unio Grœnlandicus.† *Schrö.* *Fer.*
Unio orientalis. *Fer.*
Unio nitidens. *Fer.*
Unio obtusus. *Fer.*
Unio preciosus. *Fer.*
Unio pulchellus. *Fer.*
Unio purpuriatus. *Say.*
Unio musivus.† *Speng.*
Unio gibbus.† *Speng.*
Unio truncatus.† *Speng.*
Unio oviformis. *Con.*
Unio furvus. *Con.*
Unio Juliani. *Rang.*
Unio psammoica. *D'Orb.*
Unio rhuacoica. *D'Orb.*
Unio Fontainiana. *D'Orb.*
Unio hylœa. *D'Orb.*
Unio Guaraniana. *D'Orb.*

The following species are supposed to exist in a fossil state. As the casts only are usually observed, it must be a matter of great doubt as to the propriety of making species where that is the case:—

Unio crassiusculus. *Sow.* *Flem.*
Unio concinnus. *Sow.* *Flem.*
Unio uniformis. *Sow.* *Flem.*
Unio acutus. *Sow.* *Flem.*
Unio Listeri. *Sow.* *Flem.*
Unio Solandri. *Sow.* *Flem.*
Unio porrectus. *Sow.*
Unio compressus. *Sow.*
Unio antiquus. *Sow.*
Unio aduncus. *Sow.*
Unio cordiformis. *Sow.*
Unio crassissimus.‡ *Sow.* *Flem.*
Unio subconstrictus. *Sow.* *Flem.*
Unio hybridus. *Sow.* *Flem.*
Unio Urii. *Flem.*
Unio abductus. *Phil.*
Unio peregrinus. *Phil.*
Unio petrosus. *Mort.*
Unio tumulatis. *Mort.*
Unio terrenus. *Mort.*
Unio saxulum. *Mort.*

II. SUBGENUS MARGARITANA.§

SYMPH. MARG. — PLICATE.

TRIANGULAR.

*complanata. *Lea.*
Alas. complanata. *Bar.* *Hild.*
Symp. complanata. *Lea,* Trans. Am. P. S.

---

† On the authority of Ferussac.

‡ This name is pre-occupied by Ferussac.

§ The genus *Margaritana* was proposed by Shumacher in his "Essai d'un Nouveau Système des Habitations des Vers Testacés," published in 1817, for the *Mya margaritifera*, Lin. (*Unio elongata*, Lam. and *Alasmodonta arcuata*, Bar.) Mr Say, in 1818, proposed to establish this same division under the generic name of *Alasmodonta*. The Danish zoologist having priority of date must have his name preferred, unless, as Mr Gray thinks, Leach's name of *Damalis* has priority of both. Unfortunately, I have not the means of referring to his description.

NON-SYMPHYNOTE MARGARITANÆ.

PLICATE.

QUADRATE.

*confragosa. *Lea.*
Alas. confragosa. *Say.*

TRIANGULAR.

*arcula. *Lea.*

OBLONG.

*marginata. *Lea.*
Alas. marginata. *Say. Bar.*
Alas. truncata.† *Say.*
Unio cariosa. (Var. 2.) *Lam.*
Unio varicosa. *Lam.*
Unio calceolus. *Say*, not of *Lea.*
Mya regulosa. *Wood.*

*rugosa. *Lea.*
Alas. rugosa. *Bar. Eat. Hild.*
Alas. abducta. *Say.*

SMOOTH.

TRIANGULAR.

*deltoidea. *Lea.*

*undulata. *Lea.*
Alas. undulata. *Say. Bar.*
Alas. sculptilis (young). *Say.*

NON-SYMPHYNOTE MARGARITANÆ.

SMOOTH.

TRIANGULAR.

Mya undulata. *Wood.*
Unio hians. *Valen.*
Unio glabratus. *Sow.*

OVAL.

*Raveneliana. *Lea.*

radiata.‡ *Lea.*
Alas. radiata. *Con.*

*calceola.§ *Lea.*
Unio calceolus. *Lea*, Trans. Am. P. S.
Alas. marginata.‖ *Say.*
Alas. truncata. *Con.*, not of *Say.*

OBOVATE.

*Bonellii. *Lea.*
Alas. Bonellii. *Fer.*
Unio depressa. *Pfeif. Mühl.*
Unio compressa. *Menke.*

*Paraguayana. *Lea.*
Monocondylœa. Paraguayana.¶ *D'Orb.*

---

† Several specimens of fine *marginata* have been sent to me from the west, marked *Alas. truncata*, Say, being one of his unpublished names, but given by him to various conchologists under that name. I have never considered it distinct from the *marginata* of the eastern rivers, although it is generally larger and of finer colour in the exterior.

‡ This shell, in the teeth, except in the size of them, very closely resembles the *An. areolatus*, Swain. which Mr Say described as *Alas. edentula.* Although in both these shells there is a small cardinal tooth, in all their other characters they so closely resemble the *Anodontæ*, that it is a matter of doubt with me as to the propriety of separating them. An examination of the animals, when satisfactorily dissected, may show the necessity of placing them both, notwithstanding their possessing small teeth, with the *Anodontæ.*

§ In my Memoir in the Trans. Am. Phil. Soc., Vol. III. page 420, (page 34 of "Observations on the Genus Unio,") I mention this shell as being closely allied to the genus *Alasmodonta* of Say. In this Synopsis I have deemed it better to transfer it to the subgenus *Margaritana*, as the lateral tooth is observable in very few individuals. Deshayes says it is between *Unio* and *Alasmodonta.*

‖ Mr Say in his "Synonymy" makes *calceolus* and *Alas. marginata* the same. I am surprised at this, as their characters, in many respects, are very different, and I have never heard it even suggested before that they could be confounded.

¶ D'Orbigny, the distinguished traveller in South America, forms the genus *Monocondylœa* for a group of shells which he has first observed, and which possess a single cardinal tooth. This tooth certainly differs from that of the *Margaritana fluviatilis*, Schum., *Alasmodonta*, Say; but for the present, at least, I prefer placing them in Schumacher's genus. The possession of one cardinal tooth, and the absence of a lateral one, is the distinguishing character of both of them. I am indebted to the great kindness of M. D'Orbigny for the first five—

NON-SYMPHYNOTE MARGARITANÆ.

SMOOTH.

OBOVATE.

*Parchappii. *Lea.*
Monoc. Parchappii. *D'Orb.*

*Corrientesensis. *Lea.*
Monoc. Corrientesensis. *D'Orb.*

*Guarayana. *Lea.*
Monoc. Guarayana. *D'Orb.*

*fossiculifera. *Lea.*
Monoc. fossiculifera. *D'Orb.*

Minuana. *Lea.*
Monoc. Minuana. *D'Orb.*

ARCUATE.

*margaritifera. *Lea.*
Mya margaritifera. *Lin. Chem. Knorr. Dill. Desh. Wood. Mat. Monta. Mühl. Retz. Nil.*
Margaritana fluviatilis. *Schum.*
Unio elongata. *Lam. Mich. Bouil.*
Unio sinuata. *Pfeif.*
Unio Roissyi. *Mich.*
Unio margaritiferus. *Pfeif. Drap. Turt.*
Unio rivalis. *Zeig.*
Alas. margaritiferum. *Flem.*
Alas. arcuata. *Bar.*

*Holstonia. *Lea.*

*fabula. *Lea.*

The following species are unknown to me:—
Alasmodonta Tripolitana. *Fer.*
Alasmodonta incurva. *Fer.*

III. SUBGENUS DIPSAS.

SYMPHYNOTE DIPSADES.

PLICATE.

TRIANGULAR.

*plicatus.† *Leach.*
Barbata plicata.‡ *Humph.*
Myt. plicatus. *Soland.*
Myt. dubius. *Gmel. Dill.*
Cristaria tuberculata. *Schum.*
An. dipsas. *Blain. Fer.*
An. tuberculatus. *Fer.*
An. alatus. *Sow.*
Symph. bi-alata. *Lea,* Trans. Am. P. S.
Unio bi-alata. *Desh.*

SMOOTH.

OVAL.

*discoideus.§ *Lea.*
Symp. discoidea. *Lea,* Trans. Am. P. S.
Unio tenuis. *Gray.*‖
An. tenuis. *Gray.*‖

---

the sixth one I place here with some hesitation, as to its proper situation, never having seen it. It is certainly a most interesting group, and it is to be regretted that we have no description of the animal.

† Perfect specimens show the whole linear tooth, and the folds on the posterior slope and on the posterior wing, but old and imperfect specimens sometimes exhibit neither. The imperfect figure and description by Leach of this fine shell, led me to believe that it could not be the same with that which I described under the name of *Sym. bi-alata.*

‡ On the authority of Gray.

§ The posterior termination of the tooth shows some disposition to duplication, and evidently inclines to pass into the subgenus *Unio.*

‖ In Griffith's Cuvier.

IV. SUBGENUS ANODONTA.

SYMPHYNOTE ANODONTÆ.

SMOOTH.

TRIANGULAR.

*Wahlamatensis. *Lea.*

OVAL.

*magnifica. *Lea.*
Symp. magnifica. *Lea,* Trans. Am. P. S.

*Woodiana. *Lea.*
Symp. Woodiana. *Lea,* Trans. Am. P. S.

*Benedictensis. *Lea.*
Symp. Benedictensis. *Lea,* Trans. Am. P. S.

*Nuttalliana. *Lea.*

NON-SYMPH. ANODONTÆ.

PLICATE.

OBOVATE.

*crispata. *Lam.*

SMOOTH.

OVAL.

*cygnea.† *Drap. Lam. Crouch. Blain. Pfeif. Turt. Des Moul. Flem. Grat. Bouil.*
Myt. cygneus. *Gmel. Chem. Schrö. Dill. Mühl. Monta. Mat.*‡ *Shep. Tur.*
Myt. anatinus. *Gmel. Chem. Schrö. Schum. Wood. Monta. Tur. Dill. Mat.*
Myt. stagnalis. *Gmel. Bosc. Dill. Sow.*
Myt. fluviatilis.§ *Gmel.*
Myt. fucatus. *Dill.*
Myt. Zellensis. *Gmel. Schrö. Bosc.*
Myt. Avonensis. *Monta. Wood. Ed. Encyclopœdia.*
Myt. radiatus.|| *Mühl. Schrö.*
Myt. incrassatus. *Shep.*
Myt. macula. *Shep.*
An. anatina. *Lam. Dill. Drap. Sow. Pfeif. Flem. Grat. Des Moul. Bouil.*
An. sulcata. *Lam.*
An. dentiens. *Menke.*
An. intermedia. *Lam. Pfeif. Bouil.*
An. variabilis. (Var. b.) *Drap.*
An. cellensis. *Pfeif.*
An. ventricosa. *Pfeif.*
An. ponderosa.¶ *Pfeif.*
An. paludosus. *Tur.*
An. grossa. *Zeig.*
An. compressa?†† *Zeig.*
An. obvoluta?†† *Zeig.*
An. spuria. *Count Yoldi's Letter.*
An. proboscidalis. *Zeig.*
An. piscinalis. *Nil.*

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† I have, after a good deal of consideration and examination of my specimens, and the figures in the numerous works describing the *Naïades*, satisfied myself that *An. cygnea* and *An. anatina* are not specifically distinct. If the observation of M. Poiret, that the first is viviparous and the last oviparous, be correct, then they should be certainly separated. I feel perfectly persuaded, however, that he must be in error. Turton, in his recent work on the Land and Fresh Water Shells of Great Britain, says he is "inclined to think that all our supposed species of this genus may be justly resolved into one."

‡ *β* of Maton and Racket (Lin. Soc. Trans., Vol. IV.) is evidently, judging from the figure, *Unio litoralis.*

§ Gmelin states this shell to be from the fresh waters of Europe, and allied to *Anatina.* If this be true, there cannot be a doubt of its being the same with *cygnea.* The *fluviatilis* of Solander and Dillwyn is said to be from North America, and is no doubt the *cataracta* of Say.

|| On the authority of Dillwyn.

¶ This and the *grossa* are certainly very different in aspect from the *cygnea,* Lam., being more ponderous and less produced behind. This difference may, however, be effected by locality. Should it prove constant, *ponderosa* ought to be considered a distinct species, and I am much disposed to think that such will prove to be the fact.

†† On the authority of Ferussac.

NON-SYMPHYNOTE ANODONTÆ. — SMOOTH. — OVAL.

Anodontites cygnea.† *Poir.*
Anodontites anatina. *Poir.*

*Oregonensis. *Lea.*

*Pepiniana. *Lea.*

*fragilis. *Lam.*

uniopsis. *Lam.*

Chaiziana.‡ *Rang.*

*undulata. *Say.*
Anodon rugosus. *Swain.*
Anodonta Pennsylvanica. *Lam.*

*Wardiana. *Lea.*
A. virgata. *Con.*

*edentula. *Lea.*
Alas. edentula. *Say.*
Anodon. areolatus. *Swain.* *Coop.*

*pavonia. *Lea.*

*limnoica. *D'Orb.*

trigona.§ *Spix.*

purpurea. *Valen.*

NON-SYMPHYNOTE ANODONTÆ. — SMOOTH. — OVAL.

*Ferussaciana. *Lea.*

*salmonia. *Lea.*

*incerta.‖ *Lea.*
imbecillis? *Say.*

*Newtonensis. *Lea.*

*fluviatilis. *Lea.*
Myt. fluviatilis.¶ *Soland.* *Dill.* *Wood.*
Myt. illitus. *Soland.*
An. cataracta. *Say.*
An. marginata. *Say.*
An. implicata? *Say.*
An. teres. *Con.*

*Mortoniana. *Lea.*
An. Chiquitana. *D'Orb.*

*glauca.†† *Valen.*
An. glauca. *Lam.*

*ovata. *Lea.*

*plana. *Lea.*
An. declivis. *Con.*

*decora. *Lea.*

---

† On the authority of Des Moulins.

‡ M. Rang informs us that this species has the singular power of maintaining its vitality in the desiccated marshes of Africa, through six months of the burning sun of that region; and that he had a specimen sent to him in Paris, which was killed nearly thirteen months after it had been taken from its native bed, having occasionally been dipped in water for an hour or two only. He also mentions that the *Iridina rubens* is found with the *Chaiziana* in the Senegal, and possesses the same peculiarities of remaining in a state of torpidity during the season of great heat.

§ Ferussac considered *trigona* as the same with *crassa* of Swainson. The two figures, however, appear to me to be too different to be considered the same.

‖ Dr Kirtland informs me, that a specimen of this shell, which he showed to Mr Say, was considered by Mr S. to be his *imbecillis*. If this be so, Mr Say's name is entitled to precedence. I have never seen the shell described by Mr S. as *imbecillis*.

¶ See note on *An. cygnea*, page 137.

†† The figure of this shell resembles some individuals of *Myt. fluviatilis*, Soland. (Say's *An. cataracta*), but is straighter on the superior margin. In this character it resembles the *trapezialis*. The observations of Barnes, being made when little was known of this genus, cannot now be admitted.

NON-SYMPHYNOTE ANODONTÆ. SMOOTH.

OVAL.

*gigantea.† *Lea.*

subvexa. *Con.*

*Stewartiana. *Lea.*

*gibbosa. *Say.*
An. inflata. *Major Le Conte's Cabinet.*

*grandis. *Say. Lesueur.*
An. corpulenta. *Coop.*

SUBROTUND.

*suborbiculata. *Say.*

OBOVATE.

*obtusa. *Spix.*
An. lituratum. *Spix.*

*sirionos. *D'Orb.*

*Patagonica. *Lam.*

NON-SYMPHYNOTE ANODONTÆ. SMOOTH.

OBOVATE.

*lato-marginata.‡ *Lea. D'Orb.*
An. trapezius?§ *Spix.*
An. rotundus? *Spix.*

*Spixii. *D'Orb.*

porcifer.|| *Gray.*

*trapezialis. *Lam. Blain.*
An. exotica.¶ *Lam. D'Orb.*
An. giganteus. *Spix.*
An. pencillatus? *Gray.*
An. Susannæ. *Gray.*
An. radiatus. *Spix.*

*anserina. *Spix.*

Georginæ. *Gray.*

Parishii.†† *Gray.*
Leila Parishii. *Gray.*

*Blainvilliana.‡‡ *Lea.*
An. trapezialis. *Crouch.*
Irid. trapezialis. *D'Orb.*

---

† *An. giganteus*, Spix., having been before described by Lamarck under the name of *trapezialis* and *exotica*, my species must retain this name.

‡ The *Patagonica* and *lato-marginata*, when they are better observed, may prove to be the same.

§ Spix's figure so closely resembles the *lato-marginata*, that I scarcely feel a doubt as to their being the same. He does not, however, notice the broad margin which is so characteristic of this species.

|| Never having seen this species, I place it here on Mr Gray's authority.

¶ So far as I have been enabled to examine specimens of this and *trapezialis*, I am disposed to think they are not distinct species.

†† On the authority of Mr Gray.

‡‡ In my description of *Blainvilliana* (Vol. V. page 77), I observed that I was induced to believe that the animal of this shell would be found to differ from that of the genus *Anodonta*. M. D'Orbigny, in his Synopsis of the Fresh Water Shells of South America, has in fact so found it. The animal has two tubes. Nevertheless, although I then proposed if such should be the case that it should be placed in a new genus, under the name of *Columba*, I have continued it in the subgenus *Anodonta*, as, with the present artificial system, which is founded on the hinge, it could not with propriety be elsewhere classed. When the family shall be arranged in a system founded on the animal structure only, it evidently must be changed, and I doubt then if it should be placed in the *Iridina*, for although it is likely that all the species of that genus have two tubes, they do not seem to possess the deflected palleal cicatrix, which I noted in the description of *Blainvilliana*.

NON-SYMPHYNOTE ANODONTÆ.

SMOOTH.

OBOVATE.

*esula.† *Jan.*
Irid. esula. *D'Orb.*

crassa. *Swain.*

WIDE.

elongata. *Swain.*

*ensiformis. *Spix.* *D'Orb.*

*cylindracea. *Lea.*

*subcylindracea. *Lea.*

*Buchanensis. *Lea.*

*exilis. *Lea.*

OBOVATE.

*angulata. *Lea.*

NON-SYMPH. ANODON.

SMOOTH.

ARCUATE.

*tenebricosa. *Lea.* *D'Orb.*

*arcuata. *Fer.*

sinuosa. *Lam.*

*soleniformis. *D'Orb.*

The following species are unknown to me:—

Anodonta folium. *Fer.*
Anodonta Chinensis. *Fer.*
Anodonta curvatus. *Fer.*
Anodonta lugubris. *Say.*
Anodonta impura. *Say.*
Anodonta arcuta. *Cail.*
Anodonta Tævaii. *Rang.*
Anodonta Ferrarisii. *D'Orb.*
Anodonta lucida. *D'Orb.*
Anodonta Puelchana. *D'Orb.*

FOSSIL SPECIES.

Anodonta? Abyssina. *Mort.*

† M. D'Orbigny thinks that this is my *Blainvilliana*, but having his specimens and mine of both the species, I am induced still to believe that I am correct. The two specimens resemble each other, but are certainly distinct. The deflected palleal cicatrix exists in both, but the *esula* is more rotund, and the dorsal margin is more sinuous, and the nacre bluish white, while the five or six specimens of *Blainvilliana* which I have seen are all salmon colour.

GENUS PLATIRIS.†

I. SUBGENUS IRIDINA.‡

NON-SYMPH. IRIDINÆ. — SMOOTH.

OBOVATE.

ovata. *Swain.*
Irid. exotica. *Children.*
Pleiodon Macmurtriei. *Con.*

ARCUATE.

exotica. *Lam.*
Irid. striata. *Swain.*
An. exotica. *Blain.*

II. SUBGENUS SPATHA.

NON-SYMPH. SPATHÆ. — SMOOTH.

OVAL.

*rubens.§ *Lea.*
Irid. rubens. *Desh. Rang.*
An. rubens. *Lam. Blain.*
An. Clappertoni. *Kœnig*, in *Denham* and *Clapperton's* Journey.

WIDE.

*Nilotica. *Lea.*
Irid. Nilotica. *Sow. Fer. Crouch. Caill.*
An. dubia? *Bosc.*
Irid. Oudnicei. *Kœnig.*

---

† Genus Platiris (*nobis*), πλατυς, latus; ιρις, iris. *Testâ æquivalvis, latè transversâ*; *impressiones musculares grandes*; *cardo longus, linearis; ligamentum externum.*

‡ When Lamarck established his genus *Iridina*, he had seen but a single species, and of that only one individual, which is figured in the Encyclop. Methodique, pl. 204. Other species have been since referred to his genus, which do not seem to me to fulfil the conditions of his generic description. The phrase "cardo per longitudinem tuberculosus, subcrenatus," is by no means descriptive of the hinge belonging to the species just alluded to, which have their hinge smooth, or very slightly tuberculated. The figure in the Encyclopædia, and that of Blainville (Pl. 66, fig. 3), represent the same individual, and exhibit a character of hinge resembling in some measure that of an *Arca*. A second species, apparently agreeing with Lamarck's generic description, has been observed and described by Swainson, under the name of *Iridina ovata* (Phil. Mag. Vol. LXI.); and it has also been described by Mr Children under the name of *I. exotica*, (Brande's Journ. Vol. XV.). The specimen described in Brande's Journal is now in the British Museum, and that accurate naturalist, Mr John Edward Gray, who is one of the officers of that noble institution, informs me that he thinks it is identical with the shell upon which Mr Conrad has lately proposed to form a new genus, *Pleiodon*. Under these circumstances, it seems to me necessary to separate those shells having a *crenulated* hinge (which are true *Iridinæ*), from those having the hinge *smooth*, or very *slightly tuberculated*. I therefore arrange the *Iridina rubens*, *Nilotica*, &c., in a new subgenus, for which I propose the name of *Spatha*.

§ Mr Gray informs me that Cailliaud figures a species near to this from Egypt, which is in his possession, but I have not seen the shell or description.

NON-SYMPH. SPATHÆ. — SMOOTH. — WIDE.

Myt. Niloticus. *Wood.*
Le mutel. *Adan.*
Irid. mutel? *Rang.*

*elongata. *Lea.*
Irid. elongata. *Sow.*

*soleniformis. *Lea.*
Mycetopoda† soleniformis. *D'Orb.*

NON-SYMPH. SPATHÆ. — SMOOTH. — WIDE.

*siliquosa. *Lea.*
An. siliquosus. *Spix.*
An. pygmœum (young). *Spix.*
An. longinus. *Spix.*
Irid. longina. *Fer.*
Mycetopoda siliquosus. *D'Orb.*

*cœlestis. *Lea.*
Irid. rostrata? *Rang.*

---

† In the present arrangement, founded on the form of the hinge, I have deemed it better not to adopt D'Orbigny's genus *Mycetopoda*, founded on the natural character or habit of the animal. He says, "perforat, sicut pholadæ." In this habit it resembles *Unio oriens* (nobis), which I have elsewhere stated buries itself about twelve inches below the surface of the sand in which it lives. D'Orbigny mentions that the two anterior cicatrices are widely separated. A more important character appears to be in the fact, that the smaller cicatrix is placed before the larger one. In the *Unio* and *Anodonta* it is placed below it, and in the *Hyria* (Lam.) it is placed above, that is, in a line with the beak. I regret that I have only the very short description that this distinguished naturalist and traveller has given in his Synopsis. Should he publish these descriptions in a fuller manner, which I believe he intends, we may be so informed as not to disagree with him.

ADDENDA.

Unio Katherinæ.† *Lea.*

*Margaritana Franciscana.‡ *Lea.*
Monocondylæa Franciscana. *Mori.*

---

† *Testâ obovatâ, inæquilaterali, subcompressâ; valvulis subcrassis; natibus prominulis; dentibus cardinalibus magnis, lateralibus subrectisque; margaritâ albâ.*

Just as this sheet was going to press I had the pleasure to receive a communication from Lady Katherine Douglas, of St Mary's Isles, Scotland, accompanied by three beautiful views, drawn by her ladyship, of a shell from Lake Superior, which appears to me not to have been before observed. Wishing that it should be appended to this Synopsis, I have given a short description of it, taking the liberty to propose that lady's name for it. At a future period I hope to be able to present it with a figure from her drawings. Its place in the preceding arrangement would be immediately after *U. purpuratus* (Lam.), being an *obovate, smooth, non-symphynote Unio.*

‡ Since this sheet was in type I have received from M. Moricand, of Geneva, a specimen of this interesting shell. Its place in this Synopsis would be between *M. calceola* and *Bonellii,* under the division *subrotund, smooth, non-symphynote Margaritanæ.* I owe to the kindness of this gentlemen also the *U. rotundus* (Spix and Wagner), and find it distinct from *U. Paranensis* (nobis), a matter which has been doubted by M. Moricand.

In Professor Rafinesque's Monograph, and in his subsequent Papers, are inserted descriptions under the following names. Not being able to identify them, I have deemed it better simply to give a catalogue of them. Those which I suppose I have identified will be found in the foregoing table.

Alasmodonta atropurpureum ?
badium ?
costata ?
hians ?
ponderosum ?
papyraceum ?
rugosum ?
sulcatum ?
scriptum ?
viridis ?

Anodonta atra ?
aperta ?
cuneata ?
digonota ?
inflata ?
lata ?
Ohiensis ?
solenoides ?

Unio antrosa ?
atroviolacea ?
argyratus ?
attenuata ?
aurata ?
bicolor ?
bullata ?
biloba ?
cardium ?
Cliffordiana ?
calendis ?
chloris ?
castaneus ?
crassa ?
cinerescens ?
cuneata ?

Unio cyclips ?
cuprea ?
cyphia ?
decorticata ?
diploderma ?
diaphanus ?
ellipsaria ?
elliptica ?
fasciata ?
fulvus ?
fontinalis ?
fulgens ?
fasciolaris ?
flava ?
flexus ?
fragilis ?
granulatus ?
interrupta ?
lateralis ?
latissima ?
leptodon ?
lævigata ?
lamobrachys ?
lineolata ?
lividus ?
megaptera ?
montanus ?
melaplata ?
nervosa ?
nodulata ?
obliquata ?
obovalis ?
olivaria ?
ovata ?
Paphos ?
pachostea ?

Unio ponderosus ?
pallida ?
plateolus ?
pusella ?
pallens ?
perplexus ?
quadrula ?
retusa ?
rimosus ?
rosea ?
rivularis ?
stegaria ?
sintoxia ?
sinuata ?
solenoides ?
striata ?
subrotunda ?
torulosa ?
teneltus ?
triangularis ?
triqueter ?
truncata ?
verrucosa ?
viridis ?
vittatus ?
Venus ?
zonalis ?

Odatelia radiata ?

Lasmonos fragilis ?

Diplasma marginatæ ?
similis ?
vitrea ?
striata ?

GEOGRAPHICAL DISTRIBUTION

OF THE

SPECIES OF THE FAMILY NAIADES.

To render the preceding Synoptical Arrangement more complete, it was deemed advisable to make such a table as would throw together the species from each great division of the world; and to make this more useful, it has been thrown into alphabetic arrangement.

GENUS MARGARITA.

I. SUBGENUS UNIO.

EUROPE.

Batavus. *Lam.*
crassissimus. *Fer.*
elongatus. *Pfeif.*
litoralis. *Lam.*
ovalis. *Flem.*
pictorum. *Lam.*
platyrhynchus. *Rossmaesler.*

ASIA.

Bengalensis. *Lea.*
bilineatus. *Lea.*
cœruleus. *Lea.*
corrugatus. *Lam.*
Corrianus. *Lea.*

Grayanus. *Lea.*
lamellatus. *Lea.*
Leaii. *Gray.*
marginalis. *Lam.*
Murchisonianus. *Lea.*
olivarius. *Lea.*
ponderosus. *Lea.*
tigris. *Fer.*

AFRICA.

divaricatus. *Lea.*
Egyptiacus. *Cailliaud.*
Niloticus. *Fer.*

NORTH AMERICA.

acutissimus. *Lea.*
Æsopus. *Green.*

alatus. *Say.*
altilis. *Con.*
Anodontoides. *Lea.*
angustatus. *Lea.*
apiculatus. *Say.*
arcæformis. *Lea.*
arctior. *Lea.*
arctatus. *Con.*
arcus. *Con.*
asperrimus. *Lea.*
asper. *Lea.*
Barnesianus. *Lea.*
Blandingianus. *Lea.*
brevidens. *Lea.*
camelus. *Lea.*
camptodon. *Say.*
capsæformis. *Lea.*
carbonarius. *Lea.*
cariosus. *Say.*
castaneus. *Lea.*
Claibornensis. *Lea.*
clavus. *Lam.*
circulus. *Lea.*
cœlatus. *Con.*
coccineus. *Lea.*
compressus. *Lea.*
complanatus. *Lea.*
confertus. *Lea.*
Congaræus. *Lea.*
Conradicus. *Lea.*
contradens. *Lea.*
Cooperianus. *Lea.*
cor. *Con.*
cornutus. *Bar.*
crassidens. *Lam.*
crassus. *Say.*
creperus. *Lea.*
cuprinus. *Lea.*
Cumberlandianus. *Lea.*
cylindricus. *Say.*
decisus. *Lea.*
declivis. *Say.*
dehiscens. *Say.*
dolabriformis. *Lea.*
donaciformis. *Lea.*
Dorfeuillianus. *Lea.*
dromas. *Lea.*
ebenus. *Lea.*
elegans. *Lea.*
ellipsis. *Lea.*
fabalis. *Lea.*
Fisherianus. *Lea.*
foliatus. *Hild.*
folliculatus. *Lea.*
fragosus. *Con.*
fulvus. *Lea.*
gibbosus. *Bar.*
gibber. *Lea.*
glaber. *Lea.*
glans. *Lea.*
globosus. *Lea.*
gracilis. *Barnes.*
graniferus. *Lea.*
Greenii. *Con.*
Griffithianus. *Lea.*
Haysianus. *Lea.*
heterodon. *Lea.*
Hildrethianus. *Lea.*
Hopetonensis. *Lea.*
Hydianus. *Lea.*
inflatus. *Lea.*
infucatus. *Con.*
interruptus. *Lea.*
iris. *Lea.*
irroratus. *Lea.*
Jayensis. *Lea.*
jejunus. *Lea.*
Katherinæ. *Lea.*
Kirklandianus. *Lea.*
lævissimus. *Lea.*
lacrymosus. *Lea.*
lanceolatus. *Lea.*

Lecontianus. *Lea.*
lens. *Lea.*
lienosus. *Con.*
lugubris. *Lea.*
luteolus. *Lam.*
maculatus. *Con.*
Masoni. *Con.*
Medellinus. *Lea.*
Menkianus. *Lea.*
metanever. *Lea.*
Mühlfeldianus. *Lea.*
multiplicatus. *Lea.*
multiradiatus. *Lea.*
mytiloides. *Raf.*
modioliformis. *Lea.*
monodontus. *Say.*
Nashvillianus. *Lea.*
nasutus. *Say.*
notatus. *Lea.*
Novi-Eboraci. *Lea.*
obesus. *Lea.*
obliquus. *Lam.*
obscurus. *Lea.*
occidens. *Lea.*
ochraceus. *Say.*
orbiculatus. *Hild.*
ovatus. *Say.*
palliatus. *Lea.*
parvus. *Bar.*
patulus. *Lea.*
pectorosus. *Con.*
penitus. *Con.*
perdix. *Lea.*
perovatus. *Con.*
perovalis. *Con.*
perplexus. *Lea.*
personatus. *Say.*
phaseolus. *Hild.*
Phillipsii. *Con.*
pictus. *Lea.*
pileus. *Lea.*
pliciferus. *Lea.*
plicatus. *Lesueur.*
productus. *Con.*
pulcher. *Lea.*
pumilis. *Lea.*
purpuratus. *Lam.*
pustulatus. *Lea.*
pustulosus. *Lea.*
pyramidatus. *Lea.*
radiatus. *Lam.*
Rangianus. *Lea.*
Ravenelianus. *Lea.*
rectus. *Lam.*
retusus. *Lam.*
Roanokensis. *Lea.*
rotundatus. *Lam.*
rubellus. *Con.*
rubiginosus. *Lea.*
Schoolcraftensis. *Lea.*
securis. *Lea.*
Shepardianus. *Lea.*
simus. *Lea.*
solidus. *Lea.*
Sowerbianus. *Lea.*
spinosus. *Lea.*
splendidus. *Lea.*
stapes. *Lea.*
stramineus. *Con.*
subovatus. *Lea.*
subrotundus. *Lea.*
subtentus. *Say.*
sulcatus. *Lea.*
Taitianus. *Lea.*
Tampicoensis. *Lea.*
Tappanianus. *Lea.*
tæniatus. *Con.*
tenuissimus. *Lea.*
tenerus. *Rav.*
tetralasmus. *Say.*
trapezoides. *Lea.*
triangularis. *Bar.*

trigonus. *Lea.*
Troostensis. *Lea.*
tuberculatus. *Bar.*
turgidus. *Lea.*
undulatus. *Bar.*
Vanuxemensis. *Lea.*
varicosus. *Lea.*
Vaughanianus. *Lea.*
ventricosus. *Bar.*
venustus. *Lea.*
verrucosus. *Bar.*
vibex. *Con.*
Watereensis. *Lea.*
Zeiglerianus. *Lea.*
zigzag. *Lea.*

SOUTH AMERICA.

ambiguus. *Lea.*
angulatus. *Lea.*
atratus. *Lea.*
auratus. *Lea.*
Brownianus. *Lea.*
Burroughianus. *Lea.*
charruanus. *D'Orb.*
Childreni. *Gray.*
depressus. *Lam.*
delodontus. *Lam.*
faba. *D'Orb.*
gigas. *Lea.*
granosus. *Brug.*
membranaceus. *Lea.*
modestus. *Fer.*
multistriatus. *Lea.*
Paranensis. *Lea.*
parallelopipedon. *Lea.*
Patagonicus. *D'Orb.*
rhombeus. *Wag.*
syrmatophorus. *Lea.*
variabilis. *Lea.*

NEW HOLLAND.

Australis. *Lam.*
Novæ Hollandiæ. *Gray.*

HABITAT UNKNOWN.

angustus. *Lam.*
Cailliaudii. *Fer.*
emarginatus. *Lea.*
discus. *Lea.*
Nicklinianus. *Lea.*
nodulosus. *Lea.*
Smithii. *Gray.*
truncatus. *Swain.*

II. SUBGENUS MARGARITANA.

EUROPE.

Bonellii. *Lea.*
margaritifera. *Lea.*

NORTH AMERICA.

arcula. *Lea.*
calceola. *Lea.*
complanata. *Lea.*
confragosa. *Lea.*
deltoidea. *Lea.*
fabula. *Lea.*
Holstonia. *Lea.*
marginata. *Lea.*
radiata. *Lea.*
Raveneliana. *Lea.*
rugosa. *Lea.*
undulata. *Lea.*

SOUTH AMERICA.

Corrientesensis. *Lea.*
fossiculifera. *Lea.*

Franciscana. *Lea.*
Guarayana. *Lea.*
Minuana. *Lea.*
Paraguayana. *Lea.*
Parchappii. *Lea.*

I am unable to place the following in the table :

AFRICA.

Alasmodonta Tripolitina. *Fer.*

SOUTH AMERICA.

Alasmodonta incurva. *Fer.*

III. SUBGENUS DIPSAS.

ASIA.

discoideus. *Lea.*
plicatus. *Leach.*

IV. SUBGENUS ANODONTA.

EUROPE.

cygnea. *Drap.*

ASIA.

magnifica. *Lea.*
Woodiana. *Lea.*

AFRICA.

arcuata. *Fer.*
Chaiziana. *Rang.*

NORTH AMERICA.

angulata. *Lea.*
Benedictensis. *Lea.*
Buchanensis. *Lea.*
cylindracea. *Lea.*
decora. *Lea.*
edentula. *Lea.*
fragilis. *Lam.*
Ferussaciana. *Lea.*
fluviatilis. *Lea.*
gibbosa. *Say.*
gigantea. *Lea.*
glauca. *Valen.*
grandis. *Say.*
incerta. *Lea.*
Newtonensis. *Lea.*
Nuttalliana. *Lea.*
Oregonensis. *Lea.*
ovata. *Lea.*
pavonia. *Lea.*
Pepiniana. *Lea.*
plana. *Lea.*
salmonia. *Lea.*
Stewartiana. *Lea.*
suborbiculata. *Say.*
subcylindracea. *Lea.*
subvexa. *Con.*
Wahlamatensis. *Lea.*
Wardiana. *Lea.*

SOUTH AMERICA.

anserina. *Spix.*
Blainvilliana. *Lea.*
crassa. *Swain.*
elongata. *Swain.*
ensiformis. *Spix.*
esula. *Jan.*
Georginæ. *Gray.*
lato-marginata. *Lea.*
limnoica. *D'Orb.*

Mortoniana. *Lea.*
obtusa. *Spix.*
Parishii. *Gray.*
Patagonica. . *Lam.*
porcifer. *Gray.*
Spixii. *D'Orb.*
sinuosa. *Lam.*
sirionos. *D'Orb.*
soleniformis. *D'Orb.*
tenebricosa. *Lea.*
trapezialis. *Lam.*
trigona. *Spix.*

NEW HOLLAND.

purpurea. *Valen.*

HABITAT UNKNOWN.

crispata. *Lam.*
exilis. *Lea.*
uniopsis. *Lam.*
undulata. *Say.*

The following species are unknown to me:—

EUROPE.

Anodonta curvatus. *Fer.*

ASIA.

Anodonta folium. *Fer.*
Anodonta Chinensis. *Fer.*

AFRICA.

Anodonta arcuta. *Caill.*
Tawaii. *Rang.*

NORTH AMERICA.

Anodonta lugubris. *Say.*
Anodonta impura. *Say.*

FOSSIL SPECIES.

NORTH AMERICA.

Anodonta? Abyssina. *Mort.*

GENUS PLATIRIS.

I. SUBGENUS IRIDINA.

AFRICA.

ovata. *Swainson.*

HABITAT UNKNOWN.

exotica. *Lam.*

II. SUBGENUS SPATHA.

AFRICA.

cœlestis. *Lea.*
elongata. *Lea.*
Nilotica. *Lea.*
rubens. *Lam.*

SOUTH AMERICA.

siliquosa. *Lea.*
soleniformis. *Lea.*

Not being able satisfactorily to make out or arrange the following species, I have deemed it best simply to insert a list, in their order of habitat.

EUROPE.

Unio rubens. *Menke.*
Unio rugatus. *Menke.*
Unio gibbus.† *Speng.*
Unio truncatus.† *Speng.*

ASIA.

Unio orientalis. *Fer.*

AFRICA.

Unio Juliani. *Rang.*

NORTH AMERICA.

Unio Grœnlandicus.† *Schrö.*
Unio purpuriatus. *Say.*
Unio oviformis. *Con.*
Unio furvus. *Con.*

SOUTH AMERICA.

Unio nitidens. *Fer.*
Unio obtusus. *Fer.*
Unio preciosus. *Fer.*
Unio psammoica. *D'Orb.*
Unio rhuacoica. *D'Orb.*
Unio Fontainiana. *D'Orb.*
Unio hylæa. *D'Orb.*
Unio Guaraniana. *D'Orb.*

HABITAT UNKNOWN.

Unio pulchellus. *Fer.*
Unio musivus.† *Speng.*

The following Fossil species have been observed in Great Britain :—

Unio crassiusculus. *Sow.*
Unio concinnus. *Sow.*
Unio uniformis. *Sow.*
Unio acutus. *Sow.*
Unio Listeri. *Sow.*
Unio Solandri. *Sow.*
Unio porrectus. *Sow.*
Unio compressus. *Sow.*
Unio antiquus. *Sow.*
Unio aduncus. *Sow.*
Unio cordiformis. *Sow.*
Unio crassissimus. *Sow.*
Unio subconstrictus. *Sow.*
Unio hybridus. *Sow.*
Unio Urii. *Flem.*
Unio abductus. *Phil.*
Unio peregrinus. *Phil.*

The following have been observed in the United States:

Unio petrosus. *Mort.*
Unio tumulatis. *Mort.*
Unio terrenus. *Mort.*
Unio saxulum. *Mort.*

† On the authority of Ferussac.

LIST OF AUTHORS.

The following Authors are quoted, and their names chiefly abbreviated.

Adan.—Adanson.

Bosc.
Bouil.—Bouillet.
Blain.—Blainville.
Bar.—Barnes.
Brug.—Bruguière.
Ben.—Benson.

Crouch.
Con.—Conrad.
Chem.—Chemnitz.
Caill.—Cailliaud.
Cooper.
Children.

Dill.—Dillwyn.
Desh.—Deshayes.
Drap.—Draparnaud.
Des Moul.—Des Moulins.
Don.—Donovan.
Den.—Denham.
D'Orb.—D'Orbigny.

Eat.—Eaton.

Fer.—Ferussac.
Flem.—Fleming.
Fork.—Forkeil.
Far.—Farines.

Gray.
Green.
Grat.—Grateloup.
Grono.—Gronovius.
Gmel. Gmelin.

Hild.—Hildreth.
Humph.—Humphreys.

Jan.

Klein.
Knorr.
Kœnig.

Lam.—Lamarck.
Lesueur.
List.—Lister.
Less.—Lesson.

Mort.—Morton.
Mich.—Michaud.
Monta.—Montagu.
Mori.—Moricand.
Mat.—Maton.
Mühl.—Mühlfeld.
Menke.

Nil.—Nilsson.

Poir.—Poiret.
Petiv.—Petiver.
Pfeif.—Pfeiffer.
Poli.
Pay.—Payraudeau.
Phil.—Phillips.

Retz.—Retzius.
Rav.—Ravenel.
Ross.—Rossmaesler.
Raf.—Rafinesque.
Rang.

Shep.—Shepherd.
Speng.—Spengler.
Stud.—Studer.
Schmidt.
Schroet.—Schroeter.
Solan.—Solander.
Sow.—Sowerby.
Schum.—Schumaker.
Spix.
Swain.—Swainson.
Say.

Turt.—Turton.

Valen.—Valencienes.

Wag.—Wagner.
Wood.

Yoldi.

Zeig.—Zeigler.

CONTENTS OF Mr LEA'S MEMOIR.

ERRATA.

Page 48, line 15 from top, for 1837 read 1836.
Page 49, line 17 from top, for *is* read *in*.
Page 59, line 7 from top, for *left valve* read *right valve*.
Page 59, line 17 from bottom, for *forms* read *performs*.
Page 96, line 8 from top, for *Pepinianus* read *Pepiniana*.
Page 131, line 9 from top, for *Membranacea* read *Membranaceus*.

ARTICLE II.

Descriptions of new North American Insects, and Observations on some already described. By Thomas Say.—Continued from Vol. IV., N. S., p. 470. *Read June* 17, 1836.

ALEOCHARA, *Grav.*

9.* A. *simplicicollis.* Blackish; antennæ, feet, inner tip of the elytra and posterior margins of the segments of the tergum reddish brown.—Inhab. Missouri.

Body with short prostrate hairs: *head* black: *antennæ* reddish brown; transverse joints somewhat darker: *elytra* on the sutural margin, particularly towards the tip, obscure reddish brown; common emargination at tip very obvious: *tergum* with the posterior margins of the segments dull reddish brown: *feet* reddish brown or honey-yellow.—Length about one-tenth of an inch.

Distinguished from the two preceding species by the simplicity of the thorax and the margined segments of the tergum.

10. A. *falsifica.* Black; with converging hairs; elytra and feet yellowish.—Inhab. Indiana.

Body black, with rather long, prostrate hairs: *head* with the hairs

* In the description of the preceding species (A. *semicarinata*, see Vol. IV., N. S., p. 470), the following details were accidentally omitted:—

Length less than one-tenth of an inch.

Resembles A. *propera*, but may be distinguished by the double thoracic groove, forming an inclined carina.

converging to the middle line, and directed forward: *antennæ* blackish; basal joints obscure piceous: *palpi* dull yellowish: *thorax* with the hairs converging to the middle line and directed forwards: *elytra* dull yellowish, darker on the base, suture and outer margin; the hairs somewhat arranged so as to resemble striæ: *feet* honey-yellow.—Length about one tenth of an inch.

11. A. *verna.* Black; distinctly punctured; inner top of the elytra dull yellowish.—Inhab. Missouri.

Body with scattered hairs: *head* polished, with sparse irregularly arranged, rather large punctures: *antennæ* of the basal joints hardly tinged with piceous: *thorax* polished, with numerous, rather large, unequal and irregularly scattered punctures; middle line destitute of punctures: *feet* black-piceous.—Length about one tenth of an inch.

The more conspicuous and irregular puncturing will distinguish this species from the above described.

12. A. *exigua.* Black; punctured; antennæ and feet hardly tinged with piceous.—Inhab. Indiana.

Body black, a little polished, with short hair; punctures numerous, somewhat regular: *antennæ* at base, and *palpi* very slightly tinged with piceous: *elytra* a little indented at the scutel; at tip the common emargination obtuse, not profound: *feet* black-piceous.—Length one-twentieth of an inch.

13. A. *minima.* Black; elytra and feet dull yellowish.—Inhab. Indiana.

Body black, with numerous prostrate hairs: *antennæ* towards the base with a very slight tinge of piceous: *elytra* dull yellowish: *tergum* dirty yellowish at tip: *feet* whitish-yellow, dull.—Length nearly one tenth of an inch.

Var. *a.* Thorax nearly the colour of the elytra.

14. A. *bilobata.* Dark reddish brown; thorax subcordate, canaliculate, feet pale.—Inhab. Missouri and Indiana.

Body very dark reddish brown, with numerous regular punctures: *antennæ*, two basal joints paler: *mouth* beneath, excepting the terminal joints of the maxillary palpi, pale testaceous: *thorax* rounded before and narrower behind; very deeply canaliculate; groove abruptly abbreviated on the basal margin: *elytra* at tip and sides with smaller punctures than the thorax; suture indented: *feet* pale testaceous: *tergum*, segments with dilated punctures at base.—Length less than three-twentieths of an inch.

The thoracic canal is less dilated, but at least as profound as that of the *canaliculata*, Grav.; the thorax is more contracted behind, and the head more prominent, and distinctly separate from the thorax by a short neck.

The genus Aleochara, as is obvious to entomologists, needs reformation. The present species, and some others of Gravenhorst's first divisions, may be separated from it under the following name and characters.

Genus *Aleodorus.* Head prominent, with a distinct neck, not inserted into the thorax; antennæ inserted into the anterior internal orbit of the eye; three basal joints longest; maxillary palpi long, terminal joint acicular; thorax longitudinal, rounded on the sides, or without lateral edge; feet simple.*

BUPRESTIS, *F.*

1. B. *virginica.* Turton's Linn. p. 411; Drury's Ins., vol. I., p. 66, pl. 30, fig. 3.

This species very closely resembles B. *mariana*, L., and notwithstanding the magnitude of Drury's figure, it is somewhat smaller than the latter species, the posterior part of the thorax is a little narrower and the curvature of its lateral edge is somewhat different. It inhabits the eastern and middle states.

2. B. *liberta*, Germ. This differs more in colour from the *virginiensis*, than the latter species does from the *mariana*; but it corresponds with *virginiensis* in the form of the thorax. I am still inclined to consider it a variety of that species, which Germar does not refer to in his description of *liberta.*

3. B. *lurida*, F. (and Melsh. Catal.)

This is the *corrosa*, Deg. MSS. Herbst. Olivier did not observe the anal points, which are sometimes obscured by the hair.

* I am indebted to Professor Wiedeman for the two very useful works on "Coleoptera Microptera" by Gravenhorst. They contain detailed descriptions of many North American species of the Linnæan genus *Staphylinus*, which now constitute a large family.

4. B. *divaricata*, Nob. That this insect is closely allied to *acuminata*, F., there can be no doubt, and Dejean (in a letter) considers it the same; but, on reference to the description of that species by Gyllenhal (Insecta Svecica*), I find the following characters, "thorax ante scutellum puncta duo impressa: anus emarginatus." In the present species is only a single indentation at the base of the thoracic groove, and immediately anterior to the scutel, and the anus is tridentated, the middle tooth being more slender and acute. A variety in my collection is destitute of the punctured striæ of the elytra.

4. B. *obscura*, F. (and Melsh. Catal.)

Herbst says the side of the thorax is rectilinear, not arcuated. This would agree better with *lurida*, F.; my specimens of *obscura* are rectilinear only from before the middle to the base.

5. B. *dentipes*, Germar. This is the *characteristica* of Melsheimer's Catalogue; but, as no mere catalogue can establish a name, Germar's must be of course retained, because it is the first name recognizable by a description.

6. B. *hybernata*, F. From the specimen in my collection, I am led to believe that the *hybernata*, F. is but a variety of the *frontalis*, Olivier, and that both have serrate elytra; but I have not at present the means of referring to Olivier's work. My specimen is reddish purple; thorax immaculate; elytra serrate, with but five green spots; and the anterior thighs are armed with a prominent tooth.

7. B. *sexguttata*, Nob. (Journ. Acad. Nat. Sc.). This name being preoccupied by Herbst for an American species, we change it to *sexsignata*.

8. B. *gibbicolis*, Nob. (Journ. A. N. S.). This name is pre-occupied by Illiger for an European species, it must therefore be changed.

9. B. *pulchella*, Herbst. The *volvulus*, F. is probably the same species; but which of the two names has the priority I cannot now ascertain, not having the date of Herbst's volume. There is some confusion amongst the species of the small group to which this belongs, in consequence of the short descriptions of Fabricius. Herbst's description of this species cannot well be mistaken. I have found it in Penn-

* For this very accurately descriptive work, I am indebted to the politeness of the author.

sylvania, Florida and Arkansa. It is the *ornata* of Dejean's Catalogue; and Germar, in a letter, considers it a new species under the name of *olydonia*.

10. B. *ornata*, F. About the size of the preceding, though perhaps a little more robust, of a much darker colour; and may also be distinguished from it by the thorax having the dorsal line deeply indented, more especially on the posterior margin, and being obtusely angulated behind the middle of the lateral edge. Dejean supposed it a new species, and gave it, in MSS., the name of *multiguttata*, but I think there is no doubt that it is the Fabrician species.

11. B. *tubulus*, F. This species is described as having but five yellow punctures on the elytra, placed 2.2.1, the latter being the largest. But it varies considerably in this respect, sometimes having eight or nine spots, and again other specimens occur with not more than are indicated by Fabricius, if we consider the posterior larger one as being composed of two confluent ones. The rest of the description agrees precisely, and even the noted size corresponds with our insect; as Fabricius says, "statura omnino B. *volvuli*, at duplo minor." It may indeed be at once distinguished from *pulchella* by its much inferior size, very different colour, and the greater regularity of its elytral spots; but the lateral edge of its thorax has a similar curvature. It is the smallest of our species of the group distinguished by the want of scutel, &c., and approaches the *ornata* by its colouring and the somewhat similar arrangement of the elytral spots, but differs in the regular curvature of its lateral thoracic edge. It is the *volvulus* of Dejean's Catalogue. Germar believed it new and gave it the name of *xanthocyma*; it is the *culta* of Weber; and Dr Harris has described it under the name of *geranii*.

12. B. *acornis*. Brassy black; antennæ short; scutel green; beneath cupreous.—Inhab. Indiana.

Body with dense, rather large, confluent punctures: *head* a little tinged with cupreous, particularly towards the tip; tip of the clypeus not narrowed, not emarginate, but with a slight concave curvature: *labrum* hardly prominent, not visible when viewed from above: *antennæ* very short, not reaching the vertex, the three basal joints together about as long as all the others combined: *thorax* in breadth at least twice the length, with transverse confluent punctures: *scutel* bright green: *elytra* with transversely confluent punctures; serrate from near the humerus; surface obsoletely undulated: *beneath* cupreous: *anterior thighs* with a prominent acute spine.—Length seven-twentieths of an inch.

A small and distinct species.

13. B. *impedita.** Elytra bluish-green, grooved and punctured.—Inhab. Pennsylvania.

Head confluently punctured, green with a cupreous reflection: *antennæ* steel-blue, at base green: *labrum* green, ciliate at tip: *thorax* cupreous, with green confluent punctures; on some parts of the disk the punctures are sparse: *scutel* oval, regularly concave, green: *elytra* densely punctured, with five dilated grooves and four elevated lines, the latter sparsely punctured; green, gradually shaded into a blue vitta along the middle; suture and outer margin cupreous; tip somewhat truncated: *beneath* green cupreous.—Length three-fifths of an inch.

The specimen was taken near Philadelphia. It is evidently related to *salisburiensis*, as described by Weber, to *decora*, F., and *splendens*, F. of China. But Weber's description states the former to have striated elytra, without elevated lines. The *splendens* has only three elevated lines on the elytra, and the *decora* is larger, with the tip of the elytra two-toothed. Neither can it be the *striata*, Oliv., as the elytra are not slightly bidentate, nor are their two inner elevated lines abbreviated. A variety found by my brother, B. Say, in New Jersey, is much tinted with copper, and is smaller, but the sculpture and form are the same.

I may add, as closely allied to the *impedita* and to the *salisburiensis*, Web., in point of colouring, a specimen which I found in New Jersey many years since, and which I then described under the name of *ultramarina*; but the description was mislaid and never published, and the specimen is now deprived of its head and thorax. The following is a description of what remains of it.

* Dr Harris is of opinion that this species, the *aurulenta* of Linnæus and Olivier, and the *striata* of Fabricius are the same; and that the *decora*, F. and *salisburiensis*, Weber and Herbst, are identical. The latter differ from the *aurulenta*, L. in not having elevated lines on the elytra.

Scutel orbicular, disk indented: *elytra* blue on the disc; submargin and subsuture green, passing into golden towards the margin and suture, which are brilliant coppery or red golden; basal margin green golden; surface with seven or eight striæ of dilated profound punctures; the interstitial lines with each a single series of smaller punctures; no elevated lines; tip *truncated*, with a slight projection at the inner angle: *beneath* green-golden, with a slight coppery tinge: *tibiæ* coppery.—Length of the elytra two-fifths of an inch.

It is more brilliant than either the *impedita* or *salisburiensis*. From the former it is distinguished by being destitute of elevated lines on the elytra, and from both by its regular series of large profound punctures.

14. B. *viridicornis*, Nob. This has been mistaken by an European entomologist for the *agrilus ruficollis*, F.; but it is very different in form, which is much more like that of a true Buprestis; and the colour is also different, though that of the head and thorax probably deceived him, being coppery in each, though much more obscure in our insect. I have taken a variety in this state differing greatly in colour, so much so, that it might lead to error unless actually compared.

The colour is bright green; thorax on the disc tinged with coppery, with a common green triangle extending from the humerus to beyond the middle; beneath the green colour is less brilliant. Another variety has the cupreous colour of the thorax confined to the lateral margin, the remainder being of the colour of the elytra.

I may add to the specific description that the head has an orbicular indentation between the eyes, and a slightly indented line on the vertex; the scutel is altogether destitute of a transverse elevated line; it is convex, and widely triangular; the elytra are minutely serrate at tip.

This species has characters in common with *buprestis* and *agrilus*, and it may perhaps belong to the latter.

AGRILUS, *Megerle.*

1. A. *ruficollis*, F. We may add to the Fabrician characters that the head is profoundly indented on the vertex; the indented line is continued down the front; the elytra are scabrous, and at tip, as well as that of the abdomen, serrate.

Var. *A.* Thorax obscure green.

Var. *B.* Thorax colour of the elytra.

The great indentation of the vertex distinguishes this species from others of this country. Herbst's figure only tends to mislead, if indeed it can be intended for this insect at all. It is too robust, the thorax is not represented as indented, and the elytra are punctured in striæ, with large punctures.

2. A. *geminatus*, Nob. A numerous species; the colour of the head and thorax often resembling those of the preceding species, but the acute, arcuated, elevated line at the posterior angles, is similar to that of the *linearis*, F. of Austria, which it very much resembles.

3. A. *politus*, Nob. Much like *arcuatus*, but a little more robust, and of a brilliant colour. Like the other species its elytra are denticulated at tip. Having examined numerous specimens, I find that it is not of a larger size than *geminatus*.

4. A. *arcuatus*, Nob. A little larger than *geminatus*, and resembling it in the character of the elevated line at the posterior thoracic angles, but the antennæ are much more slender and elongated.

5. A. *granulatus*, Nob. This species has three hardly visible fulvous spots on the elytra; one on the depressed base, one near the suture before the middle, and one behind the middle, also near the suture. I have a specimen in which these spots are not at all visible.

The elevated line at the posterior angles of the thorax is short, but very obvious.

6. A. *bilineatus*, Weber, Nob. In my printed description an error occurs. When describing the elytral vittæ, instead of "extended towards the tip, where it gradually approaches the scutel," I should have said *suture* instead of "scutel."

7. A. *lateralis*, Nob. I stated in the description that the elytra are entire; I would add that they are not obviously denticulated at tip.

8. A. *pusillus*, Nob. The smallest North American species I have yet seen.

The above species of *agrilus*, excepting the first, I described in the Journal Acad. Nat. Sc. and the Annals of the Lyceum of Nat. Hist. of New York, under the genus *Buprestis*, to which most entomologists yet refer their kindred species.

9. A. *fallax*. Elytra with about three spots on each, which exhibit a different reflection.—Inhab. Indiana.

Brassy-greenish: *head* green, sometimes cupreous on the vertex; impressed line hardly obvious: *thorax* with a dorsal and lateral indented line; the former more obvious behind, the latter oblique and dilated; more or less tinged with cupreous; an arcuated, elevated line at the posterior angles; posterior angles acute: *elytra* with the basal indentation, subsutural spot behind the middle, composed of minute prostrate hairs, producing a different reflection from that of the general surface; tip denticulate: *beneath* blackish-brassy.

Var. *A*. Dull cupreous; thorax brighter.

Length more than one-fifth of an inch.

Distinguished by the elytral spots offering a different reflection from the remainder of the surface. In some positions they are hardly obvious; but seen from before or behind they are distinct, particularly the posterior one.

10. A. *putillus*. Thorax transversely indented before and behind the middle; elevated line of the posterior angle none.—Inhab. Indiana.

Body blackish-brassy: *head* greenish; longitudinal impressed line very distinct: *thorax* with a transverse indentation before, a much larger transverse indentation behind the middle, and a more profound lateral one parallel with the lateral margin; posterior angles destitute of an elevated line, rectangular or rather more obtuse; *elytra*, basal indentation ovate-oblong, oblique; tip denticulated, from the suture to the middle concave; suture rather prominent.—Length over one-tenth of an inch.

Only three of the before mentioned species are destitute of an elevated line at the posterior thoracic angles, viz. the *ruficollis*, *bilineata* and *lateralis*, to these we may add the *cogitans*, Weber. From all these the present is separable by its inferior size, excepting the *lateralis*, which has no denticulations at the tip of the elytra. One of my specimens has the head green before.

11. A. *otiosus*. Line of the thoracic angles short and obtuse; front but slightly punctured.—Inhab. Indiana.

Body greenish, or brassy-blackish, rather slender: *head* with the punctures obsolete, excepting on the vertex, where they are not profound or well defined; beneath the middle of the front with short whitish hairs: *thorax* with two slight indentations placed longitudinally, a more obvious one on the lateral margin, and another each side of the basal middle; elevated line of the posterior angles less than one-fourth of the length of the lateral edge, but slightly elevated and obtuse: *elytra* depressed from the suture to the middle; tip denticulated. —Length nearly one-fifth of an inch.

Resembles *geminatus*, but its form is rather more slender, the frontal punctures are obsolete, and the elevated line of the thoracic angles is much shorter and less distinct.

12. A. *cogitans*, Weber. The thorax is described to be serrate; but on close examination the edge will be found to be entire, and the upper surface of the edge, or extreme margin only, is serrate. The body is more dilated than in any other of our species.

TRACHYS, *F.*

1. T. *tessellata*, F.
2. T. *ovata*, Weber, Obs. p. 76.

Our species vary greatly, or are very numerous.

GENUS METONIUS, *Say.*

Thorax short, wide, and deeply emarginate before for the reception of the head; not lobate behind: antennæ subclavate, concealed when at rest in a groove of the thorax; body short, wide before and narrow behind: tibiæ angulated, and when at rest the tarsi are applied to the outer edge: præsternum prominent to the mouth, and behind applied evenly to the poststernum by a transverse line.

This genus differs from Trachys in the thorax being not lobed behind; in the præsternum terminating by a straight line; by the dilatation of the tibiæ, &c.

1. M. *ovatus*, Nob. (Trachys) Ann. Lyc. New York. Those who will retain this species in *Trachys* must change the name to *lævigatus*, as the other is preoccupied in that genus.

2. M. *purpureus*. Ovate, black; elytra purple.—Inhab. Indiana.

Body black: *head* with distinct punctures; front with an indented, abbreviated line placed low down: *thorax* with scattered discoidal punctures; no lateral indentation: *elytra* purple; indented at the middle of the base and behind the humerus; punctures rather large but not deeply impressed, placed in series and obsolete behind: *tibiæ* angulated.—Length under three-twentieths of an inch.

This insect is certainly congeneric with the preceding, but it cannot be placed in *Trachys*, or even in *Aphanisticus*, if *pusillus*, Olivier, can be considered as a type of it.

APHANISTICUS, *Latr.*

A. *gracilis*, Nob. (*Trachys*) Ann. Lyc. New York. The thorax is not laterally dilated and reflected.

MELASIS, *Oliv.*

M. *nigricornis*, Nob., Journ. A. N. S.

I was deterred from referring this species to *Cerophytum*, Latr., by the character "le pénultième article des tarses bifide. Le corps est ovale." Our insect cannot therefore be the *Melasis picea*, Beauv., which is referred to *Cerophytum*.

ELATER, *L.*

† *Tarsi not lobed beneath.*

1. E. *oblessus*, Nob. (*discoideus*, Fabr.). The Fabrician phrase, when describing the elytra, is, "elytra striata, atra, margine baseos lateralique late albo;" but as the whitish portion occupies about two-thirds of the whole surface and might lead to error, it would be better to say, *elytra whitish, with the sutural margin and exterior edge excepting at base, black.*

I change the Fabrician name, because it is preoccupied by Weber for a very different species of this country.*

2. E. *morio*, F. Herbst. E. *lævigatus*, F. Herbst. E. *piceus*, Degeer, Turton's Linn.

* Dr Harris says that Weber's species, here referred to, is the *hematus* of Fabricius; and that Mr Say does not seem to have known the *Elater discoideus* of Fabricius, which is quite distinct from the above named *oblessus*.

This species is subject to vary through all the intermediate gradations between smooth elytra and deeply striated elytra; which is the cause why several species have been made of it. The lateral edge of the thorax is grooved.

3. E. *abruptus*, Nob., Ann. Lyc. Nat. Hist. New York. Like *morio*, but more convex above, more impressed at the junction of the thorax and abdomen; more densely and minutely punctured; a little more robust; each joint of the antennæ originates much nearer the posterior angle of the preceding joint; and the lateral edge of the thorax is destitute of a groove, of a somewhat different form, and the head is not impressed, but is rounded on the front.

4. E. *attenuatus*. Reddish brown; elytra somewhat attenuated, blackish and mucronate behind.—Inhab. U. S.

Body bright reddish-brown, almost sanguineous, with small close set punctures: *head* not indented before: *antennæ*, joints not elongated: *thorax* convex, lateral margin arcuated; narrowed before; line from the posterior angle rectilinear, acute, diverging from the lateral edge so as to be as near to the inner edge: *region of the scutel* rather widely indented: *elytra* with smaller punctures than those of the thorax; with obsolete striæ; terminal oblique third black; tip somewhat attenuated and mucronate: *feet* a little darker.—Length four-fifths of an inch.

A variety occurs of which the elytra are obscure, but still the terminal third, and the exterior margin also, are black. In a particular light is a slight sericeous effect.

5. E. *viridipilis*, Nob. The thorax in form resembles those of *oculatus* and *myops*, F. but is proportionally longer.

The posterior angles are curved considerably downward. It is rare.

6. E. *cylindriformis*, Nob. In the description "a prominent edge above the antennæ, which disappears before;" instead of the three last words, read, *which is obtusely emarginate.* The head, thorax and base of the elytra have rather long, prostrate hairs; the remainder of the elytra has short hairs. Tarsi simply hairy beneath.

It may be referred to the genus *Campylus*, Fischer, but the head is inserted nearly to the eyes in the thorax; and the palpi are hardly filiform.

7. E. *rubricollis*, Herbst, Nob. (Journ. Acad. Nat. Sc.). This is the *verticinus*, Beauvois, but I do not know which has the priority.*

8. E. *limbalis.* Thorax fulvous, disc black; elytra blackish, with a testaceous margin.—Inhab. U. S.

Head blackish; *antennæ* wide, deeply serrate; three basal joints taken together not longer than the fourth joint; second and third very short, equal transverse: *thorax* fulvous-testaceous: disc in the middle, basal and posterior part of the lateral margin black: *elytra* testaceous all around and blackish along the middle: beneath blackish piceous; pectus with an oblique, fulvous spot near the posterior angles: *feet* piceous.—Length less than half an inch.

This is the *limbalis* of Melsh. Catal., and I have it noted in my MSS. interrogatively as the *limbalis* of Herbst, but I have not now his work to refer to.

9. E. *ectypus.* Blackish brassy; antennæ and feet rufous; thoracic spines very short.—Inhab. U. S.

Blackish or dark brown, tinged with brassy: *clypeus* very obtuse, almost truncated before, not appressed; above plane, with two obsolete indented lines: *antennæ* dark rufous, not dilated, and hardly serrate; second joint more than two-thirds the length of the third; terminal joint not abruptly contracted near the tip: *thorax* convex; dorsal line obvious; spines short, their excurvature hardly obvious, carina nearly parallel with the exterior edge: *scutel* a little convex: *elytra* with punctured striæ; interstitial spaces with numerous, small, definite, orbicular punctures: *feet* rufous: *tarsi* simple.—Length nine-twentieths of an inch.

It may be distinguished from the *appresifrons*, Nob., which it resembles, by the more convex thorax, of which the spines are much shorter and not much excurved; the antennæ are more slender, and the terminal joint is not abruptly narrowed near its tip, and the punctures of the interstitial spaces of the elytra are obviously orbicular, and definite.

10. E. *pyrrhos*, Herbst. Elongated: the thorax is narrow, the spines

* Dr Harris remarks that Herbst's name undoubtedly has the priority; for that of Palisot de Beauvois does not seem to have been sanctioned by a description.

hairy: the joints of the antennæ are in length about three times their greatest breadth, even the second joint is in the same proportion with respect to the third: the length of the antennæ is equal to half that of the body: clypeus subquadrate, concave towards the tip.—Length seven-tenths of an inch.

11. E. *sulcicollis*, Nob. (E. *parallelus*, Say, Ann. Lyc. New York). Dejean informs me that the name *parallelus* is preoccupied, and proposes to substitute for it that which I now give. An expressive name would be *inversicollis*, the thorax being as wide, or rather wider before than behind.

12. E. *viridis*, Nob., Ann. Lyc. New York. Antennæ short: joints in their greatest breadth nearly equal to their length; second joint hardly half as long as the third: clypeus at tip not prominent, but only distinguished by a line: thoracic spines with a carinate line parallel to the exterior edge.

13. E. *auripilis*, Nob., Journ. Acad. Nat. Sc. I obtained another specimen in the N. W. Territory.

It is remarkable for the deep indentations of the clypeus.

14. E. *semivittatus*, Nob., (Ibid.). In the only specimen at present in my cabinet, is a transverse indented line in the middle of the lateral margin: the thoracic dorsal line is polished behind the middle.

15. E. *obesus*, Nob. (Ibid.). The clypeus is not prominent, and the thoracic spines are not carinated; the elytra, in one specimen, are acuminated at tip: the nails are very robust on the basal half, which terminates at the middle in a prominent tooth, separated by a deep fissure.

16. E. *viridanus*, Nob. (Ann. Lyc. Nat. Hist.). The thorax has two orbicular indentations before the middle.

17. E. *mancus*, Nob. (Journ. A. N. S.). Second joint of the antennæ rather longer than the third. Clypeus not prominent.—Inhab. New Hampshire, Harris.*

* [Among Mr Say's suppressed descriptions is the following, which may be of use in determining the species, and is therefore worth preserving.]

18. E. *linteus*. Black; elytra whitish, tip and sutural edge black.—Inhab. U. S.

Body black: *clypeus* not prominent, rounded at tip: *antennæ* robust, deeply serrate; second joint transverse, nearly orbicular, very small: *thorax* gradually narrowed before by a

18. E. *convexus*, Nob. (Journ. A. N. S.). With a good magnifier the interstitial lines appear to have minute punctures; the third and fourth, and fifth and sixth striæ of the elytra are confluent before the tip.

19. E. *cardisce.* Thorax rounded, convex, with an elongated lateral fissure at base.—Inhab. U. S.

Body, blackish: *head* with short, dense, prostrate, cinereous hair; clypeus elevated above the front, edge a little reflected: *antennæ* nearly as long as the thorax, second joint shorter than the third: *thorax* elevated, convex, with a slight violaceous tinge, and short, prostrate, cinereous hair; regularly arcuated each side; lateral edge hardly raised, placed low down and obsolete before the middle; basal margin profoundly bisinuate, with an elongated fissure near the lateral angles and a small prominence in the middle; angles short, abrupt: *scutel* cordate, having a basal fissure: *elytra*, striæ deeply impressed, third and fourth, fifth and sixth confluent before the tip; very short hair; interstitial lines convex, minutely rugulous, an obsolete paler spot in the middle and another beyond the middle: *beneath* slightly tinged with violaceous: *tibiæ* and *tarsi* dark rufous.—Length three-tenths of an inch.

I have taken it in Pennsylvania, and Dr Harris in Massachusetts. It resembles *convexus*, S., but the thorax is much more narrowed behind, &c.

20. E. *discalceatus.* Clypeus prominent, triangularly impressed.—Inhab. New Hampshire.

Body hairy, rufous; discs of the thorax and elytra a little dusky: *head* densely punctured; clypeus prominent and obtuse before, with a larger triangular indentation: *thorax* a little dusky on the anterior margin; posterior angles a little excurved, obtuse, carinated line pro-

rectilinear edge almost to the anterior margin; an impressed line at base; posterior angles carinate, rather acute: *scutel* convex, acute behind: *elytra* whitish, with striæ of dilated punctures; tip black; a narrow, black, sutural margin, and exterior edge, behind the middle, black: *feet* piceous: *tarsi*, fourth joint hardly shorter than the third.—Length over three-tenths of an inch.

Can this be the *mixtus*, Herbst? It is the *deustus* of Melsheimer's Catalogue? a name preoccupied by Thunberg for a species of Ceylon.

[This description Mr Say originally arranged immediately after that of E. *mancus*, in the papers printed at New Harmony, during the summer of 1834, but omitted it with the following remark:]

Leconte says that it is the *lugubris*, Beauv.

minent, acute, not parallel with the edge: *elytra* with the punctures of the striæ not longer than broad: *beneath* much paler.—Length nearly half an inch.

The antennæ are not longer than the thorax, and the terminal joint is not remarkably contracted near its tip. The individual was sent to me for examination by Dr Harris. It resembles *cucullatus*, S., but is destitute of tarsal lobes.

21. E. *apicatus.* Elytra bright rufous, black at tip.—Inhab. New Hampshire.

Body black, with short yellowish hairs: *clypeus* convex, anterior edge not obtusely rounded, declining, but distinct at tip: *antennæ* dark piceous, rather shorter than the thorax, second and third joints subequal: *thorax* wider at the posterior angles; lateral edge rectilinear from the middle to the tip of the posterior angles, which are prominent and acute: *elytra* bright rufous, with a longitudinal black spot at tip; striæ impressed, rather wide, punctured; interstitial spaces convex, punctured: *tarsi* piceous.—Length nine-twentieths of an inch.

The specimen was kindly sent to me by Dr Harris for examination. Resembles *sanguinipennis*, S., but is larger, with a black spot at tip of the elytra.

22. E. *hamatus.* Blackish, thorax with golden hair; elytra whitish, with a dusky hooked line at tip.—Inhab. Massachusetts.

Body blackish piceous: *antennæ* dull rufous, hardly as long as the thorax, second and third joints subequal, ultimate joint oval, not longer than the preceding one: *thorax* convex; posterior angles excurved, prominent, obtuse at tip; hairs golden, prostrate; carinated line parallel to the edge: *elytra* yellowish-white, with a piceous vitta on the outer margin from the tip to near the middle, where it curves inward and backward towards the suture and tip; striæ impressed and punctured: *feet* rufous.—Length over two-fifths of an inch.

Sent to me by Dr Harris.

23. E. *fallax.* Clypeus appressed to the front anteriorly; posterior thoracic angles short.—Inhab. New Hampshire.

Body blackish-piceous, with yellowish sericeous hair: *clypeus* anteriorly confluent with the front: *antennæ* about as long as the thorax; joints hardly longer than their greatest breadth: *thorax* narrowed before;

lateral edge a little arcuated; punctures minute; posterior angles short, rather wide, scarcely excurved; carina short; basal margin somewhat depressed, with a longitudinal indentation in the middle, and a slender impunctured line extends to the anterior edge: *elytra* striate, the striæ not very obviously punctured, third and fourth confluent before the tip; greatest breadth posterior to the middle: *tibiæ* and *tarsi* rufous.—Length two-fifths of an inch.

This species was sent to me by Dr Harris. The particular disposition of the hair on the elytra of the specimen gives the appearance of a broad band at base, another beyond the middle, and a subsutural spot in the middle, blackish.

24. E. *armus.* Black; shoulder rufous.—Inhab. U. S.

Body black: *clypeus* with large punctures, somewhat triangularly depressed; anterior edge obtusely arcuated, distinct from the anterior part of the head: *antennæ,* joints as broad at tip as long, second and third equal, terminal one large, ovate acute, not abruptly smaller towards the tip: *thorax* convex; punctures rather distant, larger before; lateral edge subrectilinear, a little undulated; posterior angles short, their exterior edge very much arcuated, so that the tip points inward and backward, carina diverging and distant from the edge, and not very obvious: *elytra* with punctured striæ, third and fourth confluent before the tip; interstitial spaces punctured; humerus rufous.—Length one-fourth of an inch.

Different from *scapularis,* S., of which the tarsi are lobed. It inhabits the middle states, and Dr Harris sent me one from Massachusetts.

25. E. *agonus.* Posterior thoracic angles very short and rounded; antennæ longer than the thorax.—Inhab. Massachusetts, Harris. Pennsylvania.

Body violaceous-blackish: *clypeus* very obtuse before and hardly distinct from the anterior part of the head; punctures small: *antennæ* rufous, the tip of the ninth joint reaching the tip of the posterior thoracic angle, third joint a little longer than the second, which is globular; terminal joint obtuse at tip: *thorax* with small punctures, and, like the head, with prostrate hair; lateral edge slightly arcuated to each extremity; at base an impressed line in the middle, and an oblique one each side; posterior angles very short, obtusely rounded: *elytra* with short hairs, dull rufous, with punctured striæ, of which the third and fourth are confluent before the tip: *feet* and *venter* on the margin rufous.—Length seven-twentieths of an inch.

The posterior thoracic angles are unusually short and rounded.

26. F. *vernalis*, Hentz. Also inhabits Indiana. I obtained several specimens in the autumn on the root of an overturned tree.

27. E. *hieroglyphicus*, Harris; Catal. Bronzed-black; elytra pale rufous, with two undulated black bands.—Inhab. Massachusetts and New Hampshire. Harris. Pennsylvania.

Body short, robust: *head* with yellow prostrate hair: *clypeus* angulated before and but little elevated: *antennæ* rufous; second joint half as long as the third; last joint not larger than the preceding one: *thorax* convex, covered with prostrate, yellow hair, lateral edge regularly but not prominently arcuated; posterior angles excurved, subacute, slightly carinated, with a small sinus at their inner origin: *elytra* pale yellowish rufous, striated; striæ without very distinct punctures, third and fourth confluent before the tip; interstitial spaces punctured; a blackish undulated band from the humerus, is connected by a subsutural blackish vitta, with another undulated band behind the middle, which is decurrent along the subsuture nearly to the tip: *beneath* tinged with rufous: *feet* rufous.—Length less than half an inch.

In some specimens the posterior band is also decurrent along the exterior margin nearly to the tip.

28. E. *choris*. Thorax rugulous, black, with yellow hairs; elytra yellowish bifasciate with black.—Inhab. Indiana.

Body black: *antennæ* piceous, dull yellowish at base: *thorax* longitudinally rugulous, black, with numerous, golden, prostrate hairs; posterior angles acute, but not much elongated; carinated line prominent, elongated, arcuated: *elytra* pale yellowish, with a black spot at base, an angulated band on the middle, interrupted into a spot towards the suture, and another black angulated band, dilated near the suture, which it does not reach, but passes abruptly backward towards the tip; striæ as broad as the interstitial lines: *beneath* tinged with piceous: *feet* pale yellowish.—Length one-fifth of an inch.

I took three individuals.

29. E. *dorsalis*, Nob. (Journ. A. N. S.). This name was given by

Paykull to an insect which proved to be the *marginatus*, Fabr. But if it be determined, nevertheless, that the present name be changed, that of *mellillus* may be substituted. It is found in Indiana, and I obtained a specimen at New Orleans.

30. E. *pectoralis*. Yellowish; thorax rounded; head and elytral band black.—Inhab. Missouri.

Body yellowish with a slight rufous tinge; punctures hardly perceptible: *head* blackish-piceous: *clypeus* very obtusely rounded at tip to the eyes: *antennæ* and *palpi* pale yellow: *thorax* with the lateral edge much and regularly arcuated to the origin of the spines, where it becomes a little excurved; spines short, acute, carinated: *scutel* suborbicular: *elytra* with obsolete striæ; a transverse black band behind the middle running down the suture and exterior margin: *pectus* with the middle segment dilated.—Length less than one-tenth of an inch.

Resembles *areolatus*, Nob., but is much smaller, the thorax more rounded, the spines smaller, the middle segment of the pectus is dilated, &c. A variety from Dr Harris has the elytral fascia extending to the tip, and in size is a little longer.

31. E. *curiatus*. Blackish; elytra yellowish with a black band; thorax with a fissure each side at base.—Inhab. U. S.

Body blackish-livid, with minute punctures: *clypeus* obtusely rounded, edge reflected: *antennæ* rufous, rather robust, a little serrate; second joint two-thirds the length of the third; ultimate joint hardly longer than the preceding one: *thorax* with a fissure in the posterior edge near the spines; spines not carinate, but the lateral edge is somewhat reflected: *scutel* oblong, concave: *elytra* with well impressed, punctured striæ; yellowish-white, with a dusky band on the middle expanding a little on the margin and suture: *feet* pale yellow.—Length three-tenths of an inch.

I obtained three specimens in June.

32. E. *sanguinipennis*, Nob. (Journ. A. N. S.). Closely resembles *præustus*, Fabr., which, however, has the colours much more vivid; the punctures rather larger and more dense, particularly those of the interstitial lines of the elytra; the thoracic spines longer; and the second and third joints of the antennæ of our species are more cylindrical.

33. E. *inflatus*, Nob. (Ann. Lyc. Nat. Hist.). Resembles *holosericeus*, Fabr., but is still more robust, the thoracic spines are longer, and the thoracic punctures more obvious.—Inhab. also Massachusetts. Harris.

34. E. *fenestratus*, Nob. (Ibid.). As respects the elytral spot, it may be compared to the *biguttatus*, Fabr., but is not much longer than the head and thorax of that species.

35. E. *obliquus*. Piceous; thoracic disc and elytra blackish; the latter with an oblique spot before the middle.—Inhab. Indiana.

Body yellowish-piceous, punctured, with yellowish hairs: *head* black: *clypeus* not much elevated, obtusely angulated at tip: *labrum* piceous: *antennæ* distinctly serrate; second joint two-thirds the length of the third; fourth to tenth subequal; ultimate one not suddenly contracted near the tip: *thorax* blackish on the disc; lateral edge arcuated near the anterior angles, rectilinear from before the middle to the tip of the spines; spines moderate, not distinctly carinate: *elytra* with punctured striæ, and slightly punctured interstitial lines; a very oblique yellowish band from the humerus, gradually dilating to the suture and terminating before the middle, leaving a rather large black scutellar area: *pectus* paler than the postpectus: *feet* paler than the pectus: *tarsi* and *nails* simple: *venter* with an obsolete darker vitta each side.—Length nearly one-fifth of an inch.

This species somewhat resembles the *areolatus*, Nob.

To this division of the genus must be added those species which I have described under the following names, viz.: *badius*, *erosus*, *rotundicollis*, *plebejus*, *erytropus*, *collaris*, *rubricus*, *mendica*, *silaceus*, *quercinus*, *basilaris*, and *areolatus*, as well as the *stigma* and *nigricollis*, of Herbst.

†† *Tarsal joints lobed beneath.*

36. E. *lobatus*, Nob. This species, Germar thinks, is the *castanipes*, Herbst; but it certainly cannot be *castanipes*, Fabr. The anterior part of the clypeus agrees with that of *Campylus*, Fischer.

37. *Bilobatus*. Dark chestnut; front indented; spines obtuse; second and third joints of the tarsi lobed beneath.—Inhab. Indiana.

Body dark chestnut, punctured, with numerous short hairs; *head* with large, very dense punctures: *front* a little concave: *clypeus* not prominent, rather depressed between the antennæ: *antennæ* a little paler; second joint rather more than half as long as the third; terminal joint abruptly smaller near the tip, so as to appear like two joints: *thorax* with the punctures as large as those of the head, but less dense; spines obtuse, not elongated, destitute of carina: *elytra* with deep striæ, in which are rather large, close set punctures; interstitial lines convex, with minute punctures: *feet*, colour of the antennæ, honey-yellow; second and third tarsal joints extended beneath into a membranaceous, rounded pulvillus.—Length less than seven-tenths of an inch.

This species may be distinguished by the obtuse thoracic spines, and the lobed second and third tarsal joints.

38. E. *inquinatus*. Honey-yellowish, head and suture blackish.—Inhab. U. S.

Body small, honey-yellow, with short hair: *head* dusky or blackish: *antennæ* pale: *clypeus* terminating anteriorly in a rectangle: *thorax* dusky on the anterior margin; lateral edge rectilinear; posterior angles acute; base each side with an elongated fissure: *elytra*, striæ distinctly punctured; sutural margin widely dusky at base, and tapering to the tip: *beneath* reddish brown: *feet* yellowish; *tarsi* with the penultimate joint only, obviously lobed.—Length under one-fifth of an inch.

This species occurs in Pennsylvania, and Dr Harris obtained it in New Hampshire, and from North Carolina.

39. E. *memnonius*. Brown more or less dark: *antennæ* rufous, compressed; length of the joints at least twice their terminal breadth; longer than the thorax: *head* densely punctured; front concave, anterior edge depressed in the middle by the concavity, but still elevated: *thorax* densely, not confluently punctured, convex, laterally arcuated, widest in the middle; posterior angles very little excurved, and at their tips somewhat incurved; carinated line nearly parallel with the edge, elevated and acute; basal edge with an acute sinus near the posterior angles: *elytra* with punctured impressed striæ; punctures nearer each other than their own length; interstitial spaces convex, densely punctured; third and fourth striæ abbreviated and confluent at tip; apicial margin a little elevated: *beneath*, margins and feet paler.—Length less than four-fifths of an inch.

E. *nemnonius*, Herbst, Melsh. Catal. p. 42.—Inhab. middle states. Terminal joint of the antennæ abruptly smaller at tip, and the thorax is longitudinally indented behind the middle.

40. E. *baridius*. Resembles the preceding, but is much larger, more robust, the thorax more rounded each side, the second and third striæ of the elytra abbreviated and confluent at tip.—Length over nine-tenths of an inch.

Of this I have seen but one specimen, which was sent me for examination by Dr Harris. It was taken in North Carolina.

41. *Hemipodus*, Nob. (Ann. Lyc. N. Y.). Black-brown : *antennæ* with obconic-compressed joints, not obviously serrate; second joint more than half the length of the third : thoracic spines rather short and obtuse : the carina parallel with the outer edge: *tarsi*, first, second and third joints extended beneath into pulvilli: *thorax* with a slight fissure on the basal margin, near the posterior angles.

42. E. *soleatus*. Chestnut ; clypeus prominent, rounded ; second and third tarsal joints extended beneath into a prominent lobe.—Inhab. Indiana.

Body dark chestnut brown, punctured ; with very numerous, short hairs, not prostrate: *clypeus* prominent before, and obtusely rounded: *antennæ* a little serrate, rufous; second joint not longer than broad, not more than half the length of the third: *thorax* rather convex, dorsal indentation none, excepting sometimes a very slight one at base ; lateral edge rectilinear from before the middle to the tip of the spines; spines not excurved, prominent, subacute, carinate ; the carina nearly parallel to the exterior edge : indentation between the thorax and abdomen deep ; *scutel* somewhat indented : *elytra* with punctured striæ, and with minutely and irregularly punctured interstitial lines : *beneath* rufous; second and third joints of the tarsi each extending beneath into a prominent, flattened, membranaceous lobe, that of the third much more obvious, rounded at tip, and extending much beyond the tip of the penultimate joint, which is very small.—Length from seven-twentieths, to more than eleven-twentieths of an inch.

This varies considerably in size, and the prominent obtuse clypeus, together with the elongated, membranaceous lobe of the antepenultimate tarsal joint distinguish it from other species. Resembles *cucullatus*.

43. E. *cucullatus*, Nob. (Ann. Lyc. N. Y.). May be distinguished from *soleatus* by the clypeus being obviously indented above, and more obtuse, almost emarginate on the anterior edge; the antennæ are more slender, and the last joint not, or hardly longer than the preceding one: *thorax* more slender, and the spines more obtuse, shorter, and rounded at tip: the larger lobe of the tarsi is not so prominent. The thoracic spines resemble those of *hæmoroidalis*, Fabr., but are more excurved.

44. E. *dilectus*, Nob. (Ibid.). The penultimate tarsal joint of this species is produced beneath into a membranaceous lobe. Near the description of *bilineatus*, Web., Fabr.

45. E. *vespertinus*, Fabr. The penultimate tarsal joint is minute, but is extended beneath into a dilated membranaceous lobe, half the length of the last joint. This species varies considerably; the elytra have generally a connecting black band beyond the middle; they are rarely nearly all black, with one or two small spots, tip and humerus testaceous: the thoracic vittæ are sometimes reduced to very small spots: scutel always testaceous.

46. E. *circumscriptus*, Germ. The penultimate tarsal joint is at least half the length of the last, and is produced beneath into a lobe.

47. E. *bisectus*, Nob. (Journ. Acad. Nat. Sc.). Penultimate tarsal joint remarkably short above, hardly visible, but produced beneath into a dilated lobe, two-thirds the length of the ultimate joint.

48. E. *exstriatus*, Nob. This is the E. *geminatus*, Nob. (Ann. Lyc. N. Y.). Elytra destitute of striæ; joints of the tarsi, excepting the terminal one, with dilated lobes beneath. I change the name, as that of *geminatus* was previously given by Germar to a Brazilian species.

49. E. *bellus*, S. (Journ. Acad. Nat. Sc. III., p. 168.). The penultimate tarsal joint is dilated beneath into a lobe. A very pretty little species.

50. E. *binus*. Black; with two large testaceous spots on each elytron.—Inhab. Indiana.

Body black, with short yellowish hairs, almost sericeous, punctured: *clypeus* rounded at tip, somewhat prominent: *antennæ* scarcely serrate, rufous; second joint more than half as long as the third; terminal joint not, or hardly, longer than the penultimate one: *thorax* on the lateral edge rectilinear from before the middle to the tip of the posterior spine, which is rather long, acute, carinate: *scutel* black: *elytra* with punctured striæ, and minutely punctured interstitial lines; on each a large testaceous spot, extending from the base nearly to the middle, not reaching the suture, and a smaller one beyond the middle: *pectus* in the middle piceous: *feet* honey-yellow: *tarsi*, penultimate joint minute, but extended beneath into a lobe, almost half the length of the ultimate joint.—Length from one-fourth to two-fifths of an inch.

51. E. *scapularis.* Clypeus concave; antennæ longer than the thorax; humerus yellowish.—Inhab. Indiana.

Head greenish black: *clypeus* somewhat prominent, obtusely rounded at tip, much indented above: *antennæ* longer than the thorax, serrate; second joint one-third the length of the third, which is dilated at tip like the following ones, and somewhat longer than the fourth: *thorax* greenish black, rather long; sides a little contracted before the spines; spines robust, not attenuated, rounded at tip and yellowish: *scutel* piceous: *elytra* dull yellowish on the basal margin; with rather deep striæ, punctured; interstitial lines rounded with transversely confluent punctures: *feet* piceous: *tarsi* with the second, third, and fourth joints dilated beneath into rather short lobes, that of the third much wider and more prominent; fourth joint more than half the length of the third; ultimate joint equal in length to the first, and equal to the second, third and fourth taken together.—Length less than two-fifths of an inch.

This is rather slender, and the yellowish bases of the elytra are distinguishing and obvious characters.

52. E. *acanthus.* Brown; clypeus concave above; spines compressed, short, rounded.—Inhab. Indiana.

Body rather slender, punctured: *head* blackish brown, with small punctures more distant than the length of their diameters: *clypeus* prominent, obtusely rounded before, and concave above: *antennæ* longer than the thorax, not serrate; second joint more than half the length of the third: *thorax* blackish brown; long, lateral edge rectilinear, hardly broader behind than before; anterior angles a little prominent, and slightly truncate; punctures not discoidal, small, profound, and more distant than the length of their own diameters; spines very short, rounded at tip, compressed, without carina, and reflected a little from the side: *elytra* paler, with dilated, punctured striæ, and transverse wrinkles on the interstitial spaces: *beneath*, excepting the pectus, rather paler than the elytra: *tarsi*, second and third joints produced beneath into membranaceous lobes, that of the third more prominent; fourth joint minute, hardly wider than the base of the ultimate joint.—Length three-tenths of an inch.

Very much like *cucullatus*, S.; is smaller and more slender; the punctures of the head and thorax are not discoidal, as in that species, and the thoracic spines are entirely destitute of carina, are more obtuse, compressed, and reflected from the sides. Rare.

53. E. *claricollis.* Black; antennæ, mouth, and feet yellowish; thoracic spines very short, without carina.—Inhab. Indiana.

Body black, polished; punctures minute and remote: *clypeus* not prominent, tip a little reflected and rounded: *antennæ* hardly as long as the thorax, not serrate, yellowish; first joint robust; second joint but little shorter than the third; terminal joint not longer than the penultimate one: *mouth*, excepting the tip of the mandibles, honey-yellow: *thorax* polished, a little narrowed at the anterior angles; lateral edge almost rectilinear, or hardly perceptibly arcuated from near the anterior angles to the base; spines very short, obtusely rounded, without any carina: *scutel* large, angulated behind: *elytra* with punctured striæ; interstitial lines with minute, distant punctures: *pectus*, in the middle near the mouth, honey-yellow: *feet* pale yellow; *tarsi*, fourth joint small, but produced beneath into a dilated lobe; terminal joint shorter than the first.—Length one-fourth of an inch.

The thorax is remarkably polished.

54. E. *finitimus.* Dusky, obsoletely margined with rufous; tarsi, fourth joint lobate.—Inhab. N. Carolina.

Body with dense, small punctures, black brown: *vertex* longitudinally indented: *clypeus* obtusely rounded before, prominent: *antennæ* pale rufous, third joint a little longer than the second, terminal joint not obviously contracted abruptly towards the tip: *thorax* rather narrowed anteriorly, with an obsolete, dull, rufous margin and dorsal line;

posterior angles very slightly excurved, rather long, acute, with the carinated line very near to the edge: *scutel* dull rufous: *elytra* with the striæ impressed, not confluent, and in which the punctures are not very obvious; interstitial lines depressed; an obsolete, rufous, humeral spot, and another on the middle of the exterior submargin: *beneath* pale rufous: *feet* paler; penultimate joint of the *tarsi* with a membranaceous lobe.—Length three-tenths of an inch.

The body is more elongated than either *dilectus*, S., or *bisectus*, S. I am indebted to Dr Harris for an opportunity to examine a specimen.

55. E. *decoloratus*, Harris, MSS. Black; elytra, antennæ and feet rufous.—Inhabits New Hampshire and Pennsylvania.

Body blackish, with pale hairs, and minute punctures: *clypeus* with larger punctures than the thorax; two obsoletely impressed diverging lines; anterior edge subangulated, and the angles so depressed as to appear confluent with the anterior part of the head: *antennæ* rufous, a little hairy; second joint two-thirds the length of the third; last joint longer than the first, not abruptly contracted towards the tip: *thorax* convex, blackish; base with a fissure each side; posterior angles pointing backward, rather obtuse and somewhat broad, with the carinated line rather short, and not much elevated: *elytra* dull rufous; impressed, slightly punctured striæ, more deeply indented at base, and the third and fourth confluent before the tip: *feet* pale rufous; fourth joint of the *tarsi* not so distinctly lobed as the preceding joints.—Length half an inch.

Rare in Pennsylvania. Approaches the description of E. *semirufus*, Germar, which, however, I believe to be smaller.

††† *Tarsi dilated, operculiform.*

56. E. *marmoratus*, F. Our largest species of this division that I have seen. I have found it as far north as Canada, and Mr Nuttall presented me a specimen from Arkansa. It occurs both in Pennsylvania and Indiana, and Dr Harris sent to me a specimen which was found in N. Carolina. The thorax may be described as unequal, as it has several indentations; the pectus has deeply impressed tarsal grooves; and the clypeus is concave.

57. E. *operculatus*, S. (Ann. Lyc. N. Y.*). Belongs to this division. Dr Harris sent me specimens from Massachusetts and New Hampshire.

58. E. *auroratus*. Blackish, sprinkled with golden scales; pectoral tarsal impressions not profound.—Inhab. New Hampshire.

Body blackish, punctured, with bright yellow scales: *clypeus* not conspicuously concave before: *thorax* convex; a longitudinal, impressed, but not much dilated line, obsolete on the anterior third; lateral edge regularly arcuated to the origin of the posterior angles, which are rather broad, acute, and extending outward and backward, with their exterior edge perfectly rectilinear to the tip; basal edge sinuous: *elytra* destitute of elevated lines at base: *pectus*, tarsal impressions not deeply marked, but distinct, concave: *tarsi* rufous.—Length eleven-twentieths of an inch.

Sent to me for examination by Dr Harris. The lateral edge of the thorax is not undulatedly arcuated, as in E. *marmoratus*, F., and E. *operculatus*, S.

59. E. *obtectus*. Thorax with a much dilated groove; elytra with elevated lines at base, one of which extends beyond the middle.—Inhab. Massachusetts.

Body blackish piceous: *clypeus* transversely concave before: *thorax* rather short and wide; dorsal groove much dilated, the top of its lateral elevations being equidistant from the middle of the exterior edge; exterior edge arcuated, not undulated; lateral margin broadly depressed; posterior angles rather broad, extending outwards and backwards, their exterior edge rectilinear to the tip: *elytra* with elevated, obtuse lines at base, one of which is obliquely elongated and is obsolete behind the middle: tarsal groove of the *pectus* none.—Length three-fifths of an inch.

For this species I am indebted to Dr Harris. It is as large as *marmoratus*, F., and *operculatus*, S., to the latter of which it approaches in being destitute of the tarsal grooves of the pectus, and in the short, wide thorax; but it differs from it in the more regular arcuation of the lateral edge of the thorax, the exterior edge of the posterior angles

* [This is an error. There is no species in the Ann. Lyc. N. Y. bearing the name of *operculatus*. Is it not the *erosus*, S., Ann. Lyc., I., p. 258?—H.]

being rectilinear, and in the crimped appearance of the base of the elytra, &c.

60. E. *discoideus*, Weber.* Remarkable by the golden hairy head and sides of the thorax. This is the *pennatus*, Fabr.; but Weber's name has the priority, and must therefore be adopted.

61. E. *lepturus*. Blackish; spines acute; elytra with approximated series of punctures.—Inhab. U. S.—Pennsylvania, Indiana, and North Carolina. Harris.

Body black-brown, punctured, rather slender: *clypeus* concave, truncate at tip, and emarginate each side at the insertion of the antennæ: *antennæ* rufous, serrate; second joint not half the length of the third: *thorax* with a dorsal, slightly indented line; lateral edge not arcuated; a little narrowed before, and contracted at the spines; spines excurved, acute: *scutel* rounded behind: *elytra* with approximate series of deep punctures, with an appearance of striæ, the series alternately larger: *pectus*, tarsal grooves obvious.—Length two-fifths of an inch.

Resembles *discoideus*, Weber, but is always destitute of the golden hair of the head and thorax. It is the *lepturus* of Melsheimer's Catalogue.

62. E. *impressicollis*, S. (Ann. Lyc. N. Y., I., p. 260.). Resembles *lepturus*, S.; but may be distinguished by its ferruginous colour.

63. E. *rectangularis*, S. (Ann. Lyc. N. Y., I., p. 263.). The posterior angles of the thorax are rectangular, and the antennæ remarkably short.

64. E. *avitus*. Blackish; rather long; scales yellow and black; spines acute, hardly excurved.—Inhab. Indiana.

Body black, with a slight tinge of piceous, punctured; scales intermixed, black and bright yellow; rather slender: *clypeus* hardly elevated before; anterior edge very obtusely arcuated, a little concave: *antennæ* serrate, rufous; second joint small, subglobular: *thorax* with an obtusely indented line behind the middle; lateral edge very slightly arcuated, and slightly excurved at the spines; spines very slightly excurved, acute, not carinated: *scutel* concave, rounded behind: *elytra*

* "Observationes Entomologicæ." This work, which was presented to me by Professor Wiedeman, was published in the same year with the Syst. Eleut.; but, as Fabricius quotes Weber's work, the priority of the latter is evident.

with hardly perceptible, raised, obtuse lines; punctures profound, densely and irregularly set: *feet* piceous: *pectus*, tarsal grooves none.—Length eleven-twentieths of an inch.

Smaller than E. *marmoratus*, F., and more slender, with a more equal thorax; larger than E. *lepturus*, S., *discoideus*, Weber, *impressicollis*, S., and *rectangularis*, S., and the punctures of the elytra are not in regular series. It seems to approach nearer to E. *operculatus*, S., but the elytra are more obtuse at tip, and have much more profound, large, and close set punctures. I have not now an entire specimen of the latter species, and therefore cannot compare with the anterior part of the body.

†††† *Claws pectinated.*

65. E. *corticinus*, S. (Journ. Acad. Nat. Sc., III., p. 174.). The second and third joints of the antennæ are rounded, equal. The basal margin of the thorax has a fissure each side, near the lateral spines. It varies in size. The smallest one that I have seen is seven-twentieths of an inch. Can it be the *dispar* of Herbst?

66. E. *cinereus*, Weber. Second joint of the antennæ about half the length of the third: the thorax is more rounded at the sides than the preceding. It varies considerably in size. The basal margin of the thorax has a fissure each side.—Length from three-tenths to seven-tenths of an inch. The former size is rare; but the more usual length is about half an inch.

This is the *vulgaris* and *pilosus* of Melsheimer's Catalogue. It resembles the *brunnipes*, Ziegler; but the thoracic punctures are rather larger, and less crowded, the thoracic spines are longer and more acute, and the second joint of the antennæ is a little longer in proportion to the third.*

* [Among Mr Say's manuscripts is a description of the *cinereus*, under the rejected name of *fissilis*, which, as it contains the characters of this species somewhat in detail, it may be proper to insert here.]

E. *fissilis*. Brown; base of the thorax with a fissure near the posterior angles.—Inhab. U. S.

Body chestnut-brown, punctured, somewhat sericeous with short hairs: *head* convex: *clypeus* rounded at tip: *antennæ* rufous; second joint half as long as the third; ultimate joint not abruptly contracted near the tip: *thorax* with the lateral edge regularly arcuated, not con-

67. E. *communis*, Schönherr, is much like the preceding, but the thorax is canaliculate.

68. E. *insipiens*, S. (Ann. Lyc. N. Y., I., p. 267.). The fissure in the posterior margin of the thorax, near the spines, is distinct.

69. E. *recticollis*, S. (Journ. Acad. Nat. Sc., III., p. 168.).*

Distinguished from the preceding species by the lobed joints of the tarsi. In those species the joints have projecting hairs beneath, but not lobes. The clypeus descends rather low, and is almost rectangular at tip.

70. E. *quietus*. Black; antennæ and labrum rufous; palpi and feet pale yellow.—Inhab. Indiana.

Body black-brown; sericeous with short, yellowish hairs; slender; with numerous, minute, but not close set punctures: *clypeus* very obtusely angulated in front, almost rounded: *antennæ* rufous, not serrate; first joint rather long, and a little arcuated; second and third joints subequal, the second rather longer and more robust: *labrum* rufous, prominent: *thorax* rectilinear on the lateral edge from near the ante-

tracted near the spines; spines rather short and somewhat obtuse, sub-bicarinate; basal margin, near the lateral spines, with a distinct fissure: *elytra* with punctured striæ, and depressed, minutely punctured interstitial lines; suture somewhat paler: *feet* dull rufous: *tarsi* beneath with rather dense hairs: *nails* pectinated.—Length over half an inch.

The thoracic fissures readily distinguish this species. I formerly marked it in my cabinet interrogatively as the *brevicollis*, Herbst; but it can hardly be that species, as no notice is taken of the fissures. Can it be the *cinereus*, Weber?

* [The following description, which was marked to be omitted by Mr Say, contains several characters not laid down in the Journal of the Acad. Nat. Sciences on the page above quoted. It seems to apply rather to a variety of the *recticollis* that was proposed originally by Mr Say as a distinct species, under the name of E. *inscius*, but was subsequently referred to the previously described E. *recticollis*. For the reasons above stated, it may be useful to insert the rejected description in this place. T. W. H.]

E. *recticollis* (*inscius*, S., MSS.). Brown; clypeus subangulated before; suture dusky.—Inhab. Indiana.

Body light brown, somewhat sericeous, with yellowish hairs, and with numerous minute punctures: *clypeus* but little elevated, tip obtusely angulated: *antennæ* hardly serrate, pale rufous; first joint rather long, arcuated, robust; second and third joints subequal: *head* dusky: *thorax* dusky on the middle; lateral edge nearly rectilinear, arcuated at the anterior angles, and a little excurved at the spines; not elongated; spines acute, not carinate; posterior edge with a fissure from which a line extends forward upon the margin: *elytra* with punctured striæ and minute punctures on the interstitial lines; sutural margin dusky: *beneath* piceous: *pectus* honey-yellow: *feet* honey-yellow: *tarsi*, third and fourth joints lobed beneath.—Length less than one-fourth of an inch.

rior angles, where it is hardly arcuated, to the tip of the spines; spines acute, carinate; the carina, as in the preceding species, forms the apparent edge, and extends more than half the length of the thorax; posterior edge with a fissure each side, extending in an obvious line upon the margin: *scutel* angulated obtusely behind: *elytra* with punctured striæ and minutely punctured interstitial lines: *beneath* black piceous: *feet* pale yellow; *tarsi*, third and fourth joints lobed beneath; *nails* pectinated with but few rather robust teeth.—Length less than one-fifth of an inch.

Closely resembles the preceding, but is more slender, the pectens of the nails have fewer teeth, and the clypeus is much more obtuse at tip, and the colour is different.

71. E. *pertinax.* Black; antennæ and feet rufous; punctures sparse.—Inhab. Pennsylvania. Massachusetts, Harris.

Body black, immaculate, with distant grayish hairs: *clypeus* with large punctures, anteriorly obtusely rounded and elevated, the edge a little reflected: antennæ rufous; third joint a little longer than the second: *thorax* with distant punctures and hairs; lateral edge nearly rectilinear behind the middle, the posterior angles divaricating but slightly outwards; base with the lateral fissures rather long: *elytra* with regular series of punctures, the striæ not being impressed, excepting at base and the sutural one: *feet* rufous.—Length seven-twentieths of an inch.

72. E. *tenax.* Black; antennæ and feet rufous; posterior thoracic angles not excurved.—Inhab. Massachusetts.

Closely resembles E. *pertinax*, S., but is much smaller; the punctures of the thorax are much more numerous, the posterior angles not at all excurved: *elytra* with the striæ distinctly impressed and punctured, the interstitial spaces with rather large punctures: *feet* rufous. —Length less than three-tenths of an inch.

For this species I am indebted to Dr Harris.

EUCNEMIS, *Ahrens?* *Mannerheim.*

† *Pectus not inflected at the edge, nor canaliculate beneath, to receive the antennæ.*

* *Tarsi simple.*

1. E. *muscidus*, S. (*Elater muscidus*, Ann. Lyc. N. Y., I., p. 256.). The largest known species of the United States.

2. E. *unicolor*, S. (*Elater unicolor*, Ann. Lyc. N. Y., I., p. 255.). Also a large species.

3. E. *heterocerus.* Light brown, sericeous; three last joints of the antennæ largest.—Inhab. Indiana.

Body light reddish brown, sericeous, with bright yellow hair; punctures minute, universal: *antennæ*, first joint as long as the three next together; second joint smallest; third nearly as long as the two next; fourth, fifth, sixth, seventh and eighth short, equal; remaining joints each nearly as long as three of the preceding ones together, and somewhat dilated: *thorax* with an indented line at base; spines prominent, acute: *scutel* rounded behind: *elytra* with impunctured striæ: *pectus* on the lateral margin slightly concave.—Length half an inch.

The singular form of the antennæ will distinguish this fine species from any other yet known. It will form a separate genus.

4. E. *quadricollis.* Head and thorax with large crowded punctures; posterior thoracic angles nearly rectangular.—Inhab. Indiana.

Body piceous black, with yellowish hairs: *head* with crowded, large punctures, longitudinally confluent on the vertex: *antennæ* rather distant at base, not seated in approximated sinuses, but under frontal elevations; second joint more robust than the third, and equally long; fourth joint rather longer than the third; remaining joints obconic, subequal, the last a little longer: *palpi*, terminal joint oval: *thorax* transverse quadrate, with punctures like those of the head, but not much confluent; anterior angles rounded; lateral edges nearly parallel, very slightly contracted towards the posterior angles, which are nearly rectangular, a little acute, not continued backward beyond the line of the base: *elytra* with punctured striæ and minutely punctured interstitial lines: *pectus* with less crowded punctures than the thorax:

middle segment very broad; no groove: *feet*, like all beneath, dark piceous; *tarsi* a little paler.—Length over one-fourth of an inch.

This species is not perhaps in all its characters perfectly coincident with those of the genus, particularly in the remote origin of the antennæ; but the form of the præsternum and the great inflection of the head agree very well.

5. E. *frontosus*. Antennæ submoniliform; thorax indented each side of the middle.—Inhab. Indiana.

Body blackish piceous, with short yellowish hair, punctured: *front* longitudinally indented: *antennæ* ferruginous, serrato-moniliform; basal joint arcuated, obliquely truncated at tip; second joint arcuated at base: *thorax* with a longitudinal impressed line, and an indentation each side of the middle; posterior angles prominent: *elytra*, striæ not deeply impressed: *feet* piceous.—Length one-fifth of an inch.

The very short and submoniliform joints of the antennæ, as well as the general form of the body, give to this species a resemblance to the *monilicornis*, Mannerh., but the thoracic indentations, &c. distinguish it.

6. E. *ruficornis*, S. (*Melasis ruficornis*, Journ. Acad. N. S., III., p. 165.). This species, having a very small spine, and slight indentation instead of a recipient cavity, may perhaps be placed here. By the very robust antennæ it seems to approach the genus *Nematodes*, Latr.

7. E. *obliquus*. Elytra black, inner portion, bounded by a line from the middle of the base to beyond the middle of the length, yellowish.—Inhab. Indiana.—Length less than one-fifth of an inch.

In general form, and in its antennæ, this species resembles the *ruficornis*, S.

* * *Tarsi, terminal joint short and dilated.*

8. E. *atropos*. Thorax with two impressed dots and dorsal line.—Inhab. Indiana.

Body blackish piceous, somewhat sericeous, with bright yellow hair, minutely punctured: *head* with the hairs radiating from the middle of the front: *antennæ*, first joint as long as the three next together, hardly arcuated; second joint at least as long as the fourth; third nearly equal to the fourth and fifth together; remaining joints rather larger than the fourth and fifth: *thorax* convex before, almost vertical at the sides;

like the head, dark chestnut; a well impressed dot each side, a little before the middle; an impressed, acute, longitudinal line behind the middle, extending obsoletely to the anterior edge; spines prominent, acute: *scutel* with a slightly impressed line: *elytra* blackish, with impunctured striæ; punctures towards the base somewhat transversely confluent: *pectus* with the lateral margin slightly concave: *tarsi*, penultimate joint extended beneath into a lobe, a little dilated and truncated.—Length three-tenths of an inch.

Behind each of the dots of the thorax is an abbreviated, obsolete, impressed, transverse line. The dots of the thorax are more anterior than those of the *pygmæus*, Fabr.

†† *Pectus canaliculate on the lateral margin.*

9. E. *calceatus.* Reddish brown: an elevated line on the front over the base of the antennæ.—Inhab. Indiana.

Body reddish brown, or chestnut, slightly sericeous, and with minute punctures: *head* blackish, with an obvious, transverse, raised, glabrous line over the antennæ, a little advanced in the middle: *antennæ* chestnut; first joint about as long as the head, somewhat robust, obliquely truncated at the end; second hardly shorter, but less robust than the third, attenuated and arcuated at base, at its junction with the first joint; fourth joint a little shorter than the third; remaining joints gradually a little longer to the tip, subequal: *thorax* dusky, not elevated; dorsal line hardly perceptible, even at base; spines prominent, acute: *elytra* rather slightly striate; striæ impunctured: *beneath* particularly sericeous: *pectus* with the lateral groove well marked: *tarsi*, penultimate joint with a short, rather broad lobe beneath.—Length from one-fifth to three-tenths of an inch.

10. E. *cylindricollis.* Black; thorax longitudinally and widely indented behind.—Inhab. Indiana.

Body blackish, a little sericeous, subcylindric, minutely punctured: *antennæ* dark rufous, shorter than the thorax; first joint cylindrical, hardly arcuated, at base rather abruptly narrowed, at tip obliquely truncated, blackish; second joint obconic, attenuated and arcuated at base; third longer than the two following ones together; remaining ones to the last, subequal; terminal one nearly as long as the third: *thorax* obscurely subiridescent, subcylindric, the sides being almost parallel; not remarkably elevated; behind the middle a much dilated, oblong triangular, rather deeply indented line, extending to the base; spines acute, not much elongated: *scutel* rounded at tip: *elytra* with the striæ obsolete, the subsutural obvious: *pectus* with the lateral groove very obvious: *tibiæ* and *tarsi* rufous; penultimate tarsal joint produced beneath into a dilated, obtuse lobe.—Length less than three-tenths of an inch.

The dilated, elongate triangular indentation, or dilated dorsal line, extending from the undule to the base of the thorax, is probably somewhat similar to that of the *capucinus*, Ahrens; but the general form is much more cylindric.

11. E. *clypeatus*, S. (*Elater c.*, Ann. Lyc. N. Y., I., p. 266.).

12. E. *amænicornis*. Black; antennæ pectinate, second and third joints, and feet rufous.—Inhab. Indiana and New Hampshire.

Body small, black, densely punctured above and beneath: *antennæ* with a process on each joint excepting the three basal ones, black, the second and third joints dull rufous: *thorax* convex, simple; posterior angles a little excurved, acute, without carinated line; base without fissures: *elytra*, third and fourth striæ only half the length of the elytra: *feet* rufous.—Length over three-twentieths of an inch.

Resembles E. *pygmæus*, Fabr., but the thorax is without indentation. I obtained two specimens in Indiana, and received one from Dr Harris.

††† *Pectus canaliculate each side of the middle.*

13. E. *triangularis*, S. (*Elater t.*, Journ. Acad. N. S., III., p. 170.).

Antennæ, first joint slightly arcuated, obliquely truncate at tip; second obconic, small, arcuated at base: *thorax* with an impressed line behind the middle; anterior margin piceous.

It occurs in Indiana as well as Missouri.

14. E. *humeralis*. Black; elytra rufous at base.—Inhab. Indiana.

Body black, minutely punctured, and with minute hairs; *front* with an obsolete indented line: *antennæ* rather hairy; first joint slightly arcuated, obliquely truncate at tip; second obconic, arcuated at base; third shorter than the two following ones together; remaining joints subequal, to the last, which is a little longer; *thorax* convex, but not much elevated: *elytra* striate; basal fourth rufous: *feet* rufous: *pectus* distinctly canaliculate each side of the middle.—Length three-twentieths of an inch.

Note.—I am indebted to Count Mannerheim of St Petersburg, Russia, for his excellent observations on this genus. His descriptions are detailed and perspicuous. I have adopted, for the present, his views of this genus.

THROSCUS, *Latr.*

T. *constrictor.*

This species is the approximate analogue of the *adstrictor*, Fabr., of Europe, to which I had always referred it: but on comparing our insect with a specimen of the *adstrictor*, for which I am indebted to the politeness of Professor Germar, I am inclined to consider it a distinct species, and I give to it the above name, which that distinguished entomologist proposes in his letter. This insect, compared with the *adstrictor*, is of a paler colour, and a little different in form; being less attenuated behind; in size it is much the same; it is also somewhat more obviously punctured.

ARTICLE III.

Notice of a Vein of Bituminous Coal, recently explored in the vicinity of the Havana, in the Island of Cuba. By Richard Cowling Taylor, Esq., F. G. S., and Thomas G. Clemson, Esq. Read August 19, 1836.

THE bituminous coal mine of Casualidad is situated about three leagues east of the city of Havana, and on a main road (Camina Real) leading to the city of Guanabacoa, from which place it is distant six miles, and from the sea at a place of embarkation, only two miles.

The surface of the country, from Guanabacoa eastward to the mining property above mentioned, is undulating, and partakes of those characters which are so marked elsewhere in this island, where the serpentines and the euphotides are the predominant rocks.

In leaving Regla, on the south side of the bay of Havana, the euphotides, which Monsieur de Humboldt has described here, and which we found also to exist, with similar characters, in the district of Halguin, towards the northeastern end of the island, are here evidently the most predominant rocks; occupying a breadth of about two leagues, within which area the city of Guanabacoa and the adjacent Petroleum springs are situated.

Having next passed a belt of about a mile in breadth of white rock, succeeded by a narrow slip of serpentine, and again by a similar white rock, which we had not sufficient leisure to examine closely, we arrived within half a mile of the coal vein in question, when a fragile, dirty-gray coloured argillaceous rock succeeds, which alternates with the euphotides.

Towards Guanabacoa, and indeed throughout a large portion of the island of Cuba, the prevailing course of the rocks is about east and west; but in the vicinity of the coal we unexpectedly found that the direction is changed to north and south.

The coal vein of Casualidad is visible at opposite extremities of an excavation thirty feet deep, of a quadrangular form, descending on one side by steps cut in the soft rock or clay, which bounds the coal on either side. This soft rock is fragile, incoherent, distorted; of a yellowish green colour, like the prevailing euphotides, of which it is a variety. A few feet to the eastward of the vein, there occurs a hard, blue, siliceous rock, containing small cavities, that are partially filled with a leek-green mineral, which we conceive is a variety of serpentine. In close connection with the above, a beautiful diorite occurs, the base of which is petrosiliceous, tinged with green; which colour is caused by a mixture of serpentine. This rock is very hard, and has a highly crystalline structure. It crops out at several points.

The siliceous, blue rock, the diorites, and the euphotides, alternate the one with the other. The two first mentioned are in much less proportion than is the third, which is by far the most predominant rock of the country.

All these are highly inclined, and frequently vertical: their direction, as before stated, being north and south in the neighbourhood of the mine.

Appearance of the Coal Vein.

The vein commences, or crops out, immediately under the alluvial soil of the surface, and follows an irregular but nearly perpendicular direction downwards, as shown in the drawing.

It is visible to the depth of full thirty feet. The bottom of the excavation was covered with mud, washed in during the rainy season, so that we could not there readily define the breadth of the vein; but it was stated by the overseer to be nine feet. From this pit many tons of pure coal have been extracted.

On the north side of the excavation the vein is solid; having a thickness gradually increasing to four feet.

The coal is formed in parallel layers of from one to four inches in thickness. Sometimes these layers, instead of being perfectly horizontal, are slightly curved, especially towards their extremities. This is particularly the case where an accidental derangement has taken place in the vein. On its sides, near the walls of the vein, the coal for a few inches in breadth is deflected, as if it had been pressed by the sides or walls. Here the structure becomes baccillary, and the coal, on the slightest effort, divides into irregular polyhedrons. The surface of this coal, when detached from the walls, instead of being smooth, or covered with any kind of bituminous shale, is rough, and presents a baccilo-fibrous appearance, similar to the structure observed in arragonites and other fibrous minerals. Two or three small branches, or filons, are seen passing from the main vein at about the depth of twenty feet, occupying smaller fissures in the rock.

On the south side of the opening, the coal, in rising towards the surface, parts off into two separate veins, and is apparently more disseminated through the rock than on the north side, as may be seen in the ground plan accompanying this article.

We have here, in the strictest sense of the word, *a coal vein*, and unlike any we have before witnessed in any part of the world! It is distinguished from the ordinary deposites of coal, inasmuch as they occur in distinctly stratified beds, and almost invariably exhibit abundant traces of organic remains, for the most part of vegetable origin: whereas we have here before us what was evidently, originally, an irregular open fissure, terminating above in a wedgelike form, having various branches, all of which have been subsequently filled with carbonaceous matter, as if injected from below, and that not by slow degrees and by an infinite succession of depositions, but suddenly and at once.

This coal is wholly unaccompanied by traces of vegetable remains, or by the beds of bituminous or other shales, which almost invariably envelope or accompany ordinary coal seams, whether in secondary or transition formations. The layers, of which we have spoken, are for the most part horizontal; that is to say, at right angles to the sides of the vein; and when otherwise are accidental, or are produced by an after cause. This fact, together with the baccilo-fibrous structure, observed where the coal is in contact with the walls, are among the reasons which lead us to lean towards the supposition that the fissure was charged or filled at once, and that these characteristics are the result of the carbonaceous matter having passed to a more solid state in its present position.

It would be rash to pronounce an opinion on the presumed extent of this deposite, as well as on the probable magnitude of the vein below the point at which it is visible, or the depth to which we have had access; but if the vein continues to enlarge downwards, in the same proportion as it has augmented in the first thirty feet, or even if it holds the present breadth of nine feet, the quantity of this mineral must be very great, and will prove a highly acceptable discovery, so near a great city, and in a district from which nearly all the timber for fuel has been long ago removed.

Quality of the Coal.

This coal is unusually light: its specific gravity being not more than 1·142; and two other experiments on heavier specimens gave 1·18, 1·19.

It is perfectly jet black; having a resplendent lustre, which is much greater in one sense, or under one aspect, than in the other, and it divides in parallel layers in the mass. The surface of the divisions, or partings, in the coal, is brilliantly shining. Its cross fracture is rough, and has a glimmering, pitchy appearance.

We have now to advert to an external character, which is very common, and in fact is of constant and universal occurrence in this coal; a feature which distinguishes it from all other coals which have come to our knowledge, in any quarter of the globe. Its horizontal fracture or surface is marked by numerous concentric, or rather eccentric, rings of various sizes, from a twentieth part of an inch to a foot in diameter. They are perfectly regular and uniform in shape, smooth, shining; resembling the impressions made by a seal in black wax; or, when first seen, appear like the casts of the flat valves of some shells.

This coal is exceedingly friable, breaking into small fragments under the hammer. Its powder is brown, and when pressed under the pestle, takes a polish like certain resinous substances. It burns with much flame and smoke; melts, and gives a light voluminous cake, which, when incinerated, leaves comparatively a small proportion of cinders or ashes.

The following analysis, which was made by one of us, gave, per cent, as follows:

Volatile matter (gas, &c.), ...	63·00
Carbon, ...	34·97
Ashes, ...	2·03
	100.00

The foregoing examination of this bituminous coal, fixes definitively the respective proportions of its component parts; consequently, it determines the applications to which that combustible would be the best adapted. Its quality of burning with a long, licking flame, gives it many advantages for evaporating, heating surfaces, &c., over many combustibles which contain a smaller quantity of volatile matter.

For the generating of steam power, for the boiling or concentrating the juice of the sugar cane, or for the manufacture of gas, this coal is singularly well adapted. As it contains no sulphuret of iron, the gas manufactured would be free from that very deleterious portion or admixture, which it is so difficult to separate from those gases usually manufactured from bituminous coals containing sulphur. It might also be employed with advantage in manufacturing lamp black (noir de fumée).

Quantity.

As we have no knowledge of coal being ever before found in formations similar to those in which the mine of Casualidad occurs, no opportunity is offered us of reasoning from analogy, and from the experience derived from similar deposites. It will therefore be admitted that, whatever observations we might be induced to hazard, concerning the extent of carbonaceous matter existing here, they would necessarily be founded more or less upon conjecture.

The outcrop of this singular vein was accidentally discovered where the public road winds down the point of a small ridge, and is worn down sufficiently deep to expose the coal and attract attention.

In whatever way we may account for the origin of this remarkable coal deposite, in a rock of this age, we must be led to view it, in some measure, in connection with the petroleum which is found in the rocks of this region. We observed it in a liquid form, filling cavities in a mass of chalcedony, a few yards only from this coal vein; and whilst breaking fragments of various rocks in this vicinity, during a hot day, we perceived a strong odour of pitch or tar arising after every blow of the hammer.

The Petroleum springs, which rise from the fissures in the serpentine at Guanabacoa, two leagues to the west, have long ago attracted attention.

Round the bay of Havana, petroleum is still collected at low water, under the name of *chapapote*, and is employed, in the manner of tar, for paying vessels.

It is matter of history that Havana was originally called, by the discoverers of the island, by the name of *Carine*, because there they careened their ships, and pitched them with the tar which they there found washed on the shores of this beautiful bay.

The position we have described is not the only one in the island of Cuba where this remarkable variety of coal exists. It has been observed between the cities of Havana and Matansas, not far from the sea coast.

We are not aware that any other of the West India islands contain coal in sufficient quantity to be worked. In Jamaica it appears, on the authority of M. De la Beche, coal exists in veins of an inch or two in thickness, occurring stratified with the usual coal measures and carboniferous rocks: but these veins are too insignificant to be worth mining.

Of the geology of St Domingo we know very little, and shall probably remain ignorant for some time to come.

It were an interesting fact, if it be, as we conceive, that this is the first discovery within the tropics (in this part of the globe at least) of workable veins of remarkably pure coal.

ARTICLE IV.

Observations on the Changes of Colour in Birds and Quadrupeds. By John Bachman, D.D., President of the Literary and Philosophical Society of Charleston, S. C., &c. Read May 19, 1837.

No attentive observer of nature can have failed to remark the striking and wonderful mutations to which some birds and quadrupeds are subject, from the young to the adult state, and at different periods of the year. The young of our Indigo bird, and Blue Grosbeak, are clothed with brown, but in the adult state are brilliantly blue. The young of the Painted Bunting is of an humble ash colour; and, after undergoing a succession of changes, puts on a livery of bright purplish lilac, vermilion and glossy green. The young of the White Ibis and the Whooping Crane wear a homely brown garb, whilst the adult is pure white; on the other hand, the young of our Blue Heron and Reddish Egret are white; and the adult in the one case bright blue, and in the other rufous. There are other birds, such as the Reed bird, the American Goldfinch, the Yellow crowned Warbler (S. *coronata*), and various species of Gulls and Sandpipers, that disguise themselves so during six months of the year, whilst on their migrations, as to be with difficulty recognisable. Some of our quadrupeds also, as if seeking for notoriety, at one season are clothed in white; and, as if courting obscurity in the other, assume the humbler dress of the earth and the dried leaves around them. To account for these mutations, or even to describe the process by which they are effected, has been a source of much perplexity to naturalists and philosophers. In Europe, Cuvier, Temminck, Yarrell, Drs Flemming and Whitear, Mr Montagu, and several writers in the recent numbers of the journals of Paris, Dresden and Halle, have indulged in various speculations, and adopted a number of contradictory theories. Some have contended that birds moult but once, others twice a year; some that the annual mutations are produced by a gradual fading or brightening of the feathers; whilst others have contended that it is produced by a sudden moult. Dr Flemming, who adopts the theory that the feathers of birds do not arrive at maturity and drop off till they are a year old, supposes that those feathers which are received in spring, remain till the following spring, and that those added in autumn, moult on the succeeding autumn, thus making two irregular moultings in a year. One school of naturalists has supposed that the change in those quadrupeds which become white in winter, is effected by the gradual lengthening and blanching of the summer fur; whilst another presumed that this wonderful mutation can only occur by a shedding of the summer hair, which is replaced by the snowy pelage of winter. In our own country, few observations have been made on this subject. Our celebrated ornithologists, Wilson, Bonaparte and Audubon, appear to have dwelt very sparingly on the changes of plumage in birds, which, however overlooked, seems to belong to their department; and, with the exception of a paper by Mr Ord, in the Transactions of the American Philosophical Society, I do not recollect having read any article on this department of the physiology of birds and quadrupeds. In our investigations of nature, we are perhaps too prone to build our theories first, and afterwards seek for the facts which are to support them. Hence, naturalists, having the same field of inquiry before them, and reading from the same book of nature, which is open to all, are very apt to be swayed by their preconceived notions, and thus retard the progress of science by unprofitable disputes.

The time perhaps has not yet arrived, when any certain theory can be built on this part of physiology. A sufficient number of experiments and observations have not been made with care and judgment; nor have such a body of facts been collected as will enable us to judge which theory is founded on nature and truth. Systems which we adopt in haste, from an examination of a few isolated facts, without awaiting the slow progress of time, are frequently obliged to be abandoned in after years. When Bonaparte wrote his long, spirited and interesting article on Peale's Egret Heron, and framed his theory that "the Egret Herons are entirely of a snowy whiteness, without any coloured markings on the plumage whatever," he could not have conceived that the next student of nature who visited the spot where his specimen was obtained, should discover that this identical species became brown and rufous; and thus compelling nature herself to scatter his fine spun theory to the winds.

It is proposed in this article to give such facts relating to the moulting of birds and quadrupeds, as some experience has enabled me to collect. Should this have a tendency to elicit further inquiry, on a subject so interesting to naturalists, and lead to the study of the causes of these wonderful changes, my object will be attained.

1. Does the change of plumage in some birds arise from a change of feathers, or from the feathers themselves assuming at one period a different colour from that which they have at another?

On this head the following observations were made.

Falco leucocephalus. A pair of birds were sent to me in the spring of 1830, taken from a nest in the neighbourhood of Beaufort, S. C., two years before. The old birds having appeared unusually large, and destitute of the white heads and tails of the Bald Eagle, the individual who had preserved the young, sent them to me under an impression that they were the long disputed Sea Eagle (F. *albicilla*) of Europe. Perceiving that they were the young of our F. *leucocephalus*, and being aware that some of these birds, when in confinement, required five and six years before they attained their full plumage, I did not much value these troublesome and expensive pets. On a closer examination, however, I observed that the male had some of the feathers of his head streaked with white, whilst the outer edges were bordered with brown. I discovered also, when he spread out his tail, that some of the inner portions of his feathers were broadly and irregularly patched with white. I concluded that the important change I was desirous of witnessing was in progress. The birds were therefore carefully fed and noticed. The female had evidenced no appearance of change, or progress towards a change, until the moulting season arrived. This commenced in June: both birds moulted freely, the female three weeks later than the male. In the latter, the feathers of the head came out nearly pure white; those of the tail continued still irregularly barred with brown and ash, but became gradually whiter till about the latter end of October, when he had all the markings of an adult bird. The feathers of the female assumed nearly the colours of the male, at the time I first received him. In the beginning of November, all further change in the plumage of the female appeared to have been checked. The birds remained in my possession till the following January, when they were sent to Europe.

The above observations, in addition to the facts they present with regard to the process by which changes in colour are effected in this species, enable us to form some idea of the time it may require to produce the full plumage. Birds in confinement, deprived of the exercise, air and food to which they are accustomed in a state of nature, often moult irregularly, and the time they attain full plumage is considerably protracted. An individual of this species which was for some time in my possession, did not moult for eighteen months, although apparently in good health; and when at last this process took place, it was in January, the coldest month of the year in Carolina. In the present instance the male received the white feathers in his head and tail a year earlier than the female, which, I have reason to believe, would not have been the case if they had been left at liberty. Here, however, is one instance established, with a tolerable degree of certainty, of this species arriving at full plumage in three years.

Strix asio. The young of this species was first described under the above name; and the old as *strix nævia.* Its general colour above is reddish brown, but when it receives its mature plumage it is mottled with white, ash and pale brown. I have possessed very few opportunities of examining the change of plumage in this species. Having, however, once found an individual sitting on its nest while yet in the red stage, I conclude that they do not arrive at full plumage till they are more than a year old.

In the month of February (the year was not noted, and is unnecessary to our present inquiry) I saw in the possession of some lads, who were dragging it through the streets by a string, an individual of this species, so singularly marked that I was induced to ask them for it. They stated that they had found it with a broken wing in the woods. The wing was nearly severed, but the wound apparently healed; a proof that the injury was of long standing. The bird, though lean, was in moult. The lesser wing coverts, a portion of the head, and an irregular spot on the breast, had nearly attained the markings of the mature bird; the rest of the feathers that had not been moulted remained the colour of the young. It survived but a few days. Whether this was a spring moult, or that of summer retarded in consequence of the wound, I had no means of ascertaining.

Psittacus Carolinensis, Carolina parrot. This bird has become so rare in Carolina, that I only once noticed a small flock of five or six among the cypress trees of the Salt Katcher swamps. In the autumn, however, of 1831, a friend received from St Augustine five young birds of this species. They were never in my possession, but I visited them occasionally, and scarcely ever without the expense of a wound, which they were at all times ready to inflict upon any strange visiter. They continued in the uniform plumage of the young of this species till the beginning of February, when they all about the same time commenced moulting, more perceptibly and more extensively in some of the individuals than in others. A striking increase of brightness was visible in all the new feathers. Those on the neck, which first came out a yellowish green, gradually and irregularly became bright yellow; but in all cases, as far as I had an opportunity of judging, the change of plumage was in the new feather. Absence from the city prevented me from seeing these birds after they had arrived at full plumage.

Icterus Baltimore, Baltimore Oriole. The only opportunity afforded me of observing the changes of colour in this beautiful species, was in the state of New York, in May 1815. A young male had been obtained and confined in a cage, where it was for some time fed by its parents. In the month of October of the same year it moulted; the young feathers were much brighter than those which were dropping out; and in two months afterwards the bird was in full plumage. Our ornithologists, Wilson and Audubon, who state that this bird requires three years before it arrives at full plumage, may have been led into this mistake from having seen birds of the late brood of July, not in perfect plumage in the following spring. Mr Audubon, indeed, recently informed me that he had satisfied himself of this error, in examining an aviary kept by some gentleman in Baltimore, and I acknowledge myself indebted to him for the hint which induced me to refer to the long neglected notes I had made on this species.

Icterus spurius, Orchard Oriole. This sprightly species was for several years preserved in an aviary, where I employed my leisure moments in studying the habits of this beautiful race. There, among various others of the feathered tribe, it built its pensile nest, and reared annually two broods of young. Its curious *gestures*, its varied and often melodious notes, as well as its continually varying colours, rendered it one of the most interesting and admired species. The young were yellow on the under surface, and the males could scarcely be distinguished from the females. They moulted in autumn, the last brood not until January, being two months later than the first. There was no perceptible change in colour for two weeks, when the birds of the first brood assumed the black patch under the throat; the later birds still remained yellow in those parts. They retained these colours during spring, whilst they were engaged in the cares and duties of reproduction. The moulting season now commenced in August, when the elder males became mottled on the back with irregular streaks, and the younger assumed the black patch under the throat. In the month of January the first assumed the bright chestnut colour on the breast, and were in full plumage, and the others but one stage removed from it; thus passing through all their variations of colour to their full plumage in less than two years. Our naturalists have extended the time to four years; a pretty long time to be concealed under a mask.

Fringilla cœrulea, Blue Grosbeak. A pair of young birds of this species was taken from the nest in May 1836, and raised by a friend, who since presented them to me. They were then of an humble drab colour, and commenced moulting about the beginning of December. The female died in the moult. The new feathers in the male came out blue, edged outwardly with brown; the moulting has proceeded rather slowly, owing, no doubt, to the cold weather. On the 21st of March young feathers were still making their appearance on various parts of the body, whilst the first feathers that appeared after the moult were bright blue, even to their extremities; the latter ones are still, along their outer edges, near their points, tipped with brown and drab, which continue to brighten as the feathers become more matured. The male undoubtedly attains his bright and perfect plumage before he is a year old. Although I have occasionally seen a young male in early spring with a few brown feathers (the result, no doubt, of an imperfect moult), yet, out of many hundreds that I have noticed in the breeding season, I have never seen any males that were not in full plumage. They are not subject to a change of colour during winter, as supposed by Wilson, nor do they require three years to attain their full plumage, as stated by Audubon.

Fringilla ciris, Painted Bunting. This beautiful and social species is very common among the caged birds of the south. Having long preserved it in an aviary, where it raised two or three broods in a season, I have it in my power to state, from personal observation, the changes through which it passes from immature to perfect plumage. For the period of a year, the male strongly resembles the female, being of an olive green colour above. The birds moulted late in autumn, without any perceptible change of colour. In this homely dress they in the following spring commenced building their nests, rearing their young, and, with their sprightly song, cheering the females engaged in incubation. In August and September they began to moult; the new feathers on the head came out bright blue; those on the breast of a light ash colour, tinged with carmine; the colours on the head appeared to have been received in their full perfection, immediately after the moult; those on the breast and neck continued to brighten gradually for some weeks. The perfect plumage, as far as it is acquired in this species in confinement, was obtained in less than two years. Our ornithologists have assigned the period of four or five years for this process. To the objections which may be urged against experiments made on birds in confinement, as affording no certain guide in ascertaining the time at which they arrive at full plumage, it may be observed, that in caged birds, excluded from the full influence of sun, air and suitable food, the period may be extended, but not accelerated.

The above instance may suffice to show the process which nature pursues in effecting the changes of plumage, from the young to the adult state, in land birds. I shall, therefore, omit adding the notes I had prepared on several others: particularly on those of *Polyborus vulgaris*, Carracara Eagle, from Florida, a pair of which I have now in confinement; *Falco borealis*, Red Tailed Hawk; *Picus erythrocephalus*, Red Headed Woodpecker; *Fringilla cardinalis*, Red Bird; *Tanagra rubra*, and *æstiva*, Scarlet Tanager, and Summer Red Bird; *Columba leucocephala*, White Crowned Pigeon, &c. In all of them, however, there is a striking uniformity, the changes being effected during the space of a year, and in most of them the feathers become gradually brighter immediately after the moult.

I shall now proceed to note a few observations on those water birds that are subject to striking variations in plumage, from the young to the adult state, which will prove that nature, although varying in some particulars in some of the species, is still subject to the same general laws.

Grus Americana, Whooping Crane. The young of this bird is of a brownish ash colour, and at a year old is still one fourth smaller than the adult bird. In this state it has been considered by all our writers on American ornithology, with the exception of Audubon, as a distinct species.

Grus Canadensis, the Canada Crane. Dr Richardson, who found its eggs (which were smaller than those of the Whooping Crane) in the polar regions, is also under the impression that it is a distinct species. It will be recollected, however, that all our birds, as far as we are acquainted with their histories, breed at a year old, even before they have attained their full plumage; and that young birds lay smaller eggs than old. How long a time the Whooping Crane requires to arrive at full maturity, I have had no means of ascertaining. I however had an opportunity of witnessing the change of colour in a pair of this species, which convinced me that the Canada Crane was the young of the Whooping Crane. The birds were obtained, it was said, from Florida, in what manner I was not informed, and were represented as two years old. They were very tame, feeding from the hand, and evidencing no vicious disposition; preferring, as food, the sweet potatoe (*Convolvulus batata*) and Indian corn (*Zea mays*). They had not quite completed their moult. They appeared a shade lighter than the Canada Crane, and considerably larger. The feathers were white nearly to their extremities, where the ash colour prevailed; the brown edges on the feathers continued to become narrower. At each successive visit the change was rendered more visible. In a few weeks some of the feathers became pure white, while others were slightly tinged with a cinereous colour. The change was not perfect, though nearly so, when the birds were removed from the city, and all who saw them unhesitatingly pronounced them Whooping Cranes.

Ardea cærulea, Blue Heron. Our writers on American ornithology were not, until recently, aware that the young of this species was white. In this state of plumage it so much resembles the Snowy Heron (*Ardea candidissima*) that it can scarcely be distinguished from that species, except by its black legs and toes. I had many opportunities of witnessing the changes of plumage to which this bird is subject, and discovered that, both in captivity and in a state of nature, the time and process do not materially vary. The young birds continue pure white till late in autumn, when they moult. No perceptible change in colour takes place, except in a very few instances; a few feathers have a slight tinge of blue near their inner webs. All the old birds retire south of Carolina in winter; a few of the young, in white plumage, remain. When this species return from their winter retreat in Florida and Mexico, they possess their beautiful trains, some white, others white and blue. Even in spring, a few new feathers may be seen here and there pushing forwards, and are easily known by their having a tinge of blue. On some the breasts are spotted; some of the feathers having become blue, others still remaining white: every where, however, a tendency to the change which is approaching, is visible in each new feather, its inner vaine being more or less marked with blue. A few still continue white, probably the late brood of the former year. It is amusing to witness the breeding place of these birds. A thousand nests may sometimes be seen on some small islands among the reserve dams of the rice fields of Carolina. Here is seen an indiscriminate mixture of all colours, engaged in incubation and providing for their families. A blue male may be seen mating with a white female, a blue female choosing for her companion a white male. Birds strangely spotted, some with white, others with blue trains sweeping through the air, rising in hundreds over your head, and presenting so many variations in plumage, that the young ornithologist is tempted to believe that he has a half dozen new species to describe. In August a regular moult commences, and before the old birds leave Carolina, in autumn, they have acquired their blue colour; thus attaining their full plumage in less than two years.

Ardea rufescens, Reddish Egret. This Heron, which I have had in a state of domestication, in its changes of plumage, and the period in which these changes are effected (as far as an imperfect experiment was made), seems to partake strongly of the character of the last mentioned species.

The various and opposite changes which our species of *Grus* and *Ardea* undergo, from the young to the adult state, is striking and wonderful. In all of them there is no perceptible difference in the plumage of the sexes of each species, except in the least Bittern (*Ardea exilis*), where it is very striking. In the *Ardea herodias*, *A. minor*, *A. Ludoviciana*, *A. virescens* and *A. exilis*, no very striking mutations take place, from the young to the adult. The *Ardea occidentalis* (great White Heron of Audubon), *A. alba* and *A. candidissima* are white in all stages of growth, and at all seasons. The *Grus Americana* and *Ardea nycticorax* are ash or brown, when in the first year of their existence, and then the former becomes white, and the latter greenish black and white; whilst, on the other hand, the *Ardea cærulea* and *Ardea rufescens* are white when young, and blue or rufous when in full plumage.

Plotus anhinga, Black Bellied Darter. I discovered several nests of this rare and singular species in the immediate vicinity of each other, in one of the dark and gloomy morasses of Carolina in June last. No naturalist has heretofore spoken as having seen its nest, except Mr Abbot, in his letter to Mr Ord, who describes the eggs as blue, and the nest containing six young and two eggs. I have sometimes thought that my excellent old friend mistook some heron's nest for that of this species, as the nests I examined contained only three eggs, and in one instance four, on which the females had for some time been sitting, and the eggs were white, covered over with a calcareous matter, like those of Cormorants. The young were brought home, fed on fish, and became very familiar and amusing. The sexes, when young, are alike of a brown colour. The male commenced moulting in November. The young feathers came out black, and seemed to assume nearly all their bright colours immediately. When it had nearly arrived at full plumage, in January, it was unfortunately killed by a dog, in revenge for the severe bites it was wont to inflict on all intruders upon it at meal time. In this species the full plumage is received before it is a year old. In all the instances I have enumerated, it will be perceived that in the changes which occur in the plumage of birds, from the young to the adult state, nature is nearly uniform in her operations. That these changes occur immediately after the moulting of the bird, and that many feathers may, in process of time, become of a different colour; in short, that the colour may change without a change of plumage.

This leads to a further inquiry.

2. Whether old birds, whose plumage has arrived at full maturity, are subject to the same general law with those who advance from immature to perfect plumage. In other words, does their plumage become perfect at once, or is it subject to gradual changes, as in the case of young birds?

It is admitted that in a great majority of birds, as in the Crow, Blackbirds, Blue Jays, &c., these colours are permanent, and there is no perceptible change in colour from the formation of the feathers till they have matured and drop off. But in many species this is not the case. Many instances have fallen under my observation, to satisfy me fully, that feathers change their colours in adult as well as in young birds.

A female wild Turkey was sent to me eighteen months ago by my friend Dr Tidyman, in order to enable me to ascertain whether this species, when taken wild and full grown, could be domesticated. It had been just caught in a trap, and was excessively wild. By subjecting it to confinement with the tame variety, and excluding the light, in part, it lost all its wild habits, and eventually became so gentle as to approach my hand to be fed. In the month of October last it moulted, like the tame turkeys, with which it now associated. But I was surprised to find many of the tail and wing feathers, and some of the feathers on the back, coming out of a light ash colour, whilst others were nearly white; insomuch, that some of my friends were induced to pronounce it only one of our varieties of the tame turkey. Shortly afterwards these feathers began to change in colour, and gradually become darker and brighter, till, after the expiration of a month, it had again all the rich plumage of the wild female turkey.

A male of the Summer Duck (*Anas sponsa*) has been in my possession for several years. In the moulting season, which occurred in August last, he lost all his fine plumage, and the new feathers were at first so much of the colour of the female, that the sexes could scarcely be distinguished by the plumage. Shortly afterwards, however, a change commenced; from day to day the beautiful tints of the male were returning; his rich colours were gradually restored; and in the course of six weeks, this, the most elegant of all the species, was again in full plumage.

These observations are calculated to strengthen the opinion advanced by the Rev. Mr Whitear, contained in the twelfth volume of the Transactions of the Linnæan Society of London, that "a change in the colour of the plumage of birds does not always arise from a change of feathers, but sometimes proceeds from the feathers themselves assuming at one season of the year a different colour from that which they have at another."

To this theory I am disposed to subscribe, to a certain extent, and under some limitations. That feathers are changed in colour, without a change of the plumage, is admitted, and, I think, satisfactorily proved. But, as far as I have been able to ascertain, this change is always preceded by a recent moult.

At this stage of our inquiries we arrive at an interesting point. There are many birds that are subject to a semi-annual change of colour, after they have arrived at full maturity. The male Rice Bird (*Emberiza oryzivora*) is of a brownish yellow colour during six months of the year, and returns to its breeding place, in the northern and middle states, clothed in a livery of white and black. The male American Goldfinch (*Fringilla tristis*) is of a homely olive brown colour during winter, whilst in summer it is a bright yellow. The Yellow Crowned Warbler is ash coloured during half of the year; of a beautiful blue in the other. Our Plovers, Tringas, Gulls, &c., are subject to the same changes. Our ornithologists have widely differed in investigating this part of the physiology of birds. The subject of inquiry here seems to present itself under a new aspect, and the inquiry is:

3. Do birds which are subject to these semi-annual changes in plumage receive their new colours in the spring, in consequence of a fresh moult, as they do in summer, or are they produced by a gradual fading or brightening of the feathers, without a fresh moult?

Mr Ord, in a well written article published in the third volume, new series, of the Transactions of the American Philosophical Society, has advanced the following theory. "It being now satisfactorily proved that a change of colour obtains, in some birds, in the winter and spring, without a change of plumage, I am disposed to conclude that the state of moulting, properly so called, takes place in all birds but once a year."

To this theory the following difficulties seem to present themselves. The colour in the plumage of birds, especially in the small feathers, most subject to a change, appears to be advanced to the extent it is intended to arrive at, in a few weeks, or, at furthest, in a few months. At that point it seems to become stationary, and to remain so for a considerable length of time. If the same feathers are afterwards to receive a fresh set of colours, there must be some secretions in the body of the bird, and a fresh impulse given to the feathers already advanced to maturity, imparting to them properties which they did not possess before. When it is necessary for a bird, in summer, to receive a new dress, differing in colour from the old, there are no secretions by which it can impart fresh colouring matter to its old feathers, which have long become stationary in their growth and colour. It is, then, essential that these feathers should be thrown off, and those substituted, which, in the progress of their growth, and their advance to maturity, may receive those hues destined for them by nature. This law of nature seems to be so simple, that it can be easily comprehended; but if a different and opposite process is observed, in giving new and entirely different colours to the old feathers of the bird in spring, the law of nature, so uniform in other respects, cannot be traced. The feathers and other appendages in birds may (without adopting the nice distinctions and scientific terms used in botanical science) be compared to the leaves and other appendages of plants. In early spring, the juices, together with the influence of sun and air, impart that nourishment which causes the leaf to expand, and assume its beautiful colours; but when the leaf has arrived at maturity, no fresh growth of the tree will give a new colouring to its leaves. New ones may be formed, and these may continue to grow and flourish, but the old ones fade and drop off. Even among our evergreens of the south, whose leaves are persistent, as the orange tree, &c., which may be said to have two periods of growth (April and September), the leaves, when once matured, seem to have lost the power of further circulation; they cease to grow; their rich colours fade; and they only await the time appointed them by nature, to return to the ground. If the feathers in birds, then, which have been long stationary in their growth, are capable of receiving a new set of secretions, and of assuming opposite colours, we must seek for some new law of nature, not hitherto understood.

The origin of the feathers is the matrix which is placed in the skin, or under it. The structure of the matrix is a pulpy substance called bulb, and a capsule, which is composed of several layers. The bulb furnishes the material of the stem and vane, which, when complete, disappears, leaving no residue but the almost imperceptible ligament, connecting the quill to the bottom of the cavity, which receives and embraces it. Whenever a new feather is to be formed, a new matrix is necessary to the process. The early connection of this matrix with the body, is by means of vessels. From these the pulp or bulb derives its nourishment. The feather is, whilst young, enclosed in a sheath, and this, as well as the quill itself, is filled with a coloured fluid. In a few weeks the secretions have been imparted to the feathers, and the sheath, by a process of absorption, becomes dry, and is rubbed off. In the tube of the feather now remains a jointed membranous body, which every one has observed in the barrel of a common quill. This shaft is now filled with air. After this process, the object of nature in providing covering and the means of flight to the bird, seems to have been accomplished, and the feather ceases to grow.

In order to renew the nourishment of the quill, it would be necessary to renew the vascular connection. It is doubtful whether any revivescence of colour can take place without this. As long as this lasts, the assimilative powers within the feather may continue to act. When this ceases, these are extinguished with it. As the vascular fluid, then, which fills the sheath and the quill gradually disappears, as also the bulb which nourishes it, after the feather has arrived at full maturity and becomes stationary in its growth, it would appear that after this period no further change of colour can take place. This point, however, has not been so satisfactorily investigated by physiologists, as to enable us to express a positive opinion, and, until this is done, we are obliged to resort to an examination of individual species, in order to ascertain how far there is a uniformity in these changes of colour in all birds.

The fact that birds in winter are, by a wise Creator, furnished with a thicker covering than they possess in summer, does not appear to have received that attention from naturalists who have made inquiries on the subject, that its important bearing on this point seems to require. Several of the birds subject to these semi-annual changes in colour, spend their winter in climates comparatively cold. The *Sylvia coronata* is seen by thousands in Carolina, where the thermometer, during winter, stands for several days in succession, below the freezing point. The *Fringilla tristis* also braves our coldest winters; and the *Saxicola sialis* and *Sylvia petechia* linger among our copse woods and orange groves. These birds are clothed with a covering suited to the rigorous season. In summer their dress is lighter, as well as more gaudy. If, then, there is no dropping off of feathers, it would be reasonable to inquire what becomes of their winter clothing? This would have to be borne through all the heats of summer, till the moulting season; and their thick blanket of down would damp their ardour, and silence many a joyous song.

I am well aware, however, that we may build theories, and indulge in speculations, which, however plausible they may appear, and however satisfactory to our own minds, may be easily overturned by a single glance at the manner in which nature performs her operations. Admonished, therefore, to resort to a better book than philosophers can write, the book of nature itself, I was determined in some hour, not devoted to any higher pursuits, to make the inquiry by a simple examination of facts, not difficult to collect. The point in dispute seemed susceptible of an easy solution, by a careful examination of those birds that are subject to semi-annual changes of colour, and to ascertain if they moulted once or twice in a year.

The following was the result of my investigations. I copy from notes taken on a succession of visits into the country.

February 23, 1837. Visited a country residence about two miles from Charleston. Slight indications of early spring. Weather windy and unsettled; a slight frost during the night. A few of the trees in the city in blossom, especially the peach and plum. In the country the *Laurus geniculatus*, *Prunus chicasa*, *Acer rubrum* and *Salix nigra*, the only trees in bloom. Procured a number of specimens in ornithology.

The following had no change from winter plumage, and no appearance of a moult. Mocking Bird (*Turdus polyglottus*), one specimen. Pine Creeping Warbler (*Sylvia pinus*), two specimens. *Sylvia coronata*, two specimens. Solitary Thrush (*Turdus minor*), one specimen. White Eyed Fly-Catcher (*Vireo noveboracensis*), one specimen. *Fringilla tristis*, ten specimens, of both sexes. The males of the latter species differed considerably in colour in the different specimens. Whilst some strongly resembled the females in their plumage, others were considerably brighter in colour, especially on the breast; and in two or three specimens there were irregular markings of black on the frontlets, as if nature during the last moulting season had been making an effort at advancing the birds to the bright plumage of which they had just been deprived.

The following had commenced moulting. Wax Bird (*Bombycilla Carolinensis*), two specimens, males. Both birds were considerably advanced in the moult; new feathers, in great quantities, were coming out on every part of their bodies; these were much more brilliant than the old, and seemed to receive their bright colours at once. Crested

Titmouse (*Parus bicolor*), one specimen, moulting along the sides and on the head. Solitary Fly-Catcher (*Vireo solitarius*), one specimen. (This bird, contrary to the assertions of ornithologists, has a soft and melodious song. It is becoming more common every spring.) A great many young feathers were appearing on the head, around the lores of the eyes, and on the breast and back. Savannah Finch (*Fringilla Savanna*), one male specimen; far advanced in the moult; about one half of the feathers on the breast young, and still sheathed. Bay Winged Bunting (*Fringilla graminea*); a row of young feathers appearing on each side of the neck. Chipping Sparrow (*Fringilla socialis*); moulting commenced on the breast, and a few young feathers on the head.

The same day I examined some living birds, in a state of confinement. The male of the Caraccara Eagle (*Polyborus vulgaris*), flew fiercely at my face whilst I was inspecting the female. Neither of them was in moult. The English Pheasant (*Phasianus colchicus*), the Wild Turkey (*Meleagris gallipavo*) and Virginian Partridge (*Perdrix Virginiana*) showed no indication of moulting. This was also the case with the different species of pigeon, and among all the *Emberizæ* and *Fringillæ*. The Song Sparrow (*Fringilla melodia*) was only shedding its feathers.

March 3. Visited the country. No very perceptible advance in vegetation. Nights cool, with slight frosts. The only additional plants in flower were *Leontodon taraxicum*, *Laurus sassafras* and *Oxalis stricta*. These facts, with regard to the advance of spring, are noted in order to enable us to form some idea of its probable effects on the time of the moulting of birds.

Obtained the following birds.

Bombycilla Carolinensis, fifteen specimens. About one half of this number were moulting on the breast, neck, and under the throat; some of them extensively; and in one of them especially, it appeared as if every feather on the body, except those in the tail and scapulars, was already replaced by new ones, half formed. In some of the specimens moulting had not yet commenced, or had already been completed. Bonaparte states, in regard to the genus *Bombycilla*, "that they moult once a year." *Fringilla graminea*, two specimens, moulting extensively on every part of their bodies. I noticed that these two birds, which were males, were in full song. *Fringilla socialis*, two specimens. In one a large quantity of new feathers were coming out from the sides; and in the other the whole head was covered over with young feathers still sheathed. *Troglodytes ædon*, one specimen. Far advanced in the moult along the breast.

The following had no appearance of any change in colour or of moulting.

Fringilla hyemalis, two specimens; *Fringilla cardinalis*, three specimens; *Regulus cristatus*, two specimens; *Troglodytes Carolinensis*, two specimens; *Sylvia coronata*, eleven specimens; *Turdus migratorius*, six specimens; *Fringilla tristis*, twenty-two specimens.

The *Fringilla tristis* and *Sylvia coronata* seemed wild and restless, as if preparing to migrate. Their numbers had also considerably diminished, and it is possible that they may not remain long enough to enable me to ascertain the process of their change of colour in spring.

March 6. Since I last visited the country there has been a fall of snow of about three inches in depth, remaining on the ground for twenty-four hours; an unusual occurrence in S. Carolina. This cold change brought back a number of birds that appeared to have left us for the season.

Obtained and examined the following species of birds. *Sylvia coronata*, twelve specimens. About one half of these (both males and females) had commenced moulting. The new feathers were of the bright colour which this bird assumes in summer plumage; the old remained stationary. *Fringilla Savanna*, seven specimens. These birds were receiving new feathers on various parts of their bodies; those on the head were all changing; under the chin, the ash coloured feathers of winter were replaced by those of pure white, the colour of summer. *Turdus migratorius*, two specimens. In one of these specimens a considerable number of young feathers were appearing along the breast, under the chin and on the head. *Troglodytes Carolinensis*. A row of new feathers along the sides.

No change was apparent in the following species. *Corvus ossifragus*, six specimens; *Corvus cristatus*, two specimens; *Fringilla tristis*, sixteen specimens; *Picus pubescens*, three specimens; *P. villosus*, two specimens; *P. auratus*, two specimens; *Icterus Phœniceus*, eleven specimens, females; the males of the last species are found in separate flocks at this season, a few of the young males occasionally associate with the females.

After the above period, I was for a short time in Georgia, where, through the kindness of my friends, who furnished me with specimens, I was enabled to examine a number of species of birds. On my return to Charleston I resumed my inquiries into this subject, and through my own exertions and the aid of some of my young friends, had an opportunity of inspecting a considerable number of specimens, of various species, subject to a semi-annual change of colour. The result of examinations made on the 13th, 16th, 17th, 21st, 23d and 28th of March; on the 3d, 10th, 17th and 20th of April; and on the 4th and 5th of May, I will condense under a notice of each species, as the notes taken on these different occasions would swell this article to an unreasonable length.

Fringilla Pensylvanica, White Throated Sparrow. Of this species I was enabled to examine about thirty specimens, in addition to those in an aviary. The light ash colour under the chin is in every instance replaced by a fresh moult; the new feathers coming out pure white. This is the case in both sexes. The birds too appear to moult on every part of the body, some having the whole head covered with young feathers still sheathed; the same process is going on with others, on the breast; and in others, moulting first commences in spots on the back. Thus nature seems to leave one portion of the clothing as a covering to the bird, whilst it is renewing the rest; and the feathers of one part of the body are fully formed before moulting commences on other parts.

Fringilla Savanna, Savannah Finch; *Fringilla palustris*, Swamp Sparrow; *Fringilla melodia*, Song Sparrow; *Fringilla pusilla*, Field Sparrow. The same process was observed in these species. They all moulted extensively, but irregularly; and in many specimens every feather, except those in the wings and tail, appeared to be renewing.

Fringilla erythropthalma, Towhee Bunting. Of this species I received seven specimens. Two males had the whole head covered with new feathers; one other was moulting extensively on the back; not an old feather was remaining on that part; and in another this process was going on among the feathers on the breast and sides. In the remainder there were a few young feathers, but no regular moult.

Sylvia petechia, Yellow Red-Poll Warbler. This species I was extremely anxious to examine, in reference to this subject. The difference of its plumage in winter and summer is as striking as that of *Sylvia coronata*. It however becomes yellow olive in spring, whilst the other becomes blue, streaked with black, with a yellow spot on its rump and crown. The *Sylvia petechia* has been described under two names, that of the above and *Sylvia palmarum*, by Bonaparte and Audubon; the latter recently acknowledged his error. I obtained of this species twenty-four specimens. Every individual was moulting extensively. The new feathers came out at once in summer dress, leaving not a shadow of doubt on my mind that this bird receives its bright colours from a change of feathers, and not from a change of colours in the old feathers.

Sylvia pensilis, Yellow Throated Warbler. This is one of the small number of the species of this large genus that breeds in Carolina. Its note was first heard on the 16th of March. Obtained, at various times, thirteen specimens. In every instance the whole of the yellow on the throat was replaced by young feathers just pushing forward, and in several individuals moulting was general over other parts of the body. The above observations apply equally to *Sylvia trichas*, Maryland Yellow Throat, of which I inspected about five specimens.

Fringilla tristis, American Goldfinch. This was one of the birds referred to by Mr Ord, as a proof of the correctness of his theory, that birds moult but once a year. Although this species is common in Carolina in winter, feeding on the seeds of the long moss (*Tillandsia usnoides*) that hangs in festoons from the limbs of our venerable live oaks (*Quercus virens*), and at a later period on the imported, but very common chick weed (*Alsina media*), it generally leaves us for the north early in March, and, no doubt, undergoes its changes of plumage in spring in the immediate vicinity of Philadelphia. This bird had left us for about two weeks, but was driven back to this vicinity in consequence of a succession of cold days; and from the 16th to the 22d of March I had an opportunity of obtaining forty specimens. On the former day two or three individuals were brought to me in which moulting had commenced. From this period until every straggler appeared to have left us, on the 23d, I discovered that the process of moulting was advancing rapidly. It seemed to commence in the old males, extending itself to the females; and on my last examination not an individual of either sex was brought to me that was not in extensive moult. The young feathers on the head came out black; those on the rest of the body of a bright yellow. In the old feathers no change whatever had taken place. Mr Ord is correct when he states that this species is in full song in March; this was the case in all the individuals I observed; but he appears to have overlooked the opportunity of ascertaining that it was also in full moult. The theory that the song of birds is silenced in consequence of the exhausting process of moulting, is not calculated to bear the test of close examination. The *Fringilla tristis*, *Troglodytes ædon*, *Fringilla Pensylvanica*, *F. graminea*, *Sylvia pensilis*, and many others, were in full song, although they were moulting very extensively. This is also the case at the moment I am writing, in several species now in my aviary. It will probably be found that the vocal powers of birds are called forth by an increased development of the sexual organs, in the vivifying season of spring, and that their song is suspended in autumn, when these organs are sensibly diminished.

Psittacus leucocephalus, White Fronted Parrot. A bird of this species, now in the possession of my friend Dr Wilson of this city, was carefully examined on the 20th of March. It was in fine health, repeated several words, and made attempts at a song. We found it in extensive moult, and all who examined it were satisfied that it was receiving a full set of new feathers on every part of the body. This species exhibits a variety of colours, green, white, yellow, pink and red. The feathers came out apparently in the bright hues which the bird assumes when in perfect plumage. In pursuing my investigations on the change of plumage in birds, I have observed that old birds, moulting in spring, usually receive their bright colour at once, whilst many species, that moult in autumn, have these colours imparted to them by a gradual process.

Psittacus coccinocephalus, Scarlet Headed Parrot; *Psittacus purpu-*

reus, Purple Bellied Parrot. I have had in my possession, for several years past, a living bird of the first named species, and frequently seen one of the latter in the cage of a friend. Both species moult in summer, and again in the months of February and March. The moult, with the exception of the larger feathers in the tail and wings, was as general in spring as in autumn.

Emberiza oryzivora, Reed Bird. This species, which is so singular in its habits and changes, passes under different names in various parts of the country, referring either to its colour, food or song. In the eastern states it is usually called Bob-Link, from its notes bearing a fancied resemblance to those syllables. In New York I have heard the farmers call it Skunk Bird, in consequence of its black breast and sides and broad white streak on the back bearing a resemblance, in colour, to that animal (*Mephitis Americana*). In the middle states it is called Reed Bird, in consequence of its feeding on the seeds of that plant (*Zizania*); and in the southern states the Rice Bird, from the extensive depredations it commits on our rice fields; hence its specific name (*Oryzivora*).

In autumn, the male of this bird, as is well known, lays aside its black and white summer dress, not by a change of colour in the old feathers, but by a thorough moulting, extending even to the large feathers in the wings and tail. It now becomes of the plain colour of the female. In this dress it continues till March, when it gradually changes again, and in May is once more in full summer plumage. Mr Ord states, from personal observation, on birds confined in cages, that "during the time the male is undergoing this metamorphosis, there is no change of feathers, their colours being altogether the result of their organic secretions." I have no positive evidence to prove that there was any inaccuracy in his observations. These birds generally make their appearance in Carolina from the 1st to the 10th of May, when they have already attained full plumage. Having never kept them during winter and spring, I am obliged to consider the examinations of Mr Ord, in reference to this species, as conclusive. This will, then, show that the Rice Bird is an exception to the general rule, and that, whilst all our other known species that assume two distinct colours in a year moult in spring as well as in autumn, the Rice Bird is an instance where a different process takes place. This, however, affords no proof of the truth of the assertion that all birds moult but once a year, since it is now certain that the majority of birds moult twice a year. I do not however consider it impossible, that even in regard to this species some mistake may have occurred. These changes progress silently and rapidly, and unless watched with great care, are effected without our observing the process. The males made their first appearance this year in our rice fields, in scattered flocks, on the 5th of May; and on that and the three following days I had an opportunity, through the politeness and attention of several planters, of examining fifty specimens. Nine-tenths of the birds were in full plumage, and there was no appearance of their having moulted; but in five or six specimens, where the black colour on the breast had not been fully restored, I perceived several places where rows of young feathers, still sheathed, existed in spots of an inch or two in extent. These feathers, instead of coming out yellowish brown, as is the case with the species when they moult in autumn, were black, narrowly edged on the points with brown. Whether the moult was accidental in these specimens, or whether it extends to every individual in the species, I had no means this spring of ascertaining; certain it is, that the young feathers perceptible on the specimens sent with this communication, do not undergo the process of the change from brown to black, which must be the case if the colours of spring are imparted without a fresh moult.

Sylvia æstiva, Blue-Eyed Yellow Warbler. This species, in autumn, is of a pale yellow colour, changing in spring to bright yellow, streaked on the breast with orange. It probably undergoes this change within the tropics. On the 27th of April I had an opportunity of examining eleven specimens; two of these were not in full plumage, and I observed that in one instance the whole head was covered with new feathers, and in another the young feathers on the back had recently been produced, and were still enclosed in a tube.

Fringilla cyanea, Indigo Bird. This is a rather rare species in the maritime districts of Carolina, and breeds but sparingly in these parts. On the 3d of May I obtained three male Indigo Birds. They were in full song, and I was enabled to discover them by their notes. One of the birds was in perfect plumage, and I could observe no evidences of a moult; the other two were mottled, and the points of the feathers were edged with brown. They were receiving new feathers extensively on every part of their bodies; one of the birds would probably have been in full plumage in a week, the other was less advanced, and would have required a longer time. Whether these were young birds receiving their bright colours for the first time, or old birds renewing their colours by a fresh moult, I could not ascertain.

The arguments of Dr Flemming (vol. II., p. 26, 27) in favour of his theory that a spring moult is unnecessary to a change of colour in feathers, as confirmed by the examination of Captain Cartwright on the Ptarmagin (*Tetrao lagopus*) of Labrador, is very far from being satisfactory to my mind; on the contrary, it appears to me that Cartwright's own notes, taken on the spot, ought to have caused the Doctor to have hesitated, before he adopted, so confidently, a theory which may yet be discovered, on a more careful examination, to be wholly founded in error. The following is an extract from the Captain's Journal (see Transactions, On the Coast of Labrador, vol. I., p. 278): "When I was in England, Mr Banks [Sir Joseph Banks], Dr Solander, and several other naturalists, having inquired of me respecting the manner of these birds changing colour, I took particular notice of those I killed, and can aver for a fact, that they get at this time of the year (September 28) a very large addition of feathers, all of which are white, and that the coloured feathers at the same time change to white. In spring, most of the white feathers drop off, and are succeeded by coloured ones, or, I believe all the white feathers drop off, and they get an entire new set. At the two seasons they change very differently; in the spring beginning at the neck, and spreading from thence; now they begin at the belly, and end at the neck." Captain Cartwright here asserts that the Ptarmagin, in autumn, receives a very large addition of white feathers, but that the coloured feathers are changed to white. I perceive no difficulty in explaining this autumnal change. Presuming that the birds moulted in the middle of August, as is the case in Labrador, some of the feathers would not come out pure white, but would gradually become so, as is the case with other birds I have mentioned, and they would thus, for a time, retain a mottled appearance. The summer moult in birds extends over the whole body, even to the wing and tail feathers, in every species I have examined, and I presume that the Ptarmagin does not form an exception. The only point of difficulty lies in the spring moulting, and in this Captain Cartwright is pretty explicit. He states, with some hesitation, his belief, from an examination of many specimens, that "all the feathers, in spring, drop off." There could have been no difficulty in ascertaining this fact, from the manner in which young feathers are sheathed during the process of moulting. Here, then, we have another well attested proof of a double moult in those species of birds that are subject to a semi-annual change of colour.

Before concluding my remarks on land birds, it may be necessary to state how far I have found my observations to apply, in regard to a second moult in birds in general. I have examined no species in which an individual was not occasionally found, that was not moulting sparingly during spring. This may, however, in some species, have been accidental. The Mocking Bird, Blue Bird, Cardinal Grosbeak, Loggerhead Shrike (*Lanius ludovicianus*), and some others, I have reason to believe, do not moult to any extent in spring, although a considerable number of feathers drop off, which are not replaced; and yet in many other species of the genera *Turdus* and *Fringilla*, even where no very great change of colour occurred, the moult extended to every part of the body; whilst the Mocking Bird and the Brown Thrush (*Turdus ferrugineus*) did not appear to moult. The Solitary Thrush (*Turdus minor*), which loses nearly all its spots on the breast in spring, seemed, on the 29th of March, to have acquired a full set of young feathers on the breast.

Although in many species the moult appeared to be complete in other respects, yet in but two species, the Savannah Finch and Swamp Sparrow, did I discover that the scapulars and tail feathers were moulted; these are stronger and firmer, and as far as my observations have gone, seem, in most of the species, to be shed but once a year; this will not surprise us, when we take into consideration the diversity in the operations of nature in other animals. The horse, for instance, sheds his hair on every part of the body at least once a year, and yet the hairs in the mane and tail continue to grow during the life of the animal. On the other hand, the thinner and lighter hairs of animals, and feathers of birds, are frequently removed, and easily replaced. The feathers on the breast of female Canary Birds, and most other species that I have noticed, drop off during incubation, and are successively replaced during the season, at every time they recommence building their nests.

On the spring moulting of water birds the following information has been collected.

In the spring of 1825 a specimen of our beautiful Fresh Water Rail (*Rallus elegans*) was sent me from the country. It was so completely in moult, that it could not be preserved as a specimen. The young feathers came out in their full brightness.

On the 7th of April 1835 I examined several Shearwaters (*Rhincops nigra*). About one half of the birds were in the moult; the remainder still retained their winter dress and colours.

On the 20th of April 1836 I procured three males of the Semi-palmated Snipe (*Totanus semipalmatus*). They were changing from winter to summer plumage, and were moulting very extensively.

Early in the month of May 1833 I saw a large string of Black Bellied Plovers (*Charadrius helveticus*) in the markets of New York, and being desirous of obtaining some specimens for the cabinet, as this bird has not arrived at full plumage in its spring passage along the sea shore of Carolina, I found so many of them in fresh moult, and their young feathers still sheathed, that it was difficult to find specimens suited to my purpose.

In September 1835 a Turnstone (*Strepsilas interpres*) was sent me by a friend. It had been wounded and captured by his son, whilst in its plain autumnal plumage. I entrusted it to a lady who fed it on moistened corn meal, and on bread soaked in milk. It survived the winter, and was in fine health on the following April, when it shed its winter dress, and the new feathers, although not perfectly bright at first, became so in three weeks.

March 20th, 1837, saw about two dozen of the Ruddy Duck (*Fuligula rubida*) in the Charleston market. All that I examined were males. They were receiving their ruddy colour of spring, and were moulting very extensively.

March 21st, examined a Black Headed Gull (*Larus atricilla*). On every part of the head the ash coloured feathers were becoming replaced by young ones, still sheathed; these were of a dark lead colour, appearing in some lights quite black.

March 1834, received from Boston specimens of the Herring Gull (*Larus argentatus*), together with a number of northern species, which are now lying before me. In the majority of them, moulting had progressed to a considerable extent. Mr Ord conceives Montagu, who had made similar observations on this species, as "labouring under the influence of a theory," when he recorded the result of his investigations. The correctness of Montagu's assertions has been verified by my own observations.

Mr Ord has, moreover, doubted the accuracy of Montagu's observations on the changes of plumage in a Black Stork, taken in England. The latter gentleman stated that this bird continued very gradually to moult during summer and winter; that in the month of March, the violet and purple feathers appeared on the back, and that the whole upper parts had nearly assumed this beautiful plumage by the 1st of April. He supposes that it could not have moulted, although Montagu asserts that to be the fact, and considers this statement of Montagu as "affording one of the most apposite illustrations of the fact of a change of colour in mature plumage, that could well be desired." I have not been able to regard it in this light. Admitting that all the species of Storks and Herons moult but once a year, of which we have no certainty, it does not appear difficult to account for the slow pace with which this individual assumed its bright colours. It will be recollected that it was a foreigner, retained in captivity during winter, in the moist, cold climate of England. Had it been left at liberty to pursue its migrations to Africa, where this species hyemates, it would probably have sooner attained full plumage. It is, moreover, highly probable that this stork was changing from the young to the adult plumage; in this case the process was similar to that of the *Plotus anhinga*, referred to in a former part of this paper, and of the Blue Grosbeak, now in my possession; the latter having been gradually moulting and receiving its bright colours during the winter and spring. Young birds always shed and renew their feathers more slowly and irregularly than the old; and in this instance, where we have a process so similar in other species, we cannot avoid giving credence to the declarations of a naturalist, who was an eye witness of the facts he describes, in preference to the mere conjectures of another.

Although it has been more my intention in this paper to record the facts which I have been able to collect on this subject, than to frame a new theory, or endeavour to restore an exploded one; yet it has often occurred to me, that the advocates of the two opposite theories have run into extremes, in consequence of the adherence of each, with too much pertinacity, to a preconceived opinion. Hence Montagu, having ascertained that some birds are subject to two moultings in a year, conceived that this was the only mode by which the colours of feathers were changed, asserting that "he had no conception of the feathers themselves changing colour." On the other hand, Dr Flemming, and those of his school, including the Rev. Mr Whitear and Mr Ord (the latter advanced a step beyond all the rest, in stating as his opinion that "all birds moult but once a year"), having observed that the colours in feathers change in the early stage of their growth, came to the conclusion that the same process must always be carried on in the old feathers, and that a fresh moult being unnecessary, would consequently not take place.

The observations which I have made thus far, have led me to conceive that the truth lies between these two extremes. Although my investigations were not extended to as great a number of species as I could have wished, or repeated through a succession of seasons, it has, notwithstanding, been very apparent to my mind, that young feathers frequently change colour, particularly in autumn; but that in those cases where there is a semi-annual change of colours, there is in all, or nearly all the species, a semi-annual moult. That a much greater number of species change their feathers twice a year than is usually supposed, and that our inquiries must be directed to individual species, rather than to genera, since in the same genus one species is subject to a double moult, whilst the others moult but once a year.

4. Having now seen in what manner nature performs her operations in effecting the changes in the plumage of birds, I proceed to inquire whether the same laws may be applied to those variations in colour to which the hair of quadrupeds is subject. The vascular bulbs in which the roots of the hairs are inserted, bear an analogy to the bulbs which

contain the rudiments or sheaths of the feathers. The hair, like feathers, is nourished and receives its colour from the secretions of the animal, and is exposed to the same sun, air and moisture. It continues to grow during a certain period, and drops off when it has arrived to full maturity, as do the feathers from the bird, and the leaf from the tree. There is also a striking similarity between the covering of birds and quadrupeds, in the changes to which they are subject, from the young to the adult state, and the mutations of others during the different periods of the year. As the majority of the species of young birds are of the colour of their parents, so are the young of quadrupeds. Some young birds remain for a length of time of a very different colour from that which they assume when they arrive at maturity, as is the case with some of the species of our *Fringillæ*, *Ardeæ*, and other genera. This is also apparent in some of our quadrupeds. The young of the Deer and Cougar (*Felis cougar*), for instance, are striped or spotted with white and red, whilst their progenitors are of a uniform dun or fawn colour. Some birds are disguised in two such opposite sets of colours, in the course of the year, that the gay visiter of spring can scarcely be recognised under his homely dress in autumn. So also our Ermine, and two, at least, of our species of Hares, are brown during six months of the year, and of a snowy white pelage during the other six months. Bearing so strong a similarity in many other particulars, we are led to believe that in the process of moulting, or shedding of the hair, this harmony of nature still continues to prevail.

Here, however, the same difference of opinion has obtained among naturalists. Probably much has been written on the subject in European journals which has not fallen under my observation. Dr Flemming (see Philosophy of Zoology, vol. II., p. 24) advances an opinion, the result of personal observations, that "the change of colour in those animals which become white in winter, is effected, not by a renewal of the hair, but by a change in the colour of the secretions of the *rete mucosum*, by which the hair is nourished, or perhaps by that secretion of the colouring matter being diminished, or totally suspended." This theory, as far as I have been able to ascertain, has generally been adopted by physiologists. I have also noticed the remarks of Dr Richardson, on the changes in the colour of the American Hare (*Lepus America-*

nus), in his Fauna Boreali-Americana, where he expresses a belief, founded on examination of many specimens, that "the change to the winter dress is produced, not by the shedding of its hair, but by a lengthening and blanching of the summer fur."

From these opinions I am obliged to dissent, for the reasons already advanced, and the evidence I shall proceed to adduce.

There are but four quadrupeds yet found in our country, the Polar Hare, Northern and Prairie Hares (*Lepus pampestris*, Bach.), and the Ermine, in which these mutations are very striking. Let us now examine this peculiarity in some of these, and one or two other of our quadrupeds, and we shall be able to judge how far this theory is calculated to maintain its ground among naturalists.

Lepus glacialis, Polar Hare. I have had no other opportunity of becoming acquainted with the changes of colour to which this fine Hare is subject, than that afforded by a specimen which was kindly presented me by Audubon; but this, in itself, affords sufficient evidence on which an opinion may be grounded with safety. The animal was purchased in the flesh by our distinguished American ornithologist, from an Indian, at Newfoundland, on the 15th of August 1833. At that early season, then, in the cold regions of the north, this change from its summer to winter colours takes place. The specimen before me is in that interesting stage when the summer fur had commenced dropping off, and the white winter dress was fast advancing to resume its place. This, as far as has been ascertained, is the only specimen, in summer colour, that exists in any collection. The specimens brought home by Dr Richardson, Captain Parry, and the other adventurous explorers of our polar regions were all in the white pelage of winter. Its summer colour is grayish brown above, with conspicuously black ears. In winter the hairs all become snowy white, even to the roots. In the specimen now before me there is a large spot, nearly a hand's breadth, of pure white on the back, extending nearly to the insertion of the tail; three or four white spots, of about an inch in diameter, also exist on the sides. The hairs forming these spots are shorter than the surrounding fur; a few longer hairs of the summer dress are still interspersed, which had not yet dropped off. The short, white hairs are, in several places, seen pushing forward, whilst the surrounding ones seem to have been thinning and falling. This, then, is undoubtedly the process of the change of colour in this large and interesting species.

Let us now examine how far other quadrupeds, subject to the same mutations, differ from the above, in changing from the brown dress of summer to their white clothing of winter, so much in unison with the snows around them, and which, by concealing them from the view of a host of enemies, is often the cause of their preservation.

Lepus Virginianus, Virginian or Northern Hare. This Hare, which is an exclusively northern species, and not a resident of Virginia, seems to have been not only improperly named, but very imperfectly described by our naturalists. The habits, however, of quadrupeds and birds are, in general, only alluded to in this article, so far as it may enable us to throw some light on the subject now under discussion. I possessed favourable opportunities of witnessing the semi-annual changes of colour to which the *Lepus Virginianus* is subject; having in early life, whilst residing in the state of New York, had several of this species in a state of domestication, where they produced and reared their young. The notes made twenty-two years ago were mislaid, but I have a pretty distinct recollection that the following was the process. The animal shed its white fur in spring. The hair, although yellowish, and soiled by age and exposure, indicated no appearance of a change of colour from white to brown, before dropping off. The new hairs came out reddish brown, in which dress it continued till autumn, when the summer fur gradually dropped off, and the hairs composing the winter pelage became visible through the rest. In four weeks the summer dress had entirely disappeared. The new hairs did not, however, appear pure white, but of a light iron gray colour, mixed with occasional white and black hairs. Gradually the hair grew longer, and seemed to become whiter, till, in the course of a few more weeks, the change was complete. In this case, then, nature seems to pursue the same process as in effecting the changes of colour in some birds, by a gradual blanching after the moult. It will be observed that in this species the hairs are only white, although broadly so at the points, and not throughout their whole extent, as in the *Lepus glacialis*.

Lepus Americanus, American Hare. The changes of this Hare I have also had an opportunity of witnessing, in a warren. It cast its hair in spring, and became of a yellowish brown colour. In the autumn it again commenced shedding. Whether all of the hair dropped off or not I cannot say with positive certainty; new hairs, however, were continually adding; the points of these were white, as they came forward. In the old hairs I could perceive no change. There were many black ones interspersed, but whether these were of a new, or of a former growth, I had no means of ascertaining. I felt confident, however, that the light colour of winter was produced by the new hairs it had received in autumn. This Hare has, by some of our authors, been described as becoming white in winter. It should be observed, however, that the points of the hairs are so narrowly tipped with white, and the markings of brown and cinereous still so visible, that it can in no part of the northern United States be described as white.

Lepus palustris, Marsh Hare. For a description of this species, see Journal of the Academy of Natural Sciences, vol. VII., and an engraving in Audubon's Birds of America, vol. IV., pl. 366. This singular and almost aquatic species sheds its hair twice a year, as I have had an opportunity of ascertaining from having had one in confinement. Although much hair dropped off in autumn, I found it, however, difficult to satisfy myself that this change was as thorough as that in the spring. In the beginning of winter, the points of its hair, instead of growing whiter, as in the American Hare, grow darker, until they have become nearly black, thus proving that the effort of nature is to change the colours from brown to pure white, in some species, and to black in others.

Mustela erminea,* The Ermine. This animal, usually called

* Godman has stated, on the authority of Charles L. Bonaparte (Nat. Hist. vol. I., p. 193), that our common Weasel (*M. vulgaris*) has been proved to be the Ermine in summer pelage. I had an opportunity of ascertaining, from actual examination, that there is some inaccuracy in this statement. I preserved several of both species in the same cage, during a winter, in the northern part of New York. The Ermines became white in autumn, although some of them were still young, and not more than two-thirds grown. The other species retained through the winter their brown colour. Richardson states that the latter species also becomes white in high northern latitudes. This is certainly not the case in lat. 45°. There is another peculiarity which I had occasion to notice. Whilst the Ermine is much abroad during winter, its footprints appearing every where on the snow, the common Weasel is rarely, if at all, seen during that period. A large brood that had made the root of a tree their residence in

Weasel in the northern states, is brown during six months of the year, and in winter becomes white, with the exception of the tip of its tail, which is black.

I was not aware, until this paper had been nearly written, that any one had published an account of a particular examination of the Ermine during those periods when it is subject to change its colour. I am indebted to my friend Professor Moultrie, for a reference to a paragraph in vol. II., p. 24, of Flemming's Philosophy of Zoology, where the following remarks occur.

"The appearances exhibited by a specimen now before us are more satisfactory and convincing. It was shot on the 9th of May 1814, in a garb intermediate between its summer and winter dress. In the belly, and all the under parts, the white colour had nearly disappeared, in exchange for the primrose yellow, the ordinary tinge of these parts in summer. The upper parts had not fully acquired their ordinary summer colour, which is a deep yellowish brown. There were still several white spots, and not a few with a tinge of yellow. Upon examining those white and yellow spots, not a trace of interspersed, new, short, brown hair could be discovered. This would certainly not have been the case if the change of colour is effected by a change of fur. Besides, whilst some parts of the fur on the back had acquired the proper colour, even in those parts, numerous hairs could be observed of a wax yellow, and in all the intermediate stages, from yellowish brown, through yellow, to white.

"These observations leave little room to doubt that the change of colour takes place in the old hair, and that the change from white to brown passes through yellow. If this conclusion is not admitted, then we must suppose that this animal casts its hair at least seven times in the year. In spring it must produce primrose-yellow hair; then hair of a wax yellow; and lastly of a yellowish brown. The same process must be gone through in autumn, only reversed, with the addition of

winter, were seen around this retreat almost every day during autumn, till the ground became covered with snow. They could now no longer be traced, till the snows began to melt, when their holes were again opened, and they were seen as usual. Our *Mustela vulgaris* ought to be carefully compared with that of Europe, which goes under the same name.

a suit of white. The absurdity of this exposition is too apparent to be further exposed."

This examination, and the arguments which have been drawn from it by so able a naturalist as Dr Flemming, would appear, at first sight, to be conclusive. But, on a closer investigation of the subject, and a more careful inquiry into the operations of nature, doubts will arise, both as to the accuracy of his investigations and the soundness of his theory. The Doctor's observations were made, it will be recollected, on the 9th of May, the very period when the Ermine is shedding its winter fur. A sensible writer, in Rees's Cyclopœdia, on the article Hair, makes the following remarks. "As the pulp is intended for the nutrition of the hair, it is found to extend only to that portion of the hair which is in a state of growth; and in those which are deciduous, or are cast at particular seasons of the year, such as the hairs covering the bodies of quadrupeds, the pulp becomes entirely obliterated, before the period of shedding the hair, and its root is converted into a solid pointed mass." If, then, the change, as Dr Flemming contends, had taken place in the old hair, so much in opposition to the views of the writer above quoted, what must have been the process? In the summer, after it had cast its old hair, it must have acquired a coat of wax yellow, which, in process of time, changed to yellowish brown; then in autumn, this same hair would have turned white; now comes the spring, and even in this advanced age of the hair, it once more turns yellow, and then yellowish brown. No harlequin assumes greater changes; and it may be inquired whether the Doctor's theory is not even more absurd than that which he assails with such apparently strong facts and powerful arguments.

It has, however, appeared to me, that the changes in colour to which the Ermine is subject, have not been closely observed, or accurately described. Admitting that this quadruped sheds its hair in spring and autumn, which I hope to prove is the fact, it will be discovered that in this respect the change is not more remarkable than that produced on several other species of quadrupeds, and on many birds; among the latter, as instances, we may mention the Yellow Crowned Warbler, Rice Bird and American Goldfinch.

At an early period of life I had an opportunity of witnessing the change in the pelage of the Ermine, from white to brown. The following is the only memorandum of this occurrence that I can find in my diary. "April 17, 1814. My ermine has become a little tamer, but all its beautiful white hairs are dropping out, and it begins to look like a brown Weasel." I have endeavoured in vain to conjecture the possibility of my having in some way been deceived in my observations. The notes were made, I acknowledge, when I had no knowledge of natural history, and had read no work on the subject; but, on the other hand, I had no favourite theory to support. That the Ermine shed its hair at that early period, I feel confident, from another circumstance. I was in the habit of combing out its white hairs, which were continually falling off, and on one of these occasions it inflicted a wound with its teeth on my hand. Admitting, then, that my observations were correct, and they happened, by a singular coincidence of circumstances, to be made the very year, and within a few weeks of the time when Dr Flemming examined the same species, it will not be difficult to ascertain in what manner he had been deceived. The new hair, both in the Ermine and the Northern and Polar Hares, comes out iu spots, sometimes only of a few inches in diameter. It grows so rapidly that it appears to attain its full length in less than a week. In the meantime the surrounding hair may not yet have commenced shedding, and remains of its former colour. This may account for the white spots on the specimen examined by Dr Flemming, which, in all probability, was a prepared skin. These parts of the animal had not yet moulted, and therefore had undergone no change. With regard to the wax-coloured hair of which he speaks, they must have been the old, faded and soiled hairs of winter, as any one may easily ascertain by examining the stuffed skin of an Ermine. The white pelage soon assumes a yellowish cast.

In the autumn of 1823 I had an opportunity of witnessing the change of the Ermine from brown to its snowy mantle of winter. It had been brought to Charleston by an itinerant showman. The cage, I observed, was every where strewed over with brown hairs that had dropped off. The young hairs were white in appearance, but whether purely so at once, or became more blanched as the season advanced, I had no means of ascertaining, as the Ermine was wild and vicious, and made formidable opposition to an examination. The man raised his price upon it as soon as he ascertained that it was becoming white.

If I were not deceived in my observations, it will, then, appear that the Ermine has only two, instead of seven colours in a year. In the spring it casts off its white coat, and becomes brown; the hairs may be a little lighter at first than they become a week after, as is the case with those of other quadrupeds. In autumn these yellowish brown hairs drop off, and are replaced by the white fur of winter. In investigating the changes to which this animal, which so seldom comes under the inspection of the naturalist, is subject, we may derive some information from this process of nature in regard to species with which we are more familiar. If the old hair of the Ermine changes from white to brown, in spring, previous to its shedding, we may presume that a similar process will be observed in the Virginia Deer. A pair of the latter animals are now shedding their hair under my daily inspection. The long, gray hairs of winter are continually dropping off; they have not undergone the slightest change. Reasoning from analogy, on the principle of Dr Flemming, these ought to become red, the colour of the hair of the deer in summer. This, however, is not the case in this species, nor in any other with which I am acquainted.

Although I feel a tolerable degree of certainty that I was not deceived in my observations on the Ermine, yet, as they were not made in reference to this mooted point, I have a strong desire to have the subject further investigated by some scientific naturalist.*

* The Ermine is easily captured in a box trap, and can be fed on any kind of fresh meat, although it prefers birds and mice. The old, which I had at different times in confinement, although they did not seem to suffer in their health, never became reconciled to captivity. One of this species, however, taken when about five months old, appeared in a few weeks to have lost all its wildness and ferocity, leaving the cage at my call, following me about my study, and taking food from my hand. It was occasionally let loose in the outhouses and barn, where it made fearful havoc among the rats and mice. I observed it did not seize a rat, as this species is wont to do when it attacks poultry, by the neck, but pounced upon it suddenly, sinking its teeth into the skull, and then leaping off a few feet (as if to avoid being bitten), leaving it to struggle and die, without any further effort on the part of its enemy. When it had killed a considerable number, it was in the habit of dragging them on a heap, and covering them with straw. On these occasions it showed some reluctance to return to its place of confinement. After having tasted the sweets of liberty, it would often conceal itself for a day or two in the neighbourhood of its prey, and the calls of hunger alone would bring it back again to the house. On an occasion of this kind it disappeared, and it was supposed had been killed

How far other quadrupeds, in a state of nature, are subject to this biennial shedding of the hair, is an inquiry which we must make, not from books, but from a careful examination of the different species. The generally received opinion of quadrupeds shedding but once in a year, should be more carefully examined, in regard to some of the species, before it is fully adopted. The rule may admit of more exceptions than is generally supposed. The Deer (*Cervus Virginianus*) sheds its hair in Carolina in the month of April, and sometimes earlier. These, till autumn, are of a reddish colour, when the animal assumes a bluish dress, gradually fading to gray. In what manner is this change produced? The Harvest Mouse (*Mus leucophus*, Raff.) is of a fawn colour above in summer, and bluish ash in winter. The black variety of the common Gray Squirrel (incorrectly referred to *Sciurus Carolinensis*) is much more brilliantly black in winter than in summer. Can these old and faded hairs receive an additional blackness and brightness as the cold weather approaches? The fur of quadrupeds is thicker and warmer in winter than in summer, and if they do not shed their hair, they must at last receive an additional covering in autumn; and the same effort of nature which can produce a part, may restore the whole. Possibly it may, on a more careful examination, be found that the new hairs received by these and other species in autumn, may so predominate as to conceal in part the rest. I can easily conceive that hairs may become redder, under the influence of a burning sun; but that they should, after six months, again change and become plumbeous, cannot be credited, without a minute examination of facts. Our domesticated animals can afford no criterion by which we may judge,

by a dog. It was not again observed by the family for six months. On my return from a college vacation, I once more occupied my former chamber. During the night I found some small animal creeping among the blankets, and on procuring a light, ascertained to my great surprise and pleasure, that my long lost pet had come, as if to greet my return. It had, in the meantime, changed its colour, and was beautifully white. How long it had kept possession of the vacant chamber is unknown. I perceived it had found egress through a hole in the hearth. It was from this time no longer placed in confinement, but permitted to take its own course, as it had committed no depredations on the poultry. It attached itself to the premises for about two years afterwards, having formed a large nest of straw under the covering of a globe. In this situation it would sometimes lie for two or three days, as if dozing, and disinclined to take exercise; at other times it was absent for several days in succession. It finally disappeared, from what cause I was never able to ascertain.

with certainty, of all other quadrupeds. The Horse, although it sheds its coat freely in spring, is irregularly losing and restoring its hair throughout the year. A change in food or in health is continually accelerating or retarding this process.

If some apology be requisite for these somewhat desultory remarks, and for having entered so much into detail, it may be offered, in defence, that the subject on which it treats, although apparently trifling and unimportant, leads to many inquiries in philosophy and in natural science. In investigating the changes from brown to white, in some quadrupeds, we are led to inquire into the cause of this change. If it be answered that it is the effect of cold, the question will naturally arise, Why does not cold produce the same effect on other animals? Why do not the Fox, the Raccoon and the Bear, residing in the same neighbourhood, also become white in winter? Besides, the change commences in the heat of summer. The Polar Hare, brought by Audubon, was undergoing the change on the 15th of August. The Ermine was becoming white in the middle of October, in Carolina, when the weather was still very warm. The emperor of China is said to have preserved the *Lepus variabilis* in the warmer parts of his dominions, and even there it was subject to become white. This colour, then, rather anticipates than succeeds cold weather, and it would seem as if there was some constitutional predisposition of the animal to the change. A further examination into these mutations of colour to which birds are subject, may extend our knowledge of physiology in regard to the development and growth of feathers, and the process by which their colours are imparted. Although it is generally admitted that there is no circulation in hair or feathers, still this point does not appear to be fully determined. Bichat* supposed that there was a species of circulation in the interior substance of the hair, by which he endeavoured to explain the changes of colour. This opinion, however, has been contradicted by modern physiologists, who suppose the hairs to be constituted by a colourless, transparent epidermic or horny sheath, filled with a species of coloured pulp; and they contend that the hair

* Anatomie Générale, Tom. II., p. 788.

is not, properly speaking, caniculated, the colouring matter being deposited by the papilla at the same time as the epidermic sheath.* The chemical composition of feathers is believed to be nearly the same as that of hair, nails, &c. consisting principally of inspissated albumen, united with small portions of gelatine and animal oil; and it is a subject of inquiry what chemical action takes place, which imparts colours not only to the shafts of the quill, but to the barbs, and even the minute barbules attached to these barbs. Are these changes in colour effected by the action of the external atmosphere, or by a vital operation? As the air contained in the feathers is exposed to the influence of the vascular pulp, may it not in this way produce a chemical action on the colour of the feathers? Some birds certainly moult twice a year, with the exception of their wing and tail feathers, which, in most species, are only cast annually. As the latter are longer in coming to maturity, may not colours be imparted to them more slowly, and may not this account for the changes of colour which are progressively taking place in the bars on the tails of Hawks and other species?

These inquiries may be also attended with beneficial results to the science of ornithology, in enabling us to discriminate the true from merely nominal species. By a little attention to this subject, Wilson was enabled to expunge from our nomenclature of birds many species which Catesby, Edwards, Pennant, Latham and others had multiplied to a great extent, and to extricate the science from difficulties which were continually leading the student of nature into infinite doubts and perplexities. Through this mean also, Bonaparte, Nuttall and Audubon corrected some of the errors into which their predecessors, from a want of opportunity for a fuller investigation of the subject, had fallen. The work is not yet completed. By a further inquiry into the changes in plumage to which birds are subject, species that are now supposed distinct, may be found to be identical. Many new species of Gulls, that have been multiplying in Europe and America, may prove to be the young, or the winter plumage of species that have long since had a name.† The long disputed, often rejected, and as often readmitted

* Cruveilhier, Anatomie Descriptif, Tom. III., p. 420.

† This genus requires a more careful revision. It will be found, on an attentive examination of the changes of plumage to which the species are subject, and on a comparison with

Winter Hawk (*Falco hyemalis*) might, on being preserved in confinement for a single year, be placed where he ought to be; probably by the side of the Red Shouldered Hawk (*Falco lineatus*). The Connecticut Warbler (*Sylvia agilis*) might claim identity with the once rejected, but now admitted, Mourning Warbler (*Sylvia Philadelphia*). The Autumnal Warbler (*Sylvia autumnalis*), that is abundant in autumn, but has been sought for in vain in spring, might then perhaps find a father in the Black Poll Warbler (*Sylvia striata*). Roscoe's Yellow Throat of Audubon might come to claim relationship with the *Sylvia trichas*; his *Sylvia Childrenii* might be found to be only another name for *Sylvia æstiva*, and his *Sylvia Vigorsii* for *Sylvia pinus*. The difficulty in preserving several of the genera of birds in confinement, for the purpose of studying their habits, has been considerably overrated. Granivorous birds, as it is well known, may be fed on seeds, and in this manner thousands are annually brought from Africa and the East Indies. Warblers, Fly-Catchers, and even Swallows, the most difficult (except the Humming Birds) to preserve, are now kept in cages throughout the year in London, Paris, and especially at Rome. They are fed on vermicelli, and occasionally on chopped meat. A regular temperature in the room where they are confined is preserved throughout the winter. The various species of Ducks, which are easily caught in traps or nets, soon accustom themselves to the food of the poultry yard, and become domesticated. By this means several of our wild species may be made to minister to our pleasures and comforts. The Mergansers, Gulls, Lestris, Procellarias, Anhingas and Cormorants may be fed on fish, their natural food. The Sandpipers, and as in the instance of the Turnstone already noticed, may be preserved by being fed on various kinds of soft food, easily to be procured. I have seen the

those of the eastern continent, that our species are unnecessarily multiplied, and that some that are described as identical with those of Europe, are distinct. *Larus minutus*, *Larus canus* and *Larus fuscus*, as given in Bonaparte's Synopsis, will probably be found not to exist in the United States. Our species, which has gone under the name of *Larus minutus*, is, I am inclined to believe, the *Larus Bonapartii* of Richardson; the *Larus capistratus*, the young of *Larus Bonapartii*. The *Larus argentatoides* the young of *Larus marinus*; and the species which our authors have considered as *Larus Canus*, is probably the immature bird of *Larus zonorhynchus* of Swainson.

Ruff of Europe (*Tringa pugnax*)* for sale in a cage in the Charleston market. It was fed on soaked ship biscuit, on its passage from Liverpool.

On revising this article, which has insensibly grown upon me as I proceeded, and which has extended to a length not originally anticipated, it has occurred to me that it might be construed, by some, as evidencing a disposition to cavil at the writings, and undervalue the labours of the able and estimable naturalists of our country. I should reproach myself with ingratitude, could I for a moment conceive that I had been influenced by such unworthy motives. The number of American naturalists has been exceedingly limited; their labours have been great, and poorly requited, in a pecuniary point of view, or in what they regard of most value, fame. We are indebted to them for

* This species has recently been added to our ornithology by Mr Nuttall, in consequence of a fine specimen having been obtained in the neighbourhood of New York. I doubt whether we have a right to claim it as American. Birds well known on the eastern continent, unless they exist in high northern latitudes, ought to be admitted with great caution into our Fauna. The European Partridge has been killed in the middle states; no doubt it had escaped from a cage. I obtained, some miles from Charleston, a male Chaffinch (*Fringilla cœlebs*), in full song, and afterwards saw its imported mate in a cage in the market. I had for some years in possession a European Turtle Dove (*Columba turtur*), which had escaped from confinement, and, it was afterwards ascertained, had flown on board of a vessel at sea, three hundred miles from the coast of France; and I received two years since, from my friend Mr Nicholson, a European Kestrel (*Falco tinnunculus*), which had alighted on the rigging of the ship, several days' sail from Liverpool, on his passage to America. Surely these species, brought to our country by force or accident, cannot be claimed as belonging to us. It will be a source of regret, if, in this respect, we are led to imitate the example of European ornithologists, who, in order to swell their list of birds, publish every foreign species escaped from a cage, or driven on their coast by a tempest.

The admission of species from specimens obtained from museums, on doubtful authority, is a still greater evil. In this way Mr Nuttall, who exercised so much knowledge and caution in his botanical works, has, in his ornithology, admitted species to which I am inclined to think we have but a doubtful claim. His Reed Bunting (*Emberiza schœniclus*) of Europe, for instance, is given on the authority of specimens presented to Audubon by a keeper of a museum, who stated their having been obtained at Harrisburg, Pennsylvania. I had an opportunity of examining these specimens; the materials with which they were filled, and the English holly bush on which they were fastened, betrayed evidences of their having come from across the Atlantic, ready stuffed and perched. Mr Audubon finally came to the same conclusion. It is difficult to expunge a species once admitted into books. The Willow Wren of Catesby, and the little Spotted Grey Sparrow of Latham, have caused many a poor ornithologist to wear out his shoes in a fruitless search. It might be advisable to act towards these perplexing species as is done in some colleges, where a name, if not answered to after having been called a certain number of times, is stricken from the rolls.

those exertions and sacrifices which have removed the obstructions in the paths of science, and have tended to interest, enlighten and instruct us. Their errors were the results of circumstances beyond their control; and the best service we can render them, or their memories, is to supply the materials which will render their works immortal. In our researches after truth, in science, where the wisest are liable to err, it is not only admissible, but a duty which we owe to mankind, to point out, in the language of courtesy and respect, the mistakes into which we conceive our superiors to have fallen. Our distinguished naturalists we should claim as a portion of our country's choicest wealth, and in them, as in the railroads which are spreading comfort and sociality over every quarter of our land, we should all strive to have an interest and hold a share, in order that we, in our turn, may pass along with greater safety and comfort.

Specimens elucidating some of the Points treated of in this Communication.

No. 1. *Lepus Americanus*; obtained on the 20th of October. Examined the animal in the flesh. It was shedding its hair. On the back and a spot on each of the sides, the reddish summer fur still remains. On the sides and near the tail the lighter winter fur is visible. The difference of colour is sufficiently apparent.

No. 2. *Fringilla Savanna*; 23d of February. Moulting around the throat, and extensively on the neck, breast and back. The feathers on the breast coming forward nearly white.

No. 3, 4. *F. Savanna*; May 4. The fresh moulting nearly completed, and the summer colours restored. In these specimens the moult had extended to the larger feathers in the tail and wings.

No. 5. *Fringilla tristis*, male; 16th of March. The summer feathers appearing bright yellow on the breast. Other specimens had the feathers coming out pure black on the crown.

No. 6, 7, 8, 9. *Fringilla Pensylvanica*, White Throated Sparrow; in various stages of moulting. Obtained in March and April.

No. 10. *Bombycilla Carolinensis*; 23d of February. Young feathers appearing on the breast.

No. 11. *Fringilla cyanea*, male; May 3d. Moulting extensively. The young feathers coming forward nearly in bright colours.

No. 12, 13, 14, 15, 16, 17. *Sylvia coronata*; obtained from the 6th of March to the 10th of April. Every individual I obtained at the latter date, both male and female, was undergoing the change.

No. 18. *Sylvia coronata*; May 1st. Summer colours nearly restored. The moult has been general.

No. 19. *Fringilla palustris*; April. All the specimens procured at this season were in extensive moult.

No. 20. *Emberiza oryzivora*, Rice Bird; May 6th. Moulting on the breast. The young feathers coming forward nearly black.

No. 21. *Ardea cœrulea*, Blue Heron; female. This bird was obtained from the nest in June 1835; it became very gentle. On the following March it commenced moulting irregularly; all the new feathers were tinged, more or less, with blue. In July 1836, when a little more than a year old, it was accidentally killed.

ARTICLE V.

Determination of the Longitude of several Stations near the Northern Boundary of Ohio, from Transits of the Moon, and Moon-culminating Stars, observed in 1835, *by Andrew Talcott, M. A. P. S, late Capt. U. S. Engineers. By Sears C. Walker, M. A. P. S. Read March* 2, 1838.

SECTION I.

In the summer of 1835, Captain Talcott was employed by the government of the United States to make a series of observations near the southern boundary of Michigan. The object of this mission was to settle the long disputed question of the Northern Boundary of Ohio, which, on the occasion of the proposed admission of Michigan into the Union, had been made the subject of a controversy, that threatened, for a while, to disturb the peaceful relations between the neighbouring states. Indeed, such was the pertinacity of the rival claimants, that an armed force was arrayed on each side, and a nice geographical question was on the point of being decided by a tribunal, of all others, least competent to do justice to its merits. The cause of this controversy, which fortunately terminated without fatal consequences, may no doubt be traced to an error in the map used by the parties to the original charter of Ohio. In this charter it was ordained that the northern boundary of Ohio should be the line running due east from the southernmost point of Lake Michigan, and terminating in the southernmost point of North Cape, in the eastern extremity of Lake Erie. Subsequent observations by Captain Talcott have shown that North Cape is in latitude 41° 44′ 8″, while the South Bend, so called, of Lake Michigan, is in 41° 37′ 6″, leaving a discrepancy of about eight geographical miles. In 1817, deputy-surveyor Harris traced a boundary line from North Cape, Lake Erie, S. 87° 42′ W., towards South Bend, Lake Michigan. This was recognised by the citizens of Ohio as their true northern boundary, though differing from a parallel of latitude required by the other condition of the charter. On the contrary, another line fulfilling this condition of the charter was drawn by deputy-surveyor Fulton, in 1818, being a continuation eastward of the parallel of South Bend, Lake Michigan, to Lake Erie, seven miles south of the stipulated point, North Cape, and cutting off from Ohio the mouth of Maumee river, and the greater part of Maumee bay. This line was claimed as their true southern boundary by the citizens of Michigan, and hence the controversy referred to, for the facts of which I am indebted to Mr Henry S. Tanner.

To place this subject in its proper light before the interested parties, Captain Talcott was sent to make the necessary observations. The latitudes quoted above were obtained by a zenith micrometer, described in Pearson's Astronomy. The results furnished by this instrument present a remarkable uniformity. The probable error of a single observation does not exceed four hundred feet, and that of the mean for each station, excluding the errors of the star-catalogues, less than two hundred feet. It is hoped that these observations will be made public, as they will serve to make known in this country, one of the simplest and most accurate modes of determining latitudes by a portable instrument.

The labours of Captain Talcott were not confined to the determination of latitudes. At the two most important stations, South Bend, Lake Michigan, and Turtle Island, Lake Erie, as well as at Huron in Ohio, he observed a series of moon-culminations, the first, I believe, communicated to this society. They form an important and valuable contribution to the geography of Ohio, Indiana, Illinois and Michigan, and will be highly useful in perfecting the maps of those states. Indeed, these stations of Captain Talcott are the only well determined points in the United States, north of the Ohio river; the longitudes of the maps of these northern states having hitherto been made to depend on the observations of Ellicott and De Ferrer, at points on the Ohio river, and on meridian lines traced from this river several hundred miles northward by the deputy-surveyors. When we consider the uncertainty of such operations, from the irregularity of local variations of the compass, it will appear somewhat remarkable that the maps of those states should have been so correct as they are shown to be from the result of Captain Talcott's observations. Thus we find for the position of Turtle Island, Lake Erie,

	h.	*m.*	*s.*
By Tanner's map U. S., 1837, Turtle Island west of Capitol, - - - - - - - - - -		25	44·2
Deduct for error of Lambert's longitude of Capitol, used in this map, - - - - - - - - -			25·0
By the same map, corrected for Lambert's error, -		25	19·2
By Capt. Talcott's moon-culminations, Turtle Island, W. of Greenwich, - - - - - - - - -	5	33	31·8
Deduct longitude of the Capitol (Section XI., note), -	5	8	7·0
By Capt. Talcott's moon-culminations, T. Island west of Capitol, - - - - - - - - - -		25	24·8
By Tanner's map, Turtle Island too far east, - -			5·6

A similar comparison for South Bend, Lake Michigan, gives,

South Bend, by Tanner's map, west of Capitol, - -	41	15·2
Deduct Lambert's error, - - - - - -		25·0
Result by map, - - - - - - - - -	40	50·2
Result by moon-culminations, - - - - - -	41	11·6
By Tanner's map, South Bend too far east, - -		21·4

SECTION II.

The full advantages afforded by moon-culminations, for perfecting geography, were first pointed out by Mr Nicolai, director of the Manheim observatory, in 1821, in a paper which appeared in the first number of Schumacher's celebrated Astronomische Nachrichten. The same subject was shortly after proposed to the Astronomical Society of

London, by Francis Bailey, in a paper containing an original method for their reduction. This zealous astronomer selected lists of moon-culminating stars, and caused them to be distributed in advance to every observatory. The labours of Bessel, Hansen, Mollweide, Dumouchel, and others, have further developed the method of making and reducing this kind of observations. But the principal improvement was made in this method by the Nautical Almanac Committee, in causing the announcements of moon-culminations to be made in such a form, since 1834, that the reduction of them consists merely in the interpolation of the series there given for the right ascension of the moon's bright limb, at its upper and lower culminations at Greenwich.

These phenomena are now regularly observed at the British and continental observatories, and their longitude from each other has been determined by this method with an accuracy scarcely inferior to that of geodetic measures, powder signals, or the aggregate of observed occultations and eclipses. The observations for longitude, made by Captain Talcott, consist of one occultation, and three series of moon-culminations, at three different stations. In making the latter, a portable transit instrument was used, of three and a half feet focal length, and two inches and five-eighths aperture. Care was taken, previous to each moon-culmination, to adjust the horizontal axis by a delicate level, and the bias of the instrument was therefore as small as a temporary mounting would permit. The line of collimation of the instrument was adjusted for the mean of the wires, and does not appear to have undergone sensible change during the series, though frequent observations were made with the reversed axis, to detect the error, if any, in this adjustment. The deviation in azimuth was ascertained by observing high, low, and circumpolar stars, and a temporary meridian mark served to give steadiness to this adjustment. The sum of the deviations was usually less than 0·5 sec. in time. The results have been corrected for this sum, as far as it could be ascertained. It is difficult, with an instrument temporarily mounted, to furnish a greater degree of precision. The error arising from deviations so small is almost insensible, in the longitudes deduced from moon-culminations. The times were noted by calling out to assistants, and were registered on two chronometers by Brockbank, the assistant noting to the nearest beat 0·4 sec. The probable error of a transit thus noted, for each of five wires (excluding the personal equation to which this and all other methods are liable), may be stated at 0·2 sec., or at most 0·3 sec. in time. Below are given the observations, corrected for deviations, and for rate and error of chronometers, in the usual form.

Station No. I. East of Huron, Ohio, Latitude 41°, *nearly.*

Date	Name.	Apparent R. A. h.	m.	s.	Wires.
1835, July 8,	Moon I.,	18	5	3·95	3
	φ Sagittarii,	18	35	23·14	3
	σ Sagittarii,	18	45	4·20	3
	ζ Aquilæ,	18	57	51·64	3
9,	Moon I.,	19	12	31·77	5
	Moon II.,	19	15	2·81	5
	γ Aquilæ,	19	38	27·02	5
	59 Sagittarii,	19	46	51·09	5
10,	h^2 Sagittarii,	19	26	42·17	5
1835, July 10,	59 Sagittarii,	19	46	51·14	5
	Moon II.,	20	20	15·72	5
	υ Capricorni,	20	30	41·12	5
	ψ Capricorni,	20	36	21·25	5
11,	Moon I.,	21	21	14·06	5
	k Capricorni,	21	33	28·08	5
	δ Capricorni,	21	37	57·65	5
12,	δ Capricorni,	21	37	57·46	2
	Moon II.,	22	17	18·95	3

Station No. 2. Turtle Island, Lake Erie, Latitude 41° 45′ 4″.

Date	Name.	Apparent R. A. h.	m.	s.	Wires.
1835, Aug. 1,	α Virginis,	13	16	31·00	5
	α Bootis,	14	8	9·14	5
	Moon I.,	14	35	39·61	5
2,	Moon I.,	15	32	53·64	5
	α Serpentis,	15	36	9·95	5
	δ Scorpii,	15	50	36·98	5
	δ Ophiuchi,	15	5	43·83	5
3,	Moon I.,	16	33	43·62	5
	A Ophiuchi,	17	5	14·57	5
	θ Ophiuchi,	17	11	55·16	5
6,	μ Sagittarii,	18	3	56·13	5
	π Sagittarii,	18	59	59·26	5
	Moon I.,	19	48	54·88	5
	σ Capricorni,	20	9	54·52	5
	π Capricorni,	20	17	54·75	5
7,	σ Capricorni,	20	9	54·43	5
	π Capricorni,	20	17	54·51	5
	Moon I.,	20	51	17·82	5
	*Moon II.,	20	53	41·31	5
	χ Capricorni,	20	59	8·66	5
	ζ Capricorni,	21	17	16·72	5
	β Aquarii,	21	22	54·36	5
8,	χ Capricorni,	20	59	8·45	5
	ζ Capricorni,	21	17	16·58	5
1835, Aug. 8,	Moon II.,	21	51	48·83	5
	35 Aquarii,	21	59	58·11	5
	σ Aquarii,	22	21	56·98	5
9,	35 Aquarii,	21	59	58·00	5
	σ Aquarii,	22	21	57·08	5
	Moon II.,	22	45	36·43	5
	α Piscis Aust.	22	48	33·81	5
	α Pegasi,	22	56	35·16	5
	φ Aquarii,	23	5	48·94	3
10,	δ Aquarii,	22	45	55·74	5
	φ Aquarii,	23	5	48·64	5
	Moon II.,	23	35	42·07	5
	p Piscium,	23	50	15·65	5
	r Piscium,	23	53	31·57	5
11,	p Piscium,	23	50	15·65	5
	r Piscium,	23	53	31·89	5
	Moon II.,	0	23	6·26	5
	m Ceti,	0	44	36·59	5
14,	Moon II.,	2	40	15·99	5
	η Tauri,	3	37	42·34	4
16,	η Tauri,	3	37	42·48	5
	Moon II.,	4	17	22·20	5
	α Tauri,	4	26	28·33	5

* 0·17 sec. has been added to the time of the transit of the moon's II. limb, for defective illumination. See Table II.

Station No. 3. *South Bend, Lake Michigan, Latitude* 41° 37′ 6″.

Date	*Name.*	h.	m.	s.	*Wires.*
1835, Aug. 31,	Moon I.,	17	17	52·15	5
	D Ophiuchi,	17	33	34·17	5
	4 Sagittarii,	17	49	44·45	5
Sept. 1,	4 Sagittarii,	17	49	44·41	5
	Moon I.,	18	22	10·07	5
2,	φ Sagittarii,	18	35	23·03	5
	σ Sagittarii,	18	45	4·07	5
	Moon I.,	19	26	25·69	5
	c Sagittarii,	19	52	32·73	5
3,	59 Sagittarii,	19	46	51·44	5
	c Sagittarii,	19	52	32·88	5
	Moon I.,	20	28	35·30	5
	ψ Capricorni,	20	36	21·59	5
	ν Capricorni,	20	55	2·97	5
4,	ψ Capricorni,	20	36	21·51	5
	ν Capricorni,	20	55	2·87	5
	Moon I.,	21	27	14·72	5
6,	δ Capricorni,	21	37	58·11	5
	μ Capricorni,	21	44	20·61	5
1835, Sep. 6,	μ Capricorni,	21	44	20·34	5
	τ² Aquarii,	22	40	53·47	5
	δ Aquarii,	22	45	55·89	5
	ψ³ Aquarii,	23	10	25·23	5
	*Moon I.,	23	13	2·95	5
	Moon II.,	23	15	12·49	5
	s Piscium,	23	56	55·53	5
7,	ψ³ Aquarii,	23	10	24·86	5
	n Piscium,	23	39	30·21	5
	s Piscium,	23	56	55·65	5
	Moon II.,	0	3	26·86	5
8,	s Piscium,	23	56	55·78	5
	Moon II.,	0	49	54·54	3
	e Piscium,	0	59	55·13	5
10,	o Piscium,	1	36	43·16	5
	ξ Piscium,	1	45	3·30	5
	Moon II.,	2	21	28·19	4
	μ Ceti,	2	36	3·87	5
	π Arietis,	2	40	7·29	4

SECTION III.

To facilitate the final determination of the longitudes of these stations, a subsidiary Table I. has been prepared by interpolation from the series in the Nautical Almanac, which expresses the right ascension of the moon's bright limb at its upper and lower culmination at Greenwich. In this Table, employing the usual notation for series,

$\alpha_{0+t'}$ = The observed R. A., moon's bright limb, as given in list of moon-culminations for the several stations,

t' = The western longitude from Greenwich in seconds of time, which must be used as an argument, in order to interpolate from the series in the N. Almanac, the value of $\alpha_{0+t'}$ as observed,

log. n = Log. factor, to convert seconds of $\alpha_{0+t'}$ into seconds of t'; in other words, to convert parts of the series into parts of the argument.

* 0·10 sec. have been subtracted from the time of transit of the first limb, for defective illumination. See Table II.

These values of t' and log. n have been computed, at my request, by E. O. Kendall.

TABLE I.

Date. 1835.		Limb.	No. of Station.	Observed Right Ascension Moon's bright limb $a_0 + t'$			Resulting Longitude from Greenwich not corrected for Tabular error t'			Log. n.
				h.	m.	s.	h.	m.	s.	
July	8	I	1	18	5	3,95	5	29	45,16	1 ·32818
	9	I	1	19	12	31,77			46,61	1 ·33355
	9	II	1	19	15	2,81			48,79	1 ·33384
	10	II	1	20	20	15,72			55,29	1 ·35684
	11	II	1	21	21	14,06			46,47	1 ·39095
	12	II	1	22	17	18,95			32,58	1 ·42817
Aug.	1	I	2	14	35	39,61	5	33	15,81	1 ·41364
	2	I	2	15	32	53,64			27,90	1 ·38756
	3	I	2	16	33	43,62			28,54	1 ·36166
	6	I	2	19	48	54,88			10,86	1 ·35128
	7	I	2	20	51	17,82			5,77	1 ·37718
	7	II	2	20	53	41,31			0,76	1 ·37720
	8	II	2	21	51	48,83			9,94	1 ·41091
	9	II	2	22	45	36,43			9,68	1 ·44408
	10	II	2	23	35	42,07			12,77	1 ·47204
	11	II	2	0	23	6,26			12,99	1 ·49155
	14	II	2	2	40	15,99			24,23	1 ·49046
	16	II	2	4	17	22,20			38,85	1 ·45126
	31	I	3	17	17	52,15	5	48	63,39	1 ·35460
Sept.	1	I	3	18	22	10,07			55,44	1 ·34786
	2	I	3	19	26	25,69			63,06	1 ·35545
	3	I	3	20	28	35,30			57,82	1 ·37610
	4	I	3	21	27	14,72			51,84	1 ·40489
	6	I	3	23	13	2,95			48,26	1 ·46575
	6	II	3	23	15	12,49			47,09	1 ·46590
	7	II	3	0	3	26,86			50,64	1 ·48462
	8	II	3	0	49	54,54			65,03	1 ·49654
	10	II	3	2	21	28,19			62,69	1 ·49294

The values of t' and n, in Table I., have been interpolated by an indirect process, which consists in deducing values of the argument corresponding to given values of the series. A direct method of computing the unknown quantity t' has been given by Mollweide, Astr. Nachr., No. 40. I have preferred the formulæ given by Bessel, No. 33, of the same. As his modification of Newton's formula for interpolation adapted to this subject does not appear to have been translated into English, I propose to give the substance of it here. The grounds of preference of it are, its rapid convergency, and its adaptation to computation by logarithms.

For the arguments,

$$-2, -1, -0, +1, +2, +3,$$

let the values of a function be

$$a_{,,,}; \quad a_{,,}; \quad a_{,}; \quad a'; \quad a''; \quad a'''.$$

Denoting the differences as in the following scheme,

:	I	II	III	IV	V
	:				
a					
	b	c			
a			d		
	b	c		e	
a					
	b		d		f
a		c		e	
	b				
a			d		
	b	c			
a					
	:				
:					

and making

$$\begin{aligned} a &= \tfrac{1}{2}(a_{,} + a') \\ c &= \tfrac{1}{2}(c_{,} + c') \\ e &= \tfrac{1}{2}(e_{,} + e') \\ g &= \tfrac{1}{2}(g_{,} + g') \end{aligned}$$

then the value of the function for any argument t, expressed in parts of the constant interval unity,

$$= a + \frac{t - \frac{1}{2}}{1}\, b + \frac{t \, . \, \overline{t - 1}}{1 \, . \, 2}\, c + \frac{t \, . \, \overline{t - 1} \, . \, \overline{t - \frac{1}{2}}}{1 \, . \, 2 \, . \, 3}\, d$$

$$
(1)\quad + \frac{t+1 \,.\, t \,.\, t-1 \,.\, t-2}{1.2.3.4} e + \frac{t+1 \,.\, t \,.\, t-1 \,.\, t-2 \,.\, t-\frac{1}{2}}{1.2.3.4.5} f + \frac{t+2 \,.\, t+1 \,.\, t \,.\, t-1 \,.\, t-2 \,.\, t-3}{1.2.3.4.5.6} g
$$

Also the variation of the function for the unit of interval at the rate for the arrangement t, being the first differential quotient of the above formula,

$$
(2)\quad = \frac{b}{1} + \frac{2t-1}{1.2} c + \frac{3t^2-3t+\frac{1}{2}}{1.2.3} d + \frac{4t^3-6t^2-2t+2}{1.2.3.4} e + \frac{5t^4-10t^3+5t-1}{1.2.3.4.5} f + \frac{6t^5-15t^4-20t^3+45t^2+8t-12}{1.2.3.4.5.6} g\,*
$$

If we denote, for conciseness, the co-efficients of b, c, d, &c., in (1), by X, X′, X″, &c.; and those of c, d, e, &c., in (2), by T, T′, T″, &c., we shall have:

Value of function for argument t, $= a + b\mathrm{X} + c\mathrm{X}' + d\mathrm{X}'' + c\mathrm{X}'''$, &c.

Rate of variation for argument t, $= b + c\mathrm{T} + d\mathrm{T}' + d\mathrm{T}'' + e\mathrm{T}'''$, &c.

To apply these formulæ to the reduction of moon-culminations, for an assumed meridian t seconds in time + west of Greenwich, we must make the argument the difference of meridians, the unit of interval being 43200 seconds. Two sets of coefficients are required for each

* The coefficient of g in (2), in Bessel's paper, is thus stated, owing to a typographical error.

$$
\frac{6t^5-15t^4-40t^3+90t^2+18t-27}{1.2.3.4.5.6}
$$

new argument. The values of T, T′, &c. for the even hours, or twelfth parts of the argument, are given by Bessel; those of X, X′, &c. by Nicolai, Astr. Nach., 37. Where a single, or few observations are required to be reduced for a particular station, the labour of computing T, T′, &c. may be saved by means of the following transformation, which I do not recollect to have seen in any publication.

The comparison of (1) and (2) gives,

$$cT = c . X$$

$$dT' = d \left\{ X' + \frac{1}{3.4} \right\}$$

$$eT'' = e \left\{ X'' - \frac{1}{2.3} X \right\}$$

$$fT''' = f \left\{ X''' + \frac{1}{3.4} X' - \frac{1}{4.5.6} \right\}$$

$$gT^{iv} = g \left\{ X^{iv} - \frac{1}{2.3} X'' + \frac{1}{2.3.5} X \right\}$$

$$hT^{v} = h \left\{ X^{v} + \frac{1}{3.4} X''' - \frac{1}{4.5.6} X' + \frac{1}{4.5.6.7} \right\}$$

$$iT^{vi} = i \left\{ X^{vi} - \frac{1}{2.3} X^{iv} + \frac{1}{2.3.5} X'' - \frac{1}{4.5.7} X \right\}$$

whence, making

$$\alpha = b + \frac{1}{3.4} d - \frac{1}{4.5.6} f + \frac{1}{4.5.6.7} h -, \text{\&c.}$$

$$\beta = c - \frac{1}{2.3} e + \frac{1}{2.3.5} g - \frac{1}{4.5.7} i +, \text{\&c.}$$

$$\gamma = d + \frac{1}{3.4} f - \frac{1}{4.5.6} h +, \text{\&c.}$$

$$\delta = e - \frac{1}{2 \cdot 3} g + \frac{1}{2 \cdot 3 \cdot 5} i -, \text{ \&c.}$$

$$\varepsilon = f + \frac{1}{3 \cdot 4} h -, \text{ \&c.}$$

$$\zeta = g - \frac{1}{2 \cdot 3} i +, \text{ \&c.}$$

and calling

V = the hourly variation for argument t, we have, enclosing in brackets the log. co-efficient,

$$V = \frac{1}{12} (\alpha + \beta X + \gamma X' + \delta X'' + \varepsilon X''' + \zeta X^{vi} +, \text{ \&c.})$$

$$n = \frac{3600}{V} = [3{\cdot}55630] \frac{1}{V}$$

The value of V is the same as that given in the N. Almanac, viz. the variation of the R. A. of the moon's bright limb in one hour of longitude, and may be obtained for the argument t, as above, from the values of V, for Greenwich.

Although I have given several terms in the series for the value of V, three are, in all instances, sufficient for reducing moon-culminations; hence, adopting the usual notation for the argument of a series, the formulæ used in computing Table I. may be briefly recapitulated, t being an approximate longitude, differing less than a minute from the true longitude,

$$\alpha_{0+t} = a + bX + cX' + dX'' + eX'''$$

$$n = n_{0+t} = [4{\cdot}63548] \frac{1}{\alpha + \beta X + \gamma X'}$$

$$t' = t + n \left(\alpha_{0+t'} - \alpha_{0+t} + \frac{1}{n+1} \cdot \theta\right)$$

where,

θ = the correction of the sidereal time of observation

$$\mathrm{X} = [5{\cdot}3645163] \cdot (t - 6^h\ 0^m\ 0^s)$$
$$\mathrm{X}' = [0{\cdot}42800]\ t \cdot (t - 12^h\ 0^m\ 0^s)$$
$$\mathrm{X}'' = [9.5229]\ \mathrm{X}\mathrm{X}'$$
$$\mathrm{X}''' = [9.6499]\ \mathrm{X}' \cdot (t + 12^h\ 0^m\ 0^s)\ (t - 24^h\ 0^m\ 0^s)$$
$${}^*\mathrm{X}^{iv} = [9.3010]\ \mathrm{X}\mathrm{X}'''.$$

SECTION VI.

The observed increase of the right ascension of the moon's bright limb, as derived directly from the lists of moon-culminations, requires a correction, when the same stars have not been observed at both places, as well as when the number of wires used at each place is not uniform. The formula for computing this correction has been derived from a combination of Gauss's application of the calculus of probabilities to the reduction of moon-culminations, as given by Nicolai, Astr. Nachr., No. 26, with Dumouchel's method, No. 125 of the same, for the different stars. Thus, for the European observatory and western station respectively, let

A' and A = the observed R. A. of a star,

E = $\mathrm{A}' - \mathrm{A}$ for the same star,

E = a similar value for another star,

l and l' = the number of wires on which each limb was observed,

a and a' = similar values for a star,

$\lambda = \dfrac{l\,l'}{l + l'}$, for the moon's limb,

$\mu = \dfrac{a\,a'}{a + a'}$, for one star,

μ' = a similar value for another star,

ε = the correction of the observed increase of the right ascension of the moon's bright limb,

Σ = symbol to denote the aggregate of similar quantities.

Then we have,

* This term is not required for reducing moon-culminations.

$$\varepsilon = \frac{\Sigma \left(E \, . \, \frac{\lambda \mu}{\lambda + \mu} \right)}{\Sigma \, \frac{\lambda \mu}{\lambda + \mu}}$$

SECTION VII.

In order to deduce the final correction of t' in Table I., let τ, τ', ν and θ' denote for the European observatory values corresponding respectively to t, t', n and θ, for a western station. Effecting the interpolation by means of the same values of a, b, c, &c.; α, β, γ, &c.; and with constant values of X, X$'$, &c., for the known value of T, or longitude of each observatory from Greenwich, we derive for the longitude of the western station, independent of the stars' and moon's right ascensions in the N. Almanac,

$$T = t + \nu \left(\alpha_{0+\tau} - \alpha_{0+\tau'} + \varepsilon - \frac{\theta'}{\nu + 1} \right)$$

Also calling W the *weight* of each result, and η the probable error of a transit over a single wire (assumed equal $\pm$ 0.2 sec.), and making $\sigma = \mu + \mu' + \mu'' +$, &c. we have, after Gauss's method, quoted above,

$$W = \frac{\lambda \sigma}{(\lambda + \sigma) n n}$$

$$\text{Probable error of final result for each station} = \frac{\eta}{\sqrt{\Sigma \frac{\lambda \sigma}{(\lambda + \sigma) n n}}}$$

The values of T, for the several Stations, are given below. The weights of the Cambridge and Edinburgh observations are computed on the supposition that the moon and stars are observed on five wires, as this number is not stated in the lists of moon culminations published in Mem. Royal Astron. Soc. When both limbs are observed at the same culmination, l or l' is the sum of the wires for both limbs. The result of a single comparison of a western station has the weight w. The result for each day has the weight W computed by the above formula, making a' and l' equal to the sum of all the wires on which the moon or a star was observed at all the European observatories.

In a few instances an observation at the western station is compared with a European observation of the succeeding day, in which case $T = 24^h$ — western longitude of Greenwich from the station.

Station No. 1. *East of Huron, Ohio.*

Date. 1835.	Limb.	Observatory compared with	Date.	Limb.	Resulting Longitude.	*w* for each comparison.	Mean result for each day.	W for each day.
					h. m. s.		*h. m. s.*	
July 8	I	Greenwich	8	I	5 29 48·4	0·00276		
8	I	Kremsmunster	8	I	45·2	0·00331		
							5 29 46·65	0·00339
9	I & II	Kremsmunster	9	I	53·9	0·00307	53·90	0·00307
10	II	Edinburgh	10	II	56·4	0·00387	56·40	0·00387
							h. m. s.	
Final Result, Station No. 1, West of Greenwich,							5 29 52·46	0·01033
Probable Error,						±	2·95	

Station No. 2. *Turtle Island, Lake Erie.*

Date. 1835.	Limb.	Observatory compared with	Date.	Limb.	Resulting Longitude.	*w* for each comparison.	Mean Result for each day.	W for each day.
					h. m. s.		*h. m. s.*	
Aug. 3	I	Greenwich	3	I	5 33 34·5	0·00315		
	I	Dorpat	3	I	30·1	0·00236		
							5 33 32·62	0·00384
6	I	Edinburgh	6	I	34·4	0·00248		
	I	Cracow	6	I	20·5	0·00324		
	I	Dorpat	6	I	27·9	0·00296		
							26·99	0.00488
7	I & II	Edinburgh	7	I	32·1	0·00406		
	I & II	Greenwich	7	I	31·5	0·00406		
	I & II	Cambridge	7	I	25·6	0·00352		
							29·92	0·00680
8	II	Greenwich	8	II	39·0	0·00301		
	II	Cambridge	8	II	28·1	0·00283		
							33·72	0·00402
9	II	Greenwich	9	II	37·6	0·00237		
	II	Cambridge	9	II	29·3	0·00216		
	II	Dorpat	9	II	36·9	0·00226		
							34·73	0·00381
10	II	Greenwich	10	II	40·3	0·00190	40·30	0·00190
11	II	Greenwich	11	II	36·2	0·00173		
	II	Dorpat	11	II	25·6	0·00152		
							31·24	0·00232
							h. m. s.	
Final Result, Turtle Island, West of Greenwich,							5 33 31·82	0·02757
Probable error,						±	1·81	

Station No. 3. South Bend, Lake Michigan.

Date. 1835.	Limb.	Observatory compared with	Date.	Limb.	Resulting Longitude.	W for each comparison.	Mean Result for each day.	W for each day.
					h. m. s.		*h. m. s.*	
Aug. 31	I	Edinburgh	31	I	5 49 27·3	0·00326		
31	I	Cambridge	31	I	21·3	0·00244		
							5 49 24·73	0·00414
Sept. 1	I	Cambridge	1	I	19·4	0·00288	19·40	0·00288
2	I	Greenwich	2	I	12·6	0·00324		
2	I	Cambridge	2	I	20·5	0·00324		
2	I	Cracow	2	I	10·4	0·00365		
							14·33	0·00608
3	I	Kremsmunster	3	I	16·7	0·00332		
3	I	Dorpat	3	I	18·5	0·00307		
							17·56	0·00459
4	I	Edinburgh	5	I	25·6	0·00194		
4	I	Greenwich	5	I	14·0	0·00194		
4	I	Cracow	5	I	8·5	0·00346		
4	I	Dorpat	4	I	14·3	0·00294		
							14·42	0·00432
6	I & II	Edinburgh	6	I & II	23·1	0·00351		
6	I & II	Cambridge	6	I & II	16·6	0·00293		
							20·14	0·00355
7	II	Cambridge	7	II	14·8	0·00135		
7	II	Dorpat	7	II	23·2	0·00157		
							19·32	0·00245
8	II	Greenwich	8	II	25·6	0·00127		
8	II	Dorpat	8	II	26·0	0·00134		
							25·81	0·00173
							h. m. s.	
Final Result, South Bend West of Greenwich,							5 49 18·55	0·02974
Probable error,							± 1·74	

SECTION IX.

The longitudes of these stations may perhaps require a further correction for the comparative *irradiation* of Captain Talcott's and the European transit instruments. This subject, though frequently discussed, is still left in uncertainty. Corresponding observations, with telescopes of different optical capacity, indicate that the apparent diameter of the moon is subject to a small variation, depending upon this capacity, and upon the degree of illumination of the wires. If this were the only effect of irradiation, it could be easily allowed for by reducing the diameter, in the Nautical Almanac, to the same dimensions as that which has been observed. It is obvious that the error arising from this source must vanish, when each limb of the moon has been observed the same number of times, and with equal weights. Though this can hardly be expected, still, the error would vanish on using the mean of a great number of results for each limb, and giving equal weights to the results by each limb. The mode of deducing the correction of this error is given below, for the several instruments, and is derived from the observed interval between the transits of the two limbs of the moon, when nearly full; this duration being corrected for the defective illumination of one of the limbs. It appears from experience that there still remains an error of irradiation, which no multiplication of observations by the same observers, with fixed telescopes, can completely remove. Thus the Dorpat and Paris transit instruments appear to be liable to a constant error of this kind; and the difference of longitude between those observatories, derived from moon-culminations, cannot, without correcting for it, be made to agree with the results of occultations and of geodetic measurements. Argelander found that his transit instrument at the Abo observatory, while it gave correct longitudes, when compared with several instruments of nearly equal capacity at the German observatories, required a constant correction to reconcile with these the results by the Greenwich ten feet transit instrument. Again, Dr Robinson finds that without the application of such a correction, it is impossible to deduce a correct difference of longitude by the Greenwich and Armagh transit instruments. In some of the instances referred to, the outstanding error, even when the mean of the results by both limbs is used, amounts to three seconds of longitude in time. Dr Robinson has proposed to deduce this correction by means of comparison of the observed diameter of the sun, as deduced from the transits by the same instruments. Though successful, in his own case, I do not know that his method has been generally adopted. I will here make a remark which I have not noticed in any papers on this subject, that it seems to me highly probable that there is a personal equation, arising from the difficulty of noticing the precise instant when the moon's limb is tangent to the centre of the wire of a transit instrument. If such be the case, it must vary with the observer, and with the optical capacity of the instrument used. It would also vary with the different limbs; since the transit of the first limb exhibits the approach to tangency of the convex side of an arc, that of the second limb of the concave side of the same. Granting the existence of such an equation, it could hardly be the same for each limb; the difference, then, remains constant, with the same observer and same instrument, and cannot be eliminated otherwise than by a multiplication of observers and instruments. Whatever be the cause of the error of irradiation, experience has shown that the results of moon-culminations, like those of eclipses of Jupiter's satellites, approach nearer to the truth in proportion as the instruments approach to equality in their optical powers. The method of computing the correction of Burckhardt's semidiameter, from observations of both limbs of the moon, when nearly full, is given by Professor Airy, in the Greenwich Observations for 1836. His method, combined with Encke's formulæ, in the Berlin Jahrbuch for 1832, p. 251, may be thus analytically expressed.

S = the correct sidereal time of the moon's semidiameter passing the meridian,

S' = the computed time,

$2I$ = the observed duration of the transit of the moon's defective diameter,

α = the sid. time of U. C. of moon's defective limb,

A and D = the sun's R. A. and dec.,

$(S - I) = S' \cos. D \left(1 + \cos. {\scriptstyle (\alpha - A)}\right)$

= compliment of duration of transit of moon's defective diameter,

$i = S - S'$ = correction of Burckhardt's semidiameter,

m = the increase of the R. A. of the moon's bright limb in arc, in a lunar day,

$\varkappa$ = Burckhardt's constant value of $\frac{\text{moon's semidiameter,}}{\text{moon's horizontal parallax,}}$

ϖ = the moon's horizontal equatorial parallax,

δ = the moon's true declination,

$$S' = \frac{360^\circ + m}{360^\circ} \,.\, \varkappa\, \varpi \sec. \delta$$

The value of i for the Greenwich transit instrument, viz. + 0·2 sec. in time, or + 3″ in space, is given by the Astronomer Royal, and is found to agree precisely with that which he derives from the mural circles, from similar observations of the vertical diameter of the moon, corrected for the defective illumination. This coincidence would seem to show that this correction is required by the actual dimensions of the moon, and that if other transit instruments indicate a different correction, it must be from inferior optical capacity.

For the other instruments, with which Captain Talcott's must be compared, I have computed, by the above formulæ, the requisite correction of Burckhardt's semidiameter, as far as it could be derived from all the observations of the transit of both limbs of the moon, on the same day, which I have been able to find. The correction for the mean of all the results is + 0·15 sec. in time, or 2″·25, in space. The separate results are given in the following Table.

TABLE II.

Date.	Observatory.	Moon's Limb.	Sid. time U. C.	Half compliment of Defective Diameter S — I.	S	S′	i = S — S′	Mean i.
			h. m. s.	s.	s.	s.	s.	
1835, July 9	Station No. 1.	I	19 12 31·77	+ 0·00	75·52	75·47	+ 0·05	
		II	19 15 2·81					
Aug. 7	Turtle Island	I	20 51 17·82	+ 0·08	71·74	71·85	— 0·11	
	Lake Erie	II	20 53 41·14					s.
" Sept. 6	South Bend	I	23 13 3·05	+ 0·05	64·77	64·79	— 0·02	— 0·03
	Lake Michigan	II	23 15 12·49					
" " 6	Edinburgh	I	23 1 23·18	+ 0·00	65·17	65·01	+ 0·16	+ 0·16
		II	23 3 33·52					
1836, Jan. 3	Greenwich	I	6 54 0·46	+ 0·00	69·03	68·84	+ 0·19	
		II	6 56 18·52					
" July 27	"	I	20 17 44·10	+ 0·06	76·60	76·35	+ 0·25	
		II	20 20 17·19					
" Sept. 24	"	I	0 10 37·86	+ 0·02	65·66	65·46	+ 0·20	+ 0·20
		II	0 12 49·15					
1831, July 24	Cambridge	I	20 14 28·55	+ 0·00	65·97	65·73	+ 0·24	
		II	20 16 40·48					
1832, Feb. 15	"	I	9 46 34·31	+ 0·01	70·43	70·30	+ 0·13	
		II	9 48 55·14					
" Aug. 11	"	I	21 42 44.20	+ 0·08	63·89	63·63	+ 0·26	
		II	21 44 51·83					
1833, May 3	"	I	14 46 11·42	+ 0·00	67·38	67·13	+ 0·25	
		II	14 48 26·18					
" Oct. 28	"	I	2 32 38·82	+ 0·12	63·84	63·72	+ 0·12	
		II	2 34 46·26					
1834, May 22	"	I	15 58 44·84	+ 0·00	71·66	71·40	+ 0·26	
		II	16 1 8·15					
" Sept. 17	"	I	23 47 44·27	+ 0·02	61·28	61·32	— 0·04	
		II	23 49 46·79					
1835, Sept. 6	"	I	23 0 55·70	+ 0·00	65·33	65·03	+ 0·30	+ 0·20
		II	23 3 6·36					
1832, July 12	Kremsmunster	I	19 27 2·83	+ 0·00	65·20	65·11	+ 0·09	
		II	19 29 13·23					
1834, Sept. 17	"	I	23 46 30·18	+ 0·01	61·50	61·36	+ 0·14	+ 0·12
		II	23 48 33·17					
" Feb. 23	Cracow	I	10 37 16·94	+ 0·06	71·41	71·47	— 0·06	
		II	10 39 39·64					
" May 22	"	I	15 56 25·20	+ 0·00	71·55	71·34	+ 0·21	
		II	15 58 48·30					
1835, June 10	"	I	17 11 19·04	+ 0·00	76·07	75·97	+ 0·10	+ 0·08
		II	17 13 51·18					
1833, Oct. 28	Dorpat	I	2 29 7·64	+ 0·09	63·92	63·60	+ 0·32	
		II	2 31 15·40					
1835, Oct. 6	"	I	1 1 19·41	+ 0·06	62·06	61·84	+ 0·22	+ 0·27
		II	1 3 23·42					

Calling

i = correction of Burckhardt's semidiameter for Captain Talcott's transit instrument,

i' = a similar correction for a European instrument,

ι = $\mp (i' - i)$ = comparative correction,

the above table gives,

$\iota^{(0)} = \mp 0{\cdot}19$ for Captain Talcott's instrument with the Edinburgh,
$\iota^{(1)} = \mp 0{\cdot}23$ " " Greenwich,
$\iota^{(2)} = \mp 0{\cdot}23$ " " Cambridge,
$\iota^{(3)} = \mp 0{\cdot}15$ " " Kremsmunst.,
$\iota^{(4)} = \mp 0{\cdot}11$ " " Cracow,
$\iota^{(5)} = \mp 0{\cdot}30$ " " Dorpat.

Then T, being the result of a single comparison of Captain Talcott's instrument with the Edinburgh, &c., we have the several results corrected for the comparative values of the correction of Burckhardt's semidiameter, the upper sign for the first limb, the lower for the second,

$$= T \mp n\, \iota^{(0)}$$
$$= T \mp n\, \iota^{(1)}$$
$$= \&c.$$

Applying the correction for all the instruments in this manner, and taking the means for each day according to the weights w, and the means for the several days according to the weights W, we find the correction for this part of irradiation, of the final result for each station, to be:

Correction for station No.	1, near Huron, Ohio,	—	0·72 sec.
" "	2, Turtle Island,	+	0·28 sec.
" "	3, South Bend,	—	2·56 sec.

This hypothetical correction, it appears, must be rejected; for on submitting it to the best test which the nature of the subject furnishes, the sum of the squares of the errors of the single results derived from its application, far exceeds that which arises from the neglect of it.

SECTION X.

Reduction of Captain Talcott's observation of the occultation of τ^2 Aquarii, at Station No. 2, Turtle Island, Lake Erie, August 9, 1835. Latitude 41° 45′ 9″, longitude, as above, 5^h 33^m 31·82 sec.

	By Brockbank's gold chronometer.			Sidereal Time.			Mean Time.		
	h.	m.	s.	h.	m.	s.	h.	m.	s.
Immersion τ^2 Aquarii,	*20	7	59·40	20	8	35·10	10	56	49·55
Emersion " "	20	45	1·60	20	45	37·37	11	33	46·15

Using Bessel's method (*Beiträge zur Theorie der Finsternisse, u. s. w.*) Astr. Nachr. No. 152, and enclosing in a parenthesis the letters of his notation, and substituting for his d and d' their equivalents in the notation above, viz. — T and — t', we derive, from the moon's and stars' place in the Nautical Almanac,

$$(T) = 17^h\ 0^m\ 0^s = \text{mean time Greenwich.}$$
$$(P) = -0{\cdot}195736$$
$$(Q) = +0{\cdot}624923$$
$$(N) = +67^\circ\ 46'\ 55{\cdot}8'' + (T') \times 8{\cdot}1''$$
$$\log\cos(\delta) = +9.987162$$
$$\log\left(\frac{S}{n}\right) = +3{\cdot}793159 + (T') \times 0{\cdot}000015$$
$$-t' = -5^h\ 33^m\ 19{\cdot}57^s + 1{\cdot}814 \times (\varepsilon) + 4{\cdot}357 \times (\zeta) + 4{\cdot}720 \times (\eta).$$
$$-t' = -5\ \ 32\ \ 50{\cdot}53 + 1{\cdot}814 \times (\varepsilon) - 2{\cdot}807 \times (\zeta) - 3{\cdot}343 \times (\eta).$$

The Greenwich observations, on the 9th and 10th, give, for the corrections of the moon's place, at the time of the occultation,

$$15 \times \Delta(\alpha) = -\ 16{\cdot}38''$$
$$\Delta(\delta) = -\ 2{\cdot}30''$$

* The time of beginning has been increased one minute, a correction found necessary, in several instances, in reducing the transit observations.

The Dorpat observations of the moon-culmination that night, give

$$15 \times \Delta(\alpha) = -\ 14{\cdot}71''$$
$$\Delta(\delta) = \text{not stated.}$$

The mean corrections are,

$$15 \times \Delta(\alpha) = -\ 15{\cdot}54''$$
$$\Delta(\delta) = -\ 2{\cdot}30''$$

Also by Bessel's formulæ,

$$(\varepsilon) = \sin(N)\cos(\delta)\Delta\alpha + \cos(N)\Delta(\delta) = -\ 14{\cdot}83''$$
$$(\zeta) = -\cos(N)\cos(\delta)\Delta\alpha + \sin(N)\Delta(\delta) = +\ 3{\cdot}57''$$

whence,

$$\text{by imm.} - T = -\ 5^h\ 33^m\ 30{\cdot}7^s + 4{\cdot}720 \times (\eta)$$
$$\text{by emer.} - T = -\ 5\ \ 33\ \ 27{\cdot}6 - 3{\cdot}343 \times (\eta)$$
$$\text{mean,} = -\ 5\ \ 33\ \ 29{\cdot}2 + 0{\cdot}688 \times (\eta)$$

A result which agrees with the mean of the longitudes by moon-culminations, viz., $5^h\ 33^m\ 31{\cdot}8^s$, more nearly than could have been expected, when we consider the largeness of the co-efficients ε, ζ and η. These results are derived from the assumption that Burckhardt's semi-diameter needs no correction, in which case (η) would be equal to 0. If, however, we adopt Airy's correction for the results by meridian observations + 0·2 sec. in time, whence $\eta = +\ 3{\cdot}''$, and apply this correction to the results above, viz. to those for $\Delta\ \alpha$ and $\Delta\ \delta$, as well as to η, we derive,

$$\text{by immer.} - T = -\ 5^h\ 33^m\ 31^s{\cdot}0$$
$$\text{by emer.} - T = -\ 5\ \ 33\ \ 39{\cdot}7$$
$$\text{mean,} - T = -\ 5\ \ 33\ \ 35{\cdot}3$$

It does not appear, from experience, that Burckhardt's semidiameter requires an additive correction, for occultations of small stars; on the contrary, most computers apply a negative correction of $-\ 2{\cdot}5''$ to the value of η: this applied to the former mean result, would give,

$$T = 5^h\ 33^m\ 30^s{\cdot}9, \text{ by the occultation;}$$
$$\text{also, as above, } T = 5\ \ 33\ \ 31{\cdot}8 \text{ by all the moon-culminations.}$$

SECTION XI.

ON THE LONGITUDE OF THE CAPITOL AT WASHINGTON.

Having in the early part of this memoir alluded to the error of Lambert's value for the longitude of the Capitol, I shall here cite the authorities on which such a statement is founded. The American Almanac has, for years, pointed out this error in general terms, without however tracing it to its source, viz., the omission, on the part of Lambert, to correct his results by corresponding observations, for the errors of Burg's Tables, used in computing the Nautical Almanac. All the observations yet published at Washington, or its immediate vicinity, from which its longitude can be computed, are seven in number. The results derived from them, with the names of the observers and computers, are contained in the following table.

Phenomenon observed.	Longitude W. of Greenwich.				Remarks.
	h.	*m.*	*s.*		
Solar eclipse of April 3, 1791, observed at Georgetown, D. C., by Andrew Ellicott.	5	8	4·3	By Bowditch.	With corresponding observations at Greenwich and Paris.—*Mem. A. A. S., vol. III., p.* 269.
			6·2	By De Ferrer.	With same corr. obs.—*Mem. A. P. S., vol. VI., p.* 359.
Occultation of Aldebaran, Jan. 21, 1793, by Andrew Ellicott, supposed to have been observed on the site of the Capitol.	5	7	51·6	By Triesnecker.	With meridian observations at Greenwich and Paris.—*Ephem. Vindob.*, 1806.
			54·4	By Wurm.	With meridian observations near Thoulouse.—*Astr. Nachr. No.* 21.
			6·4	By Lambert.	Mem. A. P. S., N. Series, vol. I., p. 106. *This result must be rejected, because affected with the errors of Burg's Tables,* which are eliminated as above by Triesnecker and Wurm.

Phenomenon observed.	Longitude W. of Greenwich.				Remarks.
	h.	*m.*	*s.*		
Occultation of Alcyone, Oct. 20, 1824, observed near the Capitol, by Seth Pease.	5	8	6·8	By Wurm.	With corresponding observations at Vienna, Dessau, and Hohenneiche.—*Astr. Nachr.*, 91.
		7	39·8	By Lambert.	Ib., p. 109.—*Rejected, for reason similar to above.*
Solar eclipse of Sept. 17, 1811, observed near the Capitol, by Seth Pease.	5	8	11·4	By Bowditch.	With corresponding observations at Salem, Massachusetts.—Ib., p. 269.
			6·2	By Wurm.	With corresponding observations at Salem, N. Haven, and Bowdoin College, and N. York.—*Astr. Nachr. No.* 181.
			21·6	By Lambert.	Ib., p. 114.—*Rejected, as above.*
Occultation of γ Tauri, Jan. 12, 1813, observed near the Capitol by Seth Pease.	5	8	27·3	By Wurm.	With corresponding observation near Marseilles.—*Ast. Nach., No.* 21. This observation not good—local time not well determined.
	5	7	45·5	By Lambert.	Ib., p. 114.—*Rejected for double reason.*
Solar eclipse of Feb. 12, 1831, observed by F. R. Hassler.	5	8	7·2	By Paine.	With corresponding observations at W. C. Bond's observatory, Dorchester, Mass., and at Monomoy Point.—*Am. Almanac.*
Solar eclipse of May 15, 1836, observed by F. R. Hassler.	5	8	13·5	By S. C. Walker.	With corresponding observations at the principal observatories in Europe, reduced by H. C. F. Peters.—*Astr. Nachr., No.* 326.

Taking the mean of the results obtained by the different computers, (those of Lambert being rejected, for reasons mentioned above) we have, for the longitude of the Capitol,

	h.	*m.*	*s.*
(1)	5	8	5·3
(2)		7	53·0
(3)		8	6·8

	h.	m.	s.
(4)		8	8·7
(5)		8	27·4
(6)		8	7·2
(7)		8	13·5
Mean of seven results	5	8	8·9
Do. rejecting Nos. (2) and (5),	5	8	8·3
Do. rejecting (2), (5) and (7),	5	8	7·0
Probable error of last result,			± 0·4
Probable error of a single one of the four best results,			± 0·8

The probability that this result is 10 sec. in error, is less than 0·0001. The probability that the error amounts to 25·0 sec. (the quantity required to include Lambert's longitude, reported to congress and accepted by that body) is too small to admit of computation. The high authority of Bowditch, Triesnecker, Wurm, De Ferrer and Paine, whose combined computations give the longitude of our prime meridian *5^h 8^m $7{\cdot}0^s$ west of Greenwich, and the demonstrable error of Lambert's computations, which lead to a result of 5^h 7^m 42^s, as reported to congress, leave to geographers no room for doubt as to the proper

* In the interval between the reading and printing of this paper, Robert Treat Paine, Esq., by means of three chronometers, carried by himself from Boston to Washington, and thence to Boston, through Philadelphia, obtained the following important results, for the longitude of the Capitol.

	h.	m.	s.
Washington—Boston, going,		23	49·96
" " returning,		23	50·06
Mean,		23	50·01
Washington—Philadelphia, going,		7	26·43
returning,		7	26·50
Mean,		7	26·46
Boston state house is, by Bowditch and Paine,	4	44	16·60
Philadelphia state house is, by my computations,	5	0	39·20
Whence, Washington by Boston,	5	8	6·61
Washington by Philadelphia,	5	8	5·66
Mean,	5	8	6·14
Adopted for the longitude of the Capitol,	5	8	7·0

location of the Capitol. It must, however, be generally regretted that the omission, on the part of Lambert, of an essential correction (which, for the eclipses of 1791 and 1811 had been previously pointed out by Bowditch), should, from force of circumstances, have exercised for many years so extensive an influence in the propagation of error.

ARTICLE VI.

On the Magnetic Dip at several places in the State of Ohio, and on the relative Horizontal Magnetic Intensities of Cincinnati and London. By John Locke, M. D., Professor of Chemistry and Pharm., Medical College of Ohio. In a letter to John Vaughan, Esq., Librarian of the Am. Philos. Soc. Read June 15, 1838.

The extent of our continent and sea coast, the importance of our navigation, and our proximity to the magnetic pole, all conspire to render accurate magnetical observations highly interesting and useful. Yet, if we except the labours of Professors Bache and Courtenay, very little has been done by our countrymen, in this department of science. So far as I know, nothing has yet been communicated from this side of the Alleghanies. In my late journey abroad, it was no inconsiderable object with me, to procure the instruments and the instructions necessary for determining the elements of Dip, Declination, and Intensity, especially in the western part of the United States. On arriving in London, I was not a little gratified to find in the hands of one of our own countrymen, Professor Bache, an apparatus invented by himself, so perfectly adapted to the purpose of determining the Horizontal Intensity, by the vibration of the Hansteenian needles in a rarified medium, that I at once ordered one to be made after the same model, by the very skilful artisan Mr Robinson, of Devonshire street, London. It has not disappointed my expectations. It is portable, easy of manipulation, and gives results as consistent and satisfactory as the present state of our knowledge of the subject would authorize us to expect. I furnished myself with a dipping apparatus, and two six inch needles, adapted to it, made also by Robinson; a chronometer made by Molyneux & Sons, and a declination or variation apparatus made by Troughton & Simms. I am under obligations to Professor Bache, for the kind manner in which he communicated to me his mode of manipulation, and for the opportunity of witnessing his experiments, both at Westbourn Green and at the observatory of Paris. It would seem to be a very simple operation to count the vibrations of a freely suspended magnetic needle, and note their time by a chronometer; to perform the various reversals with the dipping apparatus, &c., &c.; yet, although not destitute of mechanical skill and experience, it was not until I had had considerable practice, that I could proceed with confidence and certainty. It had been my intention to make a series of observations at or near to London, so often repeated as to be able to refer my observations on intensity especially, to the intensity of that place as unity. But the delay of workmen to finish my instruments, and the pressure of other business, permitted me to make only a single series.

The needles which I used for determining horizontal intensity were three in number; two of them, Nos. 1 and 2, were of the Hansteenian model, cylindrical, terminating in cones, one-eighth of an inch in diameter, two and a half inches long, and weighing, with thin, light brass stirrups for suspension, about sixty-five grains each. The third, No. 3, was a flat needle, three inches long, one-fourth of an inch wide, and about one-fortieth of an inch thick, terminating in an angle or point of about sixty degrees, at each end, and weighing forty-four grains. Through the politeness of Mr Airy, the astronomer royal, I was enabled to vibrate these needles contiguous to the observatory at Greenwich, and on the site lately laid off for a magnetical observatory. From the vibration of these needles at Greenwich, August 26, 1837, and at Cincinnati, January 17, 1838, in both cases in a medium so rarified as to support only half an inch of mercury, after proper reduction for temperature, &c., I obtained indications of the ratio of horizontal intensity at the former place, to that of the latter, as follows.

By needle No. 1, 1 to 1·1624; by needle No. 2, 1 to 1·1639; by No. 3, 1 to 1·2037. I attribute the disagreement of the results obtained by Nos. 1 and 2, and that obtained by No. 3, to a probable diminution of the magnetism in the two former by means of the application of "keepers," strips of soft iron to join their dissimilar ends. The vibrations with No. 3 were twice repeated, and extended each time to five hundred, in number; and as the magnetism of the needles is liable to decrease, but not liable to increase, I attach the greater importance to the last result, and would therefore conclude that the horizontal intensity at Greenwich is, to that at Cincinnati, as 1 is to 1·2037. But little weight can, however, be attached to these observations, until they shall have been verified by repetition. I am, therefore, very desirous, that after I shall have fully ascertained here the properties of these needles, I may be enabled to send them again to Greenwich, have them vibrated satisfactorily there, and returned to be verified again in America.

It is not my intention, at this time, to go into the details of my observations on Intensity; this I will defer until my experiments shall have been more extensive. I will now proceed to give you the results of my experiments with the Dipping apparatus, at London and at several places in Ohio.

August 20th, 1837, I proceeded to the celebrated station of Westbourn Green, near London, where Captain Ross has made many of his observations, and obtained the following results:

No. of Needle.	Polarity.	Limb of Instrument.	Face of Needle.	Indication.	Mean.
1.	A	E	E	69° 15′	
		E	W	69 43½	
		W	E	69 06	
		W	W	69 40	
	B	W	W	69 03½	
		W	E	69 44	
		E	W	69 10	
		E	E	69 24	69° 23′·25
2.	A	E	E	70 12½	
		E	W	68 48	
		W	E	69 56	
		W	W	68 40	
	B	W	W	69 46	
		W	E	68 49	
		E	W	70 08½	
		E	E	68 47½	69° 23′·4375
					69° 23′·3437

These observations were made between the hours of twelve and two, P. M., the mean temperature being 86° F. In the experiments made at the same place by Captain Ross, as quoted by Professor Lloyd in the Fifth Report of the British Association,

"Needle B" gave the dip 69° 01·′5,
"Needle P", " " " 69 42·0,

and these were the extremes; from the mean of which my mean result differs only two minutes. It differs, however, from the mean of all Captain Ross's experiments, with eight different needles, near six minutes of a degree.

The following results were obtained at the garden of N. Longworth, Esq., in Cincinnati, latitude 39° 6′ N., longitude 84° 27′ W., November 26, 1837.

No. of Needle.	Polarity.	Limb of Instrument.	Face of Needle.	Indication.	Mean.
1.	A	E	E	70° 32′	
		E	W	70 56	
		W	E	70 39	
		W	W	70 53	
	B	E	E	71 20	
		E	W	70 25	
		W	E	71 21	
		W	W	70 10	70° 47′
2.	A	E	E	71 20	
		E	W	70 20	
		W	E	71 15	
		W	W	70 14	
	B	E	E	70 33	
		E	W	70 51	
		W	E	70 33	
		W	W	70 50	70° 44′·5
					70° 45′·75

At Dayton, in the state of Ohio, latitude 39° 44′ N., longitude 84° 11′ W., March 26, 1838, the dip

by No. 1, was	71° 23′
by No. 2,	71 22·5
Mean,	71° 22′·75

Time, 9 to 11, A. M.; temperature 70°, F.

At Springfield, latitude 39° 53′ N., longitude 83° 46′ W., March 29, 1838, the dip

by Needle No. 1, was,	71° 26′
by " No. 2,	71 28·75
Mean,	71° 27·375

Time 6 to 8 o'clock, A. M.; temperature 53°, F.

Professor Lloyd, in the account of his "Magnetical Observations in Ireland," points out, very clearly, the fact that there is, in some dipping needles, "a source of *constant* error, which remains uncorrected by the various reversals usually made." He proposes to ascertain this error, and "apply it as a correction to all future results within certain limits." From my observations at Springfield, I became satisfied that the discrepancy between the results with the two needles, 2′·75, arose from a want of perfect roundness in the pivots of one needle; for it showed itself only at one of the reversals of polarity, and totally disappeared at other places, where the dip was either a little more or a little less, so as to throw the pivot on another point of bearing. Such mechanical errors would be expected; yet when they are so small as above, they are scarcely worth noticing, unless to point out their nature. If the above view is correct, the "error" is far too limited in its operation to justify the application of a correction which had been made at any one place, to observations made at another. When it amounts to as much as "twenty minutes," it certainly shows a needle of bad mechanical qualities.

At Urbana, latitude 40° 03′ N., longitude 83° 44′ W., March 30, 1838, the dip by needle No. 1, was 71° 30′·44; by No. 2, 71° 29′·44. Mean, 71° 29′·94.

At Columbus, the seat of government for the state of Ohio, latitude 39° 57′ N., longitude 83° 00 W., I had expected the dip to be nearly as at Springfield, in nearly the same latitude, but was surprised to find it as follows.

By needle No. 1, 71° 04′·5; by needle No. 2, 71° 05′·25; mean, 71° 04′·875. The above observations were made in a field not far east from the state house, April 3, 1838, from eight to nine o'clock, A. M., temperature 40°. Suspecting local attraction, I removed to a wood, north west of the lunatic asylum, and went through with another series, which gave the following results.

Needle No. 1, 71° 04′·375; No. 2, 71° 05′·375; mean, 71° 04′·875, as before. Time, ten to eleven o'clock: temperature 43°. As these results agree identically, I will give the observations in full.

No. of Needle.	Polarity.	Limb of Instrument.	Face of Needle.	Indication. 1st Experiment.	Mean.	Indication. 2d Experiment.	Mean.
1.	A	E	E	70° 55′		70° 53′	
		E	W	71 30		71 27	
		W	E	70 45		70 47	
		W	W	71 25		71 21	
	B	E	E	71 40		71 45	
		E	W	70 24		70 25	
		W	E	71 35		71 39	
		W	W	70 22	71° 04′·5	70 18	71° 04′·875
2.	A	E	E	71 35		71 39	
		E	W	70 32		70 29	
		W	E	71 38		71 37	
		W	W	70 28		70 27	
	B	E	E	71 00		70 58	
		E	W	71 26		71 31	
		W	E	70 45		70 40	
		W	W	71 18	71° 05 ·25	71 22	71° 05′·375
					71° 04′·875		71° 04′·875

As we cannot rely upon observations of this kind, but within a certain latitude of error, I consider the *identity* of the above results a matter of accident. In making the last observations, no reference was made to the minutes of the first, lest an insensible leaning should be given to the mind to make them agree.

The latitude and longitude of the several places, except Cincinnati, is only an approximation, by admeasurement, of a map supposed to be accurate.

It appears from these observations, and those that have been made in the Atlantic cities, that although the lines of equal dip, in travelling from Britain westwardly, decline rapidly to the south, yet they attain their greatest southing before they reach our continent, for we find them, on the whole, in passing from the Atlantic to Ohio, proceeding rather north of west. The line of dip equal to that of Philadelphia, latitude 39° 57′ N., would pass through the western part of Ohio, in latitude 40° 43′ N.; still, in Ohio itself, these lines are again declining to the south; for the line of equal dip of Columbus, in latitude 39° 57′, would cross the meridian of Cincinnati, in latitude 39° 27′, declining half a degree of latitude in 1° 27′ of longitude. It is my intention to extend these observations over as large a portion of the western states as possible. The results, together with those for determining Intensity and Declination, I hope to be able to communicate to you at an early period.

Very respectfully,
Your obliged friend, and
Humble servant,

JOHN LOCKE.

Cincinnati, May 7, 1838.

ARTICLE VII.

New Formulæ relative to Comets. By E. Nulty, Philadelphia. Read September 21, 1838.

THE investigation which I here propose to make, respects the component velocities of a comet, observed in three positions, at consecutive and moderately small intervals of time. It has for its basis the theorem of Maclaurin, as adapted to proximate states of a variable function, and the known expressions for the sun's attractive force on the comet and the earth, referred as usual to rectangular solar axes. The means which I employ are therefore the same as those presented by Lagrange in the Mécanique Analytique, and which Mr Pontécoulant has recently adopted in his Théorie Analytique du Système du Monde, where formulæ for determining the distances and orbits of comets are given with appropriate developments. But the object which I have here in view, is not the same as that of Lagrange, in his celebrated work above mentioned; and my investigation and results are different from those of Mr Pontécoulant, and embrace a wider extent of subject. Similar diversity and extension, in mathematical research, are in perpetual requisition. They constitute an essential and important part of analytic science; and with their peculiar attractions, always lead to useful views and advantageous contrast. As to the instance now adduced, the presumed novelty, and the great accuracy and simplicity of the formulæ which I have obtained, entitle them, I should hope, to attention and preference. Their mode of investigation I also judge important, and as peculiarly eligible. It has enabled me to exhibit the formulæ hitherto given, as particular states of those just noticed; and besides others equally simple, it has furnished two new and general sets of expressions for the exceptive cases in which the observed latitudes and longitudes of the comet would render the general formulæ doubtful or indeterminate. To the analysis of the principal of these results, and with regard to practical applications, I have adjoined the data of the comet of 1805, and for which I am indebted to the excellent treatise of Mr Pontécoulant. The corresponding velocities I have computed by the formulæ now given, and by others connected with the method of La Place. Their comparison has led me to some remarks with which I conclude this paper, and which I have inserted from an opinion of their analytical and practical importance.

Before I enter on the proposed investigation, I think it may not be improper to observe, that within a few days, I have been favoured with the perusal of Mr Encke's Astronomical, Annual Register (*Astronomische Yahrbuch*) for 1833, in which its distinguished author has given a full and neat analysis of Dr Olbers' method of determining the orbits of comets. The greater part of that analysis I had in fact the earlier pleasure of reading in Dr Bowditch's Appendix to the Third Volume of his Translation of the Mécanique Céleste. But I had not been previously apprized of Mr Encke's remarks on methods which differ from that of Dr Olbers; and in this paper, I would be understood as having no wish to aim at lessening the predilection with which I am now acquainted, and which may be well and reasonably founded. My own mathematical partialities, I am not unwilling to avow. I entertain them on methods and processes of computation which furnish symmetrical and direct results; and in no slight degree am I favourable to that method which is connected with the formulæ now occupying my attention, and which I have endeavoured to present in such form as to merit the approval of Mr Encke, and the author of the Théorie Analytique du Système du Monde.

Consider a comet at any point C in its orbit, and let its place at the distance r from the centre S of the sun, be determined by the rectangular co-ordinates x, y, z. Refer the earth's centre E, to the axes of x, y, supposed to be in the plane of the ecliptic, and let (X, Y) determine its place at the distance R from S. The position of the comet relatively to E, will then depend on the values of $x - X$, $y - Y$, z; and if we denote its co-ordinates measured from E by $\rho\alpha$, $\rho\beta$, $\rho\gamma$, we shall have in its position C

$$x = X + \rho\alpha, \quad y = Y + \rho\beta, \quad z = \rho\gamma \qquad (1)$$

Accent the different letters in these expressions, in order that they may correspond to two different positions of the comet at C′, C″; the first being supposed to precede, the second to follow C, at the comparatively small intervals of time t', t''. The co-ordinates C′, C″, in the direction of the axes of x, and at the end of these intervals, will then be,

$$x' = X' + \rho'\alpha'; \quad x'' = X'' + \rho''\alpha''; \qquad (2)$$

and corresponding expressions will result in the directions of the other axes of y and z.

The determination of these co-ordinates in terms relative to the intermediate position C of the comet, and to the corresponding place E of the earth, may be effected by M'Laurin's theorem, and the known differentials

$$x_{,,} = -\frac{x}{r^3}, \quad X_{,,} = -\frac{X}{R^3};$$

which express the sun's attractive force on the comet and earth. By means of that theorem, we have the expressions

$$x' = x - x_{,}t' + \tfrac{1}{2}x_{,,}t'^2 - \tfrac{1}{6}x_{,,,}t'^3, \&c., \quad X' = X - X_{,}t' + \tfrac{1}{2}X_{,,}t'^2 - \tfrac{1}{6}X_{,,,}t'^3, \&c.$$

which, in virtue of the preceding differentials, take the usual form

$$x' = u'x - v'x_{,}, \quad X' = U'X - V'X_{,}, \qquad (3)$$

the assumed coefficients of x, $x_{,}$, and of X, $X_{,}$, having in terms of the interval t', the following values:

$$\left.\begin{aligned} u' &= 1 - \tfrac{1}{2}\frac{t'^2}{r^3} + \tfrac{1}{2}\frac{r\,t'^3}{r^5}, \text{ \&c.}; \quad v' = t' - \tfrac{1}{6}\frac{t'^3}{r^3} + \tfrac{1}{4}\frac{r_{,}\,t'^4}{r^5}, \text{ \&c.} \\ U' &= 1 - \tfrac{1}{2}\frac{t'^2}{R^3} + \tfrac{1}{2}\frac{R_{,}\,t'^3}{R^5}, \text{ \&c.}; \quad V' = t' - \tfrac{1}{6}\frac{t'^3}{R^3} + \tfrac{1}{4}\frac{R_{,}\,t'^4}{R^3}, \text{ \&c.} \end{aligned}\right\} \quad (4)$$

The forms for x'', X'' in (2) are similar to these, observing to change the single into double accents, as respects u, U; v, V; and also t' into $-\,t''$; and like expressions will evidently apply in the directions of the axes of y, z.

Substitute (3) and the similar forms for x'', X'' in (2), and then eliminate x by the first of equations (1). There will result the two expressions:

$$v'(x_{,}-X_{,}) = u'\rho\alpha - \rho'\alpha' + v'\xi', \quad v''(x_{,}-X_{,}) = \rho''\alpha'' - u''\rho\alpha + v''\xi'',$$

in which, for brevity, we have assumed;

$$v'\xi' = (V'-v')X_{,} - (U'-u')X, \quad v''\xi'' = (V''-v'')X_{,} + (U''-u'')X \quad (5)$$

and which, being respectively multiplied by $\frac{v''}{v'}$, $\frac{v'}{v''}$ and added, will give

$$\left.\begin{aligned} (x_{,}-X_{,})(v'+v'') &= \left(\frac{u'}{v'}v'' - \frac{u''}{v''}v'\right)\rho\alpha - \frac{v''}{v'}\rho'\alpha' + \frac{v'}{v''}\rho''\alpha'' + v''\xi' + v'\xi'' \\ (y_{,}-Y_{,})(v'+v'') &= \left(\frac{u'}{v'}v'' - \frac{u''}{v''}v'\right)\rho\alpha - \frac{v''}{v'}\rho'\beta' + \frac{v'}{v''}\rho''\beta'' + v''\eta' + v'\eta'' \\ z_{,}(v'+v'') &= \left(\frac{u'}{v'}v'' - \frac{u''}{v''}v'\right)\rho\alpha - \frac{v''}{v'}\rho'\gamma' + \frac{v'}{v''}\rho''\gamma''; \end{aligned}\right\} \quad (6)$$

the two last being formed by analogy from the first.

Expressions apparently more simple than these, might have been found from the preceding values; but the present forms are more convenient for the determination of the component velocities $x_{,}$, $y_{,}$, $z_{,}$, which will become known by means of the earth's velocities $X_{,}$, $Y_{,}$, when we have expressed the geocentric distances ρ, ρ', ρ'', in terms given by observation of the comet in the corresponding positions C, C$'$, C$''$.

For this purpose, equate the two values of $x_{,} - X_{,}$, which result from the expressions preceding (5); and from these and analogy we obtain

$$\left.\begin{aligned}\left(\frac{u'}{v'}+\frac{u''}{v''}\right)\rho\alpha-\frac{1}{v'}\rho'\alpha'-\frac{1}{v''}\rho''\alpha''&=\xi,\\ \left(\frac{u'}{v'}+\frac{u''}{v''}\right)\rho\beta-\frac{1}{v'}\rho'\beta'-\frac{1}{v''}\rho''\beta''&=\eta,\\ \left(\frac{u'}{v'}+\frac{u''}{v''}\right)\rho\gamma-\frac{1}{v'}\rho'\gamma'-\frac{1}{v''}\rho''\gamma''&=0;\end{aligned}\right\}\qquad(7)$$

in which we have put $\xi=\xi''-\xi'$, $\eta=\eta''-\eta'$.

Resolve these equations relatively to ρ, ρ', ρ'', with their coefficients; and in order to exhibit the results in brief terms, let the coefficients which are found to affect ξ, η be denoted by

$$\left.\begin{aligned}A&=\beta'\gamma''-\beta''\gamma', & A'&=\beta''\gamma-\beta\gamma'', & A''&=\beta\gamma'-\beta'\gamma;\\ B&=\alpha''\gamma'-\alpha'\gamma'', & B'&=\alpha\gamma''-\alpha''\gamma, & B''&=\alpha'\gamma-\alpha\gamma'.\end{aligned}\right\}\qquad(8)$$

These are known from observation of this comet at C, C′, C″. They give the conditional equations

$$\left.\begin{aligned}A\beta+A'\beta'+A''\beta''&=0, & A\gamma+A'\gamma'+A''\gamma''&=0,\\ B\alpha+B'\alpha'+B''\alpha''&=0, & B\gamma+B'\gamma'+B''\gamma''&=0;\end{aligned}\right\}\qquad(9)$$

and enable us to express the values now under consideration thus:

$$\left(\frac{u'}{v'}+\frac{u''}{v''}\right)\rho=\frac{A\xi+B\eta}{D},\ -\frac{1}{v'}\rho'=\frac{A'\xi+B'\eta}{D},\ -\frac{1}{v''}\rho''=\frac{A''\xi+B''\eta}{D};\quad(10)$$

the common denominator being either of the forms

$$D=A\alpha+A'\alpha'+A''\alpha''=B\beta+B'\beta'+B''\beta'';\qquad(11)$$

which and (9) will be of immediate use in the simplification of formulæ (6).

Values analogous to these, though very different in their form and object, are made the basis of Lagrange's method of determining the orbits of Comets. They may be seen in his Mécanique Analytique.

In consequence of the supposed proximity of the extreme positions C′, C″, to the mean position C of the comet, it is easily conceived that the denominator D of (10) is a small quantity, liable to be affected by unavoidable errors of observations. We shall therefore eliminate it, and employ, instead of (10), the following values:

$$\left.\begin{aligned} \rho' &= -\rho v'\left(\frac{u'}{v'}+\frac{u''}{v''}\right)\cdot\frac{N'}{N}, \\ \rho'' &= -\rho v''\left(\frac{u'}{v'}+\frac{u''}{v''}\right)\cdot\frac{N''}{N}; \end{aligned}\right\} \quad (12)$$

in which we have assumed

$$N = A\xi + B\eta, \quad N' = A'\xi + B'\eta, \quad N'' = A''\xi + B''\eta. \quad (13)$$

These quantities are the numerators of (10); they give, in virtue of the conditional equations (9) and (11)

$$N\alpha + N'\alpha' + N''\alpha'' = D\xi, \quad N\beta + N'\beta' + N''\beta'' = D\eta. \quad (14)$$

Let now (12) be substituted in the general expressions (6), and let us attend to the preceding forms for $D\xi$, $D\eta$. We shall then obtain the following values:

$$\left.\begin{aligned} x_{,} &= X_{,} + \frac{\rho}{N}\left(\frac{u''}{v''}N'\alpha' - \frac{u'}{v'}N''\alpha'' + wD\xi\right) + \frac{v'\xi''+v''\xi'}{v'+v''}, \\ y_{,} &= Y_{,} + \frac{\rho}{N}\left(\frac{u''}{v''}N'\beta' - \frac{u'}{v'}N''\beta'' + wD\eta\right) + \frac{v'\eta''+v''\eta'}{v'+v''}, \\ z_{,} &= \frac{\rho}{N}\left(\frac{u''}{v''}N'\gamma' - \frac{u'}{v'}N''\gamma''\right); \end{aligned}\right\} \quad (15)$$

in which we have put $w\,(v'+v'') = \frac{u'}{v'}\,v'' - \frac{u''}{v''}\,v$.

These formulæ are well adapted to the proposed determination of the comet's component velocities. The generality which we have intentionally observed in presenting them, has imposed on their last terms a complex appearance. But this will immediately vanish, when they are limited to the particular state in which approximate results are the objects of computation.

For the purpose here intimated, let us employ the expressions (4) and their similar forms with double accents. If the intervals t', t'' be regarded as small quantities, so that the terms which involve the differentials $r_{,}$, $R_{,}$ of the distances r, R, may be rejected, we shall have for the coefficients of N', N'' in (15), the values

$$\frac{u'}{v'} = \frac{1}{t'}\left(1 - \frac{t'^2}{3r^3}\right), \quad \frac{u''}{v''} = \frac{1}{t''}\left(1 - \frac{t''^2}{3r^3}\right);$$

in which we shall assume for brevity

$$\mu' = 1 - \frac{t'^2}{3r^3}, \quad \mu'' = 1 - \frac{t''^2}{3r^3}; \qquad (16)$$

and to a near approximation r may be supposed equal to unity.

The factor D in the fourth terms of the components $x_{,}$, $y_{,}$, we have already noticed as being a small quantity; and we shall presently see that ξ, η depend on factors which never exceed the radius R. We may therefore to great accuracy take $w = \frac{t'-t''}{t'\,t''}\left(1 - \frac{t'\,t''}{6r^3}\right)$, the second factor of which, analogously to (16), we shall denote by μ.

Substitute the expressions (4) just employed in the assumed quantities (5); and put the factor $\frac{1}{r^3} - \frac{1}{R^3} = k$. We shall obtain, in consequence of the minuteness of k and the intervals t', t'', the two values

$$\xi' = \tfrac{1}{2}k\left(\tfrac{1}{3}t'^2 X_{,} - t'X\right), \quad \xi'' = \tfrac{1}{2}k\left(\tfrac{1}{3}t''^2 X_{,} + t''X\right);$$

whence there results $\xi'' - \xi'$, or

$$\xi = \tfrac{1}{2}k(t' + t'')\left(X - \frac{t'-t''}{3}X_{,}\right);$$

and by substitution, the last term of the component velocity $x_,$ becomes

$$\frac{v'\xi''+v''\xi'}{v'+v''}=\tfrac{1}{6}kt't''X_,.$$

Values similar to these will evidently result for η and the last term of $y_,$; and if, for the sake of brevity, we put

$$\xi_,=X-\tfrac{1}{3}(t'-t'')X_,,\quad \eta_,=Y-\tfrac{1}{3}(t'-t'')Y_,;\qquad (17)$$

so that the quantities ξ, η may take the form

$$\xi=\tfrac{1}{2}k(t'+t'')\xi_,,\quad \eta=\tfrac{1}{2}k(t'+t'')\eta_,;\qquad (18)$$

we shall immediately perceive that after substitution in formulæ (15), the factors of $\xi_,$, $\eta_,$ will disappear; and that all the terms but the last of $x_,$, $y_,$, will be independent of the small quantity $\frac{1}{2}k$. To eliminate $\frac{1}{2}k$ from these terms, we must have recourse to the first of the equations (10), which in virtue of the values (4) becomes

$$\frac{t'+t''}{t't''}\left(1-\frac{t't''}{3r^3}\right)=\frac{A\xi+B\eta}{D}.$$

From this and the preceding values of ξ, η we get $\frac{1}{2}kt't''=\left(1-\frac{t't''}{3r^3}\right)\cdot\frac{D\rho}{A\xi_,+B\eta_,}$; so that if for conciseness we put the factor $1-\frac{t'\,t''}{3r^3}=\nu$, and

$$M=A\xi_,+B\eta_,,\quad M'=A'\xi_,+B'\eta_,,\quad M''=A''\xi_,+B''\eta_,,$$

the general expressions (15) will take the form

$$\left.\begin{aligned}
x_,&=X_,+\frac{\rho}{M}\left\{\frac{\mu''}{t''}M'\alpha'-\frac{\mu'}{t'}M''\alpha''-\mu D\xi_,\left(\frac{t'-t''}{t'\,t''}\right)+\tfrac{1}{3}\nu DX_,\right\},\\
y_,&=Y_,+\frac{\rho}{M}\left\{\frac{\mu''}{t''}M'\beta'-\frac{\mu'}{t'}M''\beta''-\mu D\eta_,\left(\frac{t'-t''}{t'\,t''}\right)+\tfrac{1}{3}\nu DY_,\right\},\\
z_,&=\frac{\rho}{M}\left\{\frac{\mu''}{t''}M'\gamma'-\frac{\mu'}{t'}M''\gamma''\right\};
\end{aligned}\right\}\qquad(19)$$

the several terms of which are completely determined as respects the intervals t', t''. It remains therefore only to assign values to the earth's velocities $X_{,}$, $Y_{,}$; and to the equations (1).

Denote by L the longitude of the earth when the comet is observed in its mean position C. Let ϖ be the longitude of the perihelion of its elliptic orbit, and $e = \sin \varepsilon$ the eccentricity corresponding to the mean distance 1. The value of ϖ in 1801 was 99° 30′ 5″, annual in. = + 1′ 2″. At the same epoch, e was ·01685301, sec. var. = — ·000041809. The co-ordinates of the earth in terms of the radius vector R and longitude L, are

$$X = R \cos L, \quad Y = R \sin L;$$

and the known expressions for R and the elementary area described in the instant dt, are

$$R = \frac{\cos \varepsilon^2}{1 + e \sin (L - \varpi)}, \quad R^2 \frac{dL}{dt} = \cos \varepsilon.$$

If the three first of these expressions be differentiated relatively to the time t of which R and L are functions; and $\frac{dL}{dt}$ be eliminated by means of the last expression; there will result

$$\left. \begin{aligned} X_{,} &= p \cos L - q \sin L, \\ Y_{,} &= p \sin L + q \cos L; \end{aligned} \right\}$$

in which we have assumed for brevity

$$p = \tan \varepsilon \sin (L - \varpi), \quad q = \frac{\cos \varepsilon}{R}; \qquad (20)$$

and which, in conjunction with the values of X, Y above given, will make known the component velocities and position of the earth.

The forms which we have here adopted, enable us to express the values of $\xi_{,}$, $\eta_{,}$ in simple terms. We may assume for the coefficients of cos L, sin L in these values;

$$s \cos a = \mathrm{R} - \tfrac{1}{3}(t' - t'')\,p, \quad s \sin a = \tfrac{1}{3}(t' - t'')\,q;$$

from which there will result

$$\tan a = \frac{(t' - t'')\,q}{3\,\mathrm{R} - (t' - t'')\,p}, \quad s = \frac{(t' - t'')\,q}{3 \sin a}; \tag{21}$$

and we shall have instead of (17), the values

$$\xi_{,} = s \cos(\mathrm{L} - a), \quad \eta_{,} = s \sin(\mathrm{L} - a);$$

in which a is evidently a small arc and s nearly equal to R.

A further simplification of the expressions last given, may be effected without diminishing their accuracy, or rendering more complex the velocities $\mathrm{X}_{,}$, $\mathrm{Y}_{,}$. Conceive the axis of x, the position of which is arbitrary, to be directed so as to form an angle equal to a with the radius vector R. From this position which we suppose to be less advanced than R, the angle $\mathrm{L} - a$ will then take its origin, and we shall have

$$\xi_{,} = s, \quad \eta_{,} = 0; \quad \mathrm{X} = \mathrm{R} \cos a, \quad \mathrm{Y} = \mathrm{R} \sin a; \tag{22}$$

the corresponding velocities being

$$\left.\begin{aligned} \mathrm{X}_{,} &= p \cos a - q \sin a, \\ \mathrm{Y}_{,} &= p \sin a + q \cos a, \end{aligned}\right\} \tag{23}$$

in which the first term of $\mathrm{Y}_{,}$ is extremely small.

With respect to the angular quantities in the equations (1), now to be considered; let l denote the geocentric longitude of the comet in its position C; and λ the corresponding geocentric latitude. If we also represent by ρ the curtate distance of the comet's projected place in the plane of the ecliptic, we shall have, in the present position of the axis of x, the following values:

$$\alpha = \cos(a + l - \mathrm{L}), \quad \beta = \sin(a + l - \mathrm{L}), \quad \gamma = \tan \lambda, \tag{24}$$

and the co-ordinates (1), by adding their squares, will give the equation:

$$r^2 = R^2 + 2R\rho \cos (l - L) + \rho^2 \sec \lambda^2; \qquad (25)$$

which establishes a relation between the curtate distance ρ and the comet's distance r from the centre of the sun.

Expressions similar to these evidently apply to the extreme positions C′, C″ of the comet; and in (19), (25) we may, if requisite, write $\rho \cos \lambda$ instead of ρ, which will then denote the ray drawn from the centre E of the earth to the comet at C.

When the distance r is given, we shall know ρ by means of (25); and in such case all the quantities in (19) being determined, we may compute the values of the required velocities $x_,$, $y_,$, $z_,$. But should r be also unknown as well as ρ; and this is generally the case, the equation (25) will not alone be sufficient, and we must join to it the differential expression

$$x_,^2 + y_,^2 + z_,^2 = \frac{2}{r}; \qquad (26)$$

which we adapt as a known form for the square of the comet's velocity in a parabolic orbit; and which will enable us to obtain the distances r, ρ, and lastly the component velocities $x_,$, $y_,$, $z_,$.

We may now present the expressions (19) in their final terms for computation. They become, in terms of the simplified values of $\xi_,$, $\eta_,$, of the following form:

$$\left.\begin{aligned} x_, &= X_, + \frac{\rho}{A}\left(\frac{\mu''}{t''} A'\alpha' - \frac{\mu'}{t'} A''\alpha'' - \mu D \frac{t' - t''}{t't''} + \nu \frac{DX_,}{3s}\right), \\ y_, &= Y_, + \frac{\rho}{A}\left(\frac{\mu''}{t''} A'\beta' - \frac{\mu'}{t'} A''\beta'' + \nu \frac{DY_,}{3s}\right), \\ z_, &= \frac{\rho}{A}\left(\frac{\mu''}{t''} A'\gamma' - \frac{\mu'}{t'} A''\gamma''\right); \end{aligned}\right\} \qquad (A)$$

in which the values of A, A′, A″ from (8) are

$$A = \beta'\gamma'' - \beta''\gamma', \quad A' = \beta''\gamma - \beta\gamma'', \quad A'' = \beta\gamma' - \beta'\gamma;$$

and the corresponding value of D is by (11),

$$D = A\alpha + A'\alpha' + A''\alpha''.$$

There is but one remark to be made relatively to the numerical conversion of these and the auxiliary quantities μ, μ', &c. and a, s. The intervals t', t'' and also $t' - t''$, given in days, must be expressed in terms of mean solar time, and in parts of radius, by multiplying them by the diurnal factor ·01720213, which corresponds to the solar arc 59′ 8″·2, and of which the logarithm is 8·2355821.

The preceding formulæ (A) are we believe the most convenient and the most accurate that have appeared for the determination of the component velocities of a comet, observed in three positions at comparatively small intervals. The factors μ, μ', &c. have here been first noticed; they give every requisite degree of precision to the values of $x_{,}$, $y_{,}$, $z_{,}$. The computation we have reduced to uniformity and facility by means of the three arcs $a+l-L$, $a+l'-L$, $a+l''-L$, of which the several angular quantities α, α', &c. are functions; and which take place of nine arcs hitherto employed. The particular form given to D is also advantageous. It directly leads to the value of this factor, by the three previously determined quantities A, A′, A″.

When the observations can be taken so that the intervals t', t'' may be equal, the factors μ', μ'', ν will each be expressed by $1 - \frac{t'^2}{3r^3}$. The term which depends on $t'-t''$ will then vanish, and we shall have the more simple expressions:

$$\left.\begin{aligned} x_{,} &= X_{,} + \frac{\rho\mu'}{At'}\left(A'\alpha' - A''\alpha'' + \frac{DX_{,}}{3R}\right), \\ y_{,} &= Y_{,} + \frac{\rho\mu'}{At'}\left(A'\beta' - A''\beta'' + \frac{DY_{,}}{3R}\right), \\ z_{,} &= \frac{\rho\mu'}{At'}\left(A'\gamma' - A''\gamma''\right); \end{aligned}\right\} \qquad (A')$$

in which the quantities A, A′, A″ and D have the same forms as before; but instead of (24), we have

$$\alpha = \cos(l-L), \quad \beta = \sin(l-L), \quad \gamma = \tan\lambda,$$

and similar values for α', α'', &c.

In the formulæ hitherto given for this particular case, the factor μ' has not been introduced or noticed; and on this account, and the last terms involving the earth's velocities $X_{,}$, $Y_{,}$, they are less exact than the preceding expressions (A′), in which the term $\frac{DY_{,}}{3R}$ at least should be computed as no negligible, minute quantity.

The general formulæ, of which we have now completed the investigation, and also (A′), fail in giving accurate results, when the quantities A, A', A'' and D are minute; and they become indeterminate, when these quantities vanish. If we conceive the apparent path of the comet during the interval $t'+t''$ to be a great circle, passing through a point in the ecliptic of which the longitude is less than that of the sun by the small arc a, the tangent of the inclination of the orbit will be evidently expressed by either of the three relations $\frac{\gamma}{\beta}, \frac{\gamma'}{\beta'}, \frac{\gamma''}{\beta''}$; and we shall have then $A=0$, $A'=0$, $A''=0$, and also $D=0$, to which the formulæ (A) and (A′) are inapplicable. The case in which these quantities become small, is now obvious without further reflection; and should it be inconvenient or impossible to take new observations of the comet at other places in its orbit, we must abandon formulæ (A), and have recourse to different expressions, capable of determining the component velocities $x_{,}$, $y_{,}$, $z_{,}$.

Such expressions are the following: they have not to our knowledge been hitherto presented.

$$\left.\begin{aligned} x_{,} &= X_{,}+\frac{\rho}{E}\left(\frac{\mu''}{t''}E'\alpha'-\frac{\mu'}{t'}E''\alpha''\right)+K\left(\frac{\varepsilon''\alpha'}{E}-\frac{t'}{\theta}+\frac{X_{,}t't''}{3R\theta}\right)\\ y_{,} &= Y_{,}+\frac{\rho}{E}\left(\frac{\mu''}{t''}E'\beta'-\frac{\mu'}{t'}E''\beta''\right)+K\left(\frac{\varepsilon''\beta'}{E}+\frac{Y_{,}t't''}{3R\theta}\right)\\ z_{,} &= \frac{\rho}{E}\left(\frac{\mu''}{t''}E'\gamma'-\frac{\mu'}{t'}E''\gamma''\right)+K\frac{\varepsilon''\gamma'}{E}. \end{aligned}\right\}(E)$$

There are in fact two sets of formulæ, comprehended in these expressions. We may take in terms of the geocentric longitudes;

$$\mathrm{E} = \sin(l''-l'), \quad \mathrm{E}' = \sin(l-l''), \quad \mathrm{E}''\sin(l'-l), \quad \varepsilon'' = \beta'';$$

or when these longitudes vary from each other less than the corresponding latitudes, we may more suitably adopt the values

$$\mathrm{E} = \alpha'\gamma''-\alpha''\gamma', \quad \mathrm{E}' = \alpha''\gamma-\alpha\gamma'', \quad \mathrm{E}'' = \alpha\gamma'-\alpha\gamma'; \quad \varepsilon'' = \gamma'',$$

the three first of which are the values of B, B′, B″ (8) taken with a change of signs. In both cases here implied, the values of α, α', &c. will be as in formulæ (A); and we have taken $\theta = t'+t''$, $\mathrm{K} = \frac{1}{2}\mathrm{R}k\theta$.

The formulæ (E) are regular in the composition of their terms, and but little more complex than (A), from which they chiefly differ in this respect, that the factor k cannot be eliminated, but must correspond to a determinate value of the comet's distance r. Any change in the value of this distance will however be attended only with small additional computation; since the calculated values of the different terms in (E) will, from the form which we have adopted, continue invariable.

When the intervals t', t'' happen to be equal, we shall have $\mathrm{K} = \mathrm{R}kt'$, and the more simple values

$$\left.\begin{aligned}
x_{,} &= \mathrm{X}_{,} + \frac{\rho\mu'}{\mathrm{E}t'}(\mathrm{E}'\alpha' - \mathrm{E}''\alpha'') + \mathrm{K}\left(\frac{\varepsilon''\alpha'}{\mathrm{E}} - \tfrac{1}{2} + \frac{\mathrm{X}_{,}t'}{6\,\mathrm{R}}\right), \\
y_{,} &= \mathrm{Y}_{,} + \frac{\rho\mu'}{\mathrm{E}t'}(\mathrm{E}'\beta' - \mathrm{E}''\beta'') + \mathrm{K}\left(\frac{\varepsilon''\beta'}{\mathrm{E}} + \frac{\mathrm{Y}_{,}t'}{6\,\mathrm{R}}\right), \\
z_{,} &= \frac{\rho\mu'}{\mathrm{E}t'}(\mathrm{E}'\gamma' - \mathrm{E}''\gamma'') + \mathrm{K}\,\frac{\varepsilon''\gamma'}{\mathrm{E}};
\end{aligned}\right\} \quad (\mathrm{E}')$$

the quantities E, E′, E″, ε'' being as in (E), and the values of α, α', &c. the same as in the particular forms (A′).

The investigation of the formulæ now given, we reserve for another paper, which will soon appear. At present we shall briefly show how the expressions given by Mr Pontécoulant may be readily deduced from our expressions (19).

If in these we omit the last terms depending on the earth's velocities $X_{,}$, $Y_{,}$; and put $\mu' = 1$, $\mu'' = 1$, &c. and also $\rho = h\,M\,t'\,t''$, there will result for the component velocities $x_{,}$, $y_{,}$, $z_{,}$, the less approximate values

$$\left.\begin{aligned} x_{,} &= X_{,} + h\,(t'M'\alpha' - t''M''\alpha'' - (t' - t'')\,D\xi_{,}), \\ y_{,} &= Y_{,} + h\,(t'M'\beta' - t''M''\beta'' - (t' - t'')\,D\eta_{,}), \\ z_{,} &= h\,(t'M'\gamma' - t''M''\gamma''); \end{aligned}\right\} \qquad (a)$$

and if to these be added the identical equations

$$\begin{aligned} &M\alpha + M'\alpha' + M''\alpha'' - D\xi_{,} = 0, \\ &M\beta + M'\beta' + M''\beta'' - D\eta_{,} = 0, \\ &M\gamma + M'\gamma' + M''\gamma'' = 0, \end{aligned}$$

respectively multiplied by $\frac{1}{2}\,h\,(t'' - t')$, we shall immediately obtain the following expressions:

$$\left.\begin{aligned} x_{,} &= X_{,} + h\,\{\tfrac{1}{2}\,\theta\,(M'\alpha' - M''\alpha'') - \tfrac{1}{2}\,\theta'\,(M\alpha + D\xi_{,})\} \\ y_{,} &= Y_{,} + h\,\{\tfrac{1}{2}\,\theta\,(M'\beta' - M''\beta'') - \tfrac{1}{2}\,\theta'\,(M\beta + D\eta_{,})\} \\ z_{,} &= h\,\{\tfrac{1}{2}\,\theta\,(M'\gamma' - M''\gamma'') - \tfrac{1}{2}\,\theta'\,M\gamma\}; \end{aligned}\right\} \qquad (b)$$

in which $\theta = t' + t''$, $\theta' = t' - t''$.

These are in fact less simple than the preceding. They become identical with the values $F_{,}$, $G_{,}$, $H_{,}$, found at page 44, vol. II. Théorie Analytique, &c. when we further neglect the arc a in the values of $\xi_{,}$, $\eta_{,}$, multiplied by the factor D. The term $D\xi_{,}$ may be removed by directing the axis of y to the earth when the comet is at C. The preceding values of $x_{,}$, $y_{,}$ will then agree with $P_{,}$, $Q_{,}$, page 45. But even in this simplified state, the computation depends on nine different angles instead of the three involved in formulæ (A).

The preceding values (a) and (b) are not the only forms that can be derived from (19), in virtue of the identical equations which we have just employed. If to (a) we add those equations respectively multiplied by $h\,(t''-t')$, the terms which depend on D will disappear, and we shall obtain a new set of values:

$$\left.\begin{aligned} x_{,} &= \mathrm{X}_{,} + h\,\{t''\mathrm{M}'\alpha' - t'\mathrm{M}''\alpha'' - (t'-t'')\mathrm{M}\alpha\}, \\ y_{,} &= \mathrm{Y}_{,} + h\,\{t''\mathrm{M}'\beta' - t'\mathrm{M}''\beta'' - (t'-t'')\mathrm{M}\beta\}, \\ z_{,} &= h\,\{t''\mathrm{M}'\gamma' - t'\mathrm{M}''\gamma'' - (t'-t'')\mathrm{M}\gamma\}; \end{aligned}\right\} \quad (c)$$

which are perfectly symmetrical, and preferable to (*b*), both as to form and facility of computation.

We presume that the advantage of our mode of solution is sufficiently tested by the different results we have obtained. We shall therefore proceed to the numerical application of formulæ (A). In the example chosen, the intervals t', t'' are considerably different, and $t'-t''$ is of no small magnitude. We have taken it as before mentioned from the Théorie Analytique du Système du Monde, vol. II., p. 68.

Data of Comet of 1805.

Times of Observation.	Longitudes Observed.	Latitudes Observed.	Intervals.
Nov. 23^{d}·32241	$l' = 24°41'04''$	$\lambda' = 27°25'35''$	$t' = 7^{d}$·18854
" 30 ·51095	$l = 15\ 39\ 40$	$\lambda = 19\ 25\ 28$	$t'' = 4$ ·78486
Dec. 5 ·29581	$l'' = 2\ 7\ 11$	$\lambda'' = 3\ 20\ 45$	

These have been corrected for aberration and parallax, and with reference to mean time at Paris.

From the tables of Delambre have been taken

(Long. of ⊙ + 180°) or $\mathrm{L} = 68°\ 25'\ 41''$; $\log \mathrm{R} = 9{\cdot}9936673$.

To these I add from values before noticed;

$\varpi = 99°\ 34'\ 13''$; $\mathrm{L} - \varpi = 31°\ 8'\ 32''$; $\sin \varepsilon = {\cdot}01685151$.

Preliminary Quantities for (A).

$t' = 9{\cdot}0922228$	$p = 7{\cdot}9403288$	$a + l' - L = -42°55'51''$	
$t'' = 8{\cdot}9154514$	$q = 0{\cdot}0062710$	$a + l - L = -51\ 57\ 15$	$s = 9{\cdot}9937738$
$t' - t'' = 8{\cdot}6164587$	$a = +48'46''$	$a + l'' - L = -65\ 29\ 44$	

The numbers in this and the following are sufficiently distinguished from the logarithms by the prefixed signs + and — .

From Computation of Formulæ (A).

Values of $X_{,}$ $Y_{,}$.

$p \cos a - q \sin a$	$p \sin a + q \cos a$
$-\,{\cdot}0087163 - {\cdot}0143914$	$-\,{\cdot}0001236 + 1{\cdot}0144421$
$X_{,} = -\,{\cdot}0231077.$	$Y_{,} = +\,1{\cdot}0143185.$

Values of A, A′, A″, &c.

$\beta'\gamma'' - \beta''\gamma'$	$\beta''\gamma - \beta\gamma''$	$\beta\gamma' - \beta'\gamma$
$-{\cdot}0398195 + {\cdot}4722050$	$-{\cdot}3208804 + {\cdot}0460401$	$-{\cdot}4086707 + {\cdot}2401851$
$A = +\,{\cdot}4323855.$	$A' = -\,{\cdot}2748403.$	$A'' = -\,{\cdot}1684856.$

At'	At''	$At't''$	$A\alpha$
8·7280941	8·5513227	7·6435455	+ ·2664756

$\rho\left(\frac{A'\alpha'}{At''} - \frac{A''\alpha''}{At'}\right)$	$\rho\left(\frac{A'\beta'}{At''} - \frac{A''\beta''}{At'}\right)$	$\rho\left(\frac{A'\gamma'}{At''} - \frac{A''\gamma''}{At'}\right)$
0·7523734; 0·1162696	0·7209781; 0·4574862	0·6028708; 9·2653444
$-5{\cdot}654229 + 1{\cdot}306982$	$+5{\cdot}259907 - 2{\cdot}867386$	$-4{\cdot}007474 + 0{\cdot}184223$
$-\rho\,(4{\cdot}347247).$	$+\rho\,(2{\cdot}392521).$	$-\rho\,(3{\cdot}823251).$

We have supposed in this computation that the factors μ, μ', &c. are each unity. But if we take for greater precision the distance $r = 1$,

$\log \mu'' = 9{\cdot}9990181$; $\log \mu' = 9{\cdot}9977807$; $\log \mu = 9{\cdot}9992627$; $\log \nu = 9{\cdot}9985244$, we shall find the corresponding values,

$-\rho\,(4{\cdot}341140)$. $+\rho\,(2{\cdot}395257)$. $-\rho\,(3{\cdot}815140)$.

If to the value of $A\alpha = {\cdot}2664756$, we join $A'\alpha' = -{\cdot}2012315$, $A''\alpha'' = -{\cdot}0698817$, obtained from the logarithms used in the preceding computation, there will result $D = -{\cdot}0046376$, and then we shall get

$\rho\left(D\frac{t''-t'}{t't''} + D\frac{X_{,}}{3As}\right)$	$\rho\left(D\frac{Y_{,}}{3As}\right)$
8·6392065; 5·9232877.	7·5657013
+ ·0435719 + ·0000838	$-\rho\,({\cdot}003679)$.
$+\rho\,({\cdot}043655)$.	

In these values we have taken $\mu = 1$, $\mu' = 1$, &c. If we employ the logarithms which correspond to $r = 1$, there will result, instead of the preceding:

$+\rho\,({\cdot}043581)$, $-\rho\,({\cdot}003662)$;

by virtue of which and the value before given, we obtain for the comet's velocities:

$$\left.\begin{aligned} x_{,} &= -0{\cdot}023108 - \rho\,(4{\cdot}297559), \\ y_{,} &= +1{\cdot}014319 + \rho\,(2{\cdot}391595), \\ z_{,} &= -\rho\,(3{\cdot}815140); \end{aligned}\right\} \quad (d)$$

in which ρ is the curtate distance from the centre of the earth.

Had we retained the values found in case of $\mu = 1$, $\mu' = 1$, &c., the coefficients of ρ would have been

(4·303592), (2·388842), (3·823251);

which are not so accurate as those in (d).

The preceding expressions for $x_{,}$, $y_{,}$, $z_{,}$, may be easily changed so as to correspond to any required position of the axis of x, and to the ray drawn from the centre E of the earth to the comet at C. If we supposed this axis to be directed to E, we shall find in terms of ρ before used ;

$$\left.\begin{aligned} x_{,} &= -0{\cdot}008716 - \rho\,(4{\cdot}263202), \\ y_{,} &= +1{\cdot}014544 + \rho\,(2{\cdot}452316), \\ z_{,} &= -\rho\,(3{\cdot}815140). \end{aligned}\right\} \qquad (e)$$

But if we also change ρ into $\rho \cos \lambda$, so that ρ may denote the ray CE, we shall get

$$x_{,} = -0{\cdot}008716 - \rho\,(4{\cdot}020544),$$

$$y_{,} = +1{\cdot}014544 + \rho\,(2{\cdot}312732),$$

$$z_{,} = -\rho\,(3{\cdot}597985).$$

The accuracy of these results we believe to be very considerable. Mr Pontécoulant's values in terms of ρ are the following:

$$x_{,} = -0{\cdot}008686 - \rho\,(4{\cdot}026273), \quad y_{,} = +1{\cdot}014545 + \rho\,(2{\cdot}314020);$$

$z_{,} = -\rho\,(3{\cdot}605632)$. (See Théorie Analytique, &c., vol. II., p. 70.)

With the desire of making a comparison between the principal terms of formulæ (E), and the values (d) above given, I have subjected them to computation. By taking the first expressions for E, E′, E″ and ε'', the coefficients of the curtate distance ρ were as here given:

$$x_{,} = X_{,} - \rho\,(4{\cdot}050920) - \&c.$$

$$y_{,} = Y_{,} + \rho\,(2{\cdot}047392) + \&c.$$

$$z_{,} = -\rho\,(3{\cdot}646140) - \&c.$$

so that the terms affected by K differ little from $-\rho\,({\cdot}245653)$, $+\rho\,({\cdot}345974)$, $-\rho\,({\cdot}168997)$, and will in the destined use of (E) not exceed the order of the intervals t', t''.

To the data of the example now considered, I have been induced to apply the method of La Place; and with surprise I found results which it may be proper here to insert. By means of the two expressions

$$dl = \frac{(l''-l)\,t'^2 + (l-l')\,t''^2}{t't''(t'+t'')}, \quad d^2 l = \frac{(l''-l)\,t' - (l-l')\,t''}{t't''(t'+t'')};$$

which are deducible from the values of l', l'', expressed by Maclaurin's theorem; I obtained in parts of radius, $d\,l = -2{\cdot}232849$; $d^2\,l = -15{\cdot}51507$. The similar values which depend on the geocentric latitudes were $d\,\lambda = -2{\cdot}498243$, $d^2\,\lambda = -22{\cdot}139036$; and adopting in this method the formulæ:

$$d\,\rho = \frac{m}{n}\,\rho, \quad m = d^2 l + \tan(\mathrm{L}-l)\left(d\,l^2 + \frac{d^2\lambda}{\sin\lambda\cos\lambda} + \frac{2\,d\,\lambda^2}{\cos\lambda^2}\right),$$

$$n = 2\,d\,l + 2\tan(\mathrm{L}-l)\frac{d\,\lambda}{\sin\lambda\cos\lambda};$$

which may be found expressed differently in the Mécanique Celeste and Theorie Analytique, &c. I obtained $\frac{m}{n}$ or $i = -3{\cdot}278562$. The three equations

$$x_{,} = \mathrm{X}_{,} + \rho\,(i\,\alpha - \beta\,d\,l),$$

$$y_{,} = \mathrm{Y}_{,} + \rho\,(i\,\beta + \alpha\,d\,l),$$

$$z_{,} = \rho\left(i\,\gamma + \frac{d\lambda}{\cos\lambda}\right),$$

resulting from the differentiation of (1), and in which $\alpha = \cos(l-\mathrm{L})$, $\beta = \sin(l-\mathrm{L})$, $\gamma = \tan\lambda$, then gave me the following values:

$$x_{,} = \mathrm{X}_{,} - \rho\,(3{\cdot}761473),$$

$$y_{,} = \mathrm{Y}_{,} + \rho\,(1{\cdot}261091),$$

$$z_{,} = -\,\rho\,(3{\cdot}965141);$$

which are exceedingly different from (e), with regard to the coefficients of ρ in the values of $x_{,}$ and $y_{,}$.

In addition to these results, I would join the remark, that the computed values of $x_{,}$, $y_{,}$, $z_{,}$, expressed by the preceding differential formulæ, cannot be made to agree with (*e*), so long as are employed the above numerical quantities found for dl, $d\lambda$; and that from this and other instances, I consider as defective the manner in which the first and second differentials of the geocentric longitudes and latitudes are determined in the method here noticed; and which, I think, should not be used for determining the component velocities of a comet, or the position of its orbit.

We might now particularize further the expressions (*d*) by means of (25) and (26), and the consequent values of the distances r and ρ. But our principal aim in the present paper has, we imagine, been sufficiently attained. We intend again to resume the subject on an early occasion.

ARTICLE VIII.

Account of a Tornado, which, towards the end of August 1838, *passed over the suburbs of the city of Providence, in the state of Rhode Island, and afterwards over a part of the Village of Somerset. Also an Extract of a Letter on the same subject from Zachariah Allen, Esq., of the city of Providence.*

Communicated by Robert Hare, M.D., Professor of Chemistry in the University of Pennsylvania. *Read October* 26, 1838.

I PROPOSE to lay before the Society, for a place in their Transactions, an account of a tornado which occurred in the state of Rhode Island, towards the end of August last.

This phenomenon was first observed near Providence, over the south western suburbs of which it passed in a course generally from west by north, to south by east. Only a few days subsequently I visited some of the most remarkable scenes of its ravages.

The characteristics of this tornado, from all that I could see or hear, are quite similar to those of the tornado which occurred at New Brunswick, New Jersey, in June 1835, and to which I referred in my paper upon the causes of tornadoes and water-spouts, published in the sixth volume of the Society's Transactions.

This recent tornado was advantageously seen by J. L. Tillinghast, Esq. from a window of his mansion, which is so situated, on the brow of a hill on the eastern side of the city of Providence, as to afford an unobstructed view of the country opposite. Mr Tillinghast alleges that his attention was at first attracted by seeing to the westward a huge inverted cone, of extremely dark vapour, which extended from the clouds to the earth. In the contortions and spiral movements of its lower extremity, this cone was conceived to resemble the proboscis of an enormous elephant, moving about in search of food. Sometimes it was elongated so as to reach the ground; at others it skipped over the intervening space without touching it; but at each contact with the terrestrial surface, or bodies resting thereon, a cloud of dust, intermingled with their fragments, was seen to rise within the vortex. To those who were sufficiently near to the meteor, a fearful explanation of these appearances was simultaneously evident. Ponds were partially exhausted. Trees uprooted or deprived of their leaves or branches. Houses were unroofed, or uplifted and then dashed to pieces. Farms were robbed of their grain, potatoes, fruit-trees or poultry: nor were human beings secure from being carried aloft, and more or less injured by subsequent descent. It was alleged that at Somerset two women were carried from a wagon over a wall, into an adjoining field. Within the same village a cellar door frame, with its doors bolted, was lifted, and then deposited on one side of its previous position; although situated to windward of the mansion to which it belonged. This result was the more striking, because, in consequence of their presenting an inclined plane to the blast, the doors and their frames would have been pressed more firmly upon their foundation by an ordinary wind. In consequence of the same dilatation of the air within the house, which lifted the cellar door, the weather-boarding on the leeward side was burst open, while that to the windward was undisturbed.

About four o'clock on the afternoon during which this tornado passed near Providence, there was heard at the farm at which I resided, twenty-five miles south of Providence and about fifteen miles from Somerset, the loudest thunder which I ever heard. It made the house in which I was tremble sensibly.

I have received from an estimable friend, Mr Allen, a most interesting account of this tornado, which passed over the river, and there produced the appearance of a water-spout, while he was sufficiently near for accurate observation. In one respect his narrative tends to justify my opinion, that the exciting cause of tornadoes is electrical attraction. In two instances in which flashes of lightning proceeded from the water, Mr Allen remarked that the effervescence produced by the tornado in the water very perceptibly subsided.*

Extract from a Letter written by Zachariah Allen, Esq., of Providence.

"It was about three o'clock, P. M., during a violent shower, that I observed a peculiarly black cloud to form in the midst of light, fleecy clouds, and to assume a portentous appearance in the heavens, having a long, dark, tapering cone of vapour extending from it to the surface of the earth. The form of this black cloud, and of the cone of vapour depending from it, so nearly resembled the engraved pictures of 'water spouts' above the ocean, which I had frequently seen, that I should have come speedily to the conclusion that one of these 'water spouts' was approaching, had I not been aware that this phenomenon occupied a space in the heavens directly above a dry plain of land. Whilst attentively watching the progress of the cloud, with its portentous dark cone trailing its point in contact with the surface of the earth, I noticed numerous black specks, resembling flocks of blackbirds on the wing, diverging from the under surface of the clouds, at a great elevation in the air, and falling to the ground. Among these were some objects of larger size, which I could discern to be fragments of boards, sailing off obliquely in their descent. This alarming indication left no room for doubt that a violent tornado was fast approaching, and that these distant, dark specks were fragments of shingles and boards uplifted high in the air, and left to fall, from the outer edge of the black conical cloud. This fearful appearance was repeatedly exhibited, as often as the tornado passed over buildings.

"The whirlwind soon swept towards an extensive range of buildings, within a few yards of me, the roof of which appeared to open at the top, and to be uplifted for a moment. The whole fabric then sunk into a confused mass of moving rubbish, and became indistinctly visible amid the cloud that overspread it, as with a mantle of mist.

* See Essay on the Cause of Tornadoes or Waterspouts in sixth vol. American Philosophical Transactions, or in Silliman's Journal, vol. 32, for 1837.

"The destructive force of the tornado now became not only apparent to the eye, but also fearfully terrific, from the deafening crash of breaking boards and timbers, startling the amazed spectator in alarm for his personal safety, amid the roar of the whirlwind, and the shattered fragments flying like deadly missiles near him. At one instant, when the point of the dark cone of cloud passed over the prostrate wreck of the building, the fragments seemed to be upheaved, as if by the explosion of gunpowder, and I actually became intensely excited with the fear that the moving mass might direct its march toward the open area of the yard, to which I had resorted, after abandoning a building in which I had previously found shelter.

"Fortunately the course of the tornado was not over the building used as a depot by the Stonington Railroad Company in Providence, where there was a numerous assemblage of passengers awaiting the departure of the cars; otherwise several lives might have been lost.

"The most interesting appearance was exhibited when the tornado left the shore, and struck the surface of the adjacent river. Being within a few yards of this spot, I had an opportunity of accurately noting the effects produced on the surface of the water.

"The circle formed by the tornado on the foaming water was about three hundred feet in diameter. Within this circle the water appeared to be in commotion, like that in a huge boiling cauldron; and misty vapours, resembling steam, rapidly arose from the surface, and entering the whirling vortex, at times veiled from sight the centre of the circle, and the lower extremity of the overhanging cone of dark vapour. Amid all the agitation of the water and the air about it, this cone continued unbroken, although it swerved and swung around, with a movement resembling that of the trunk of an elephant whilst that animal is in the act of depressing it to the ground to pick up some minute object. In truth, the tapering form, as well as the vibrating movements of the extremity of this cone of vapour, bore a striking resemblance to those of the trunk of that great animal.

"Whilst passing off over the water, a distant view of the cloud might have induced the spectator to compare its form to that of a huge umbrella suspended in the heavens, with the column of vapour representing the handle, descending and dipping into the foam of the billows.

The waves heaved and swelled, whenever the point of this cone passed over them, apparently as if some magical spell were acting upon them by the effect of enchantment. *Twice I noticed a gleam of lightning, or of electric fluid, to dart through the column of vapour, which served as a conductor for it to ascend from the water to the cloud. After the flash the foam of the water seemed immediately to diminish for a moment, as if the discharge of the electric fluid had served to calm the excitement on its agitated surface.*

"The progress of the tornado was nearly in a straight line, following the direction of the wind, with a velocity of perhaps eight or ten miles per hour.

"Near as I was to the exterior edge of the circle of the tornado, I felt no extraordinary gust of wind; but noticed that the breeze continued to blow uninterruptedly from the same quarter from which it prevailed before the tornado occurred.

"I also particularly observed that there was no perceptible increase of temperature of the air adjacent to the edge of the whirlwind, which might have caused an ascending current by a rarefaction of a portion of the atmosphere. After passing over the sheet of water, and gaining the shore, I observed the shingles and fragments of a barn to be elevated and dispersed high in the air; and the dark cloud continued to maintain the same appearance which it at first presented, until it passed away beyond the scope of a distinct vision of its misty outlines.

"The above imperfect sketch can convey to your mind only a feeble impression of this exciting scene, which in passing before me excited just enough of terror to impart to the spectacle the most awful sense of the power, sublimity and grandeur of the Almighty, as described in the glowing words of the Psalmist. 'He bowed the heavens also, and came down; and darkness was under his feet; and he did fly upon the wings of the wind. He made darkness his secret place; his pavilion round about him were dark waters and thick clouds of the skies.'"

ARTICLE IX.

Contributions to Electricity and Magnetism. *By Joseph Henry, Professor of Natural Philosophy in the College of New Jersey, Princeton.*

No. III.—On Electro-Dynamic Induction. *Read November* 2, 1838.

INTRODUCTION.

1. Since my investigations in reference to the influence of a spiral conductor, in increasing the intensity of a galvanic current, were submitted to the Society, the valuable paper of Dr Faraday, on the same subject, has been published, and also various modifications of the principle have been made by Sturgeon, Masson, Page and others, to increase the effects. The spiral conductor has likewise been applied by Cav. Antinori to produce a spark by the action of a thermo-electrical pile; and Mr Watkins has succeeded in exhibiting all the phenomena of hydro-electricity by the same means. Although the principle has been much extended by the researches of Dr Faraday, yet I am happy to state that the results obtained by this distinguished philosopher are not at variance with those given in my paper.

2. I now offer to the Society a new series of investigations in the same line, which I hope may also be considered of sufficient importance to merit a place in the Transactions.

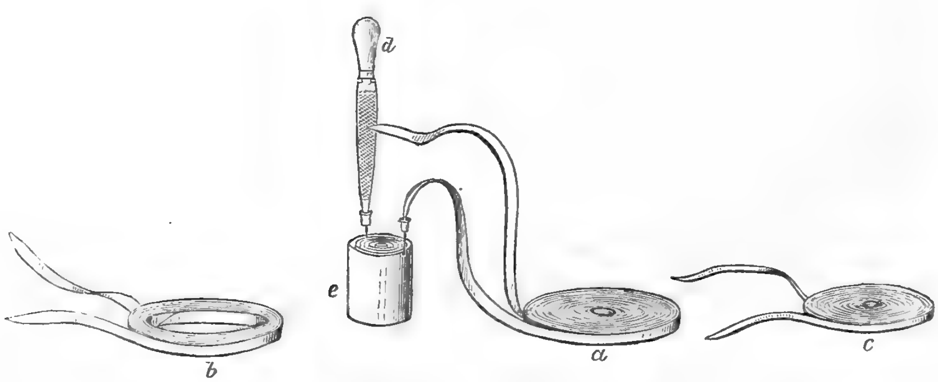
3. The primary object of these investigations was to discover, if

possible, inductive actions in common electricity analogous to those found in galvanism. For this purpose a series of experiments was commenced in the spring of 1836, but I was at that time diverted, in part, from the immediate object of my research, by a new investigation of the phenomenon known in common electricity by the name of the lateral discharge. Circumstances prevented my doing any thing further, in the way of experiment, until April last, when most of the results which I now offer to the Society were obtained. The investigations are not as complete, in several points, as I could wish, but as my duties will not permit me to resume the subject for some months to come, I therefore present them as they are; knowing, from the interest excited by this branch of science in every part of the world, that the errors which may exist will soon be detected, and the truths be further developed.

4. The experiments are given nearly in the order in which they were made; and in general they are accompanied by the reflections which led to the several steps of the investigation. The whole series is divided, for convenience of arrangement, into six sections, although the subject may be considered as consisting, principally, of two parts. The first relating to a new examination of the induction of galvanic currents; and the second to the discovery of analogous results in the discharge of ordinary electricity.*

5. The principal articles of apparatus used in the experiments, consist of a number of flat coils of copper riband, which will be desig-

Fig. 1.



a represents coil No. 1, *b* coil No. 2, and *c* coil No. 3; *e* the battery, *d* the rasp.

* The several paragraphs are numbered in succession, from the first to the last, after the mode adopted by Mr Faraday, for convenience of reference.

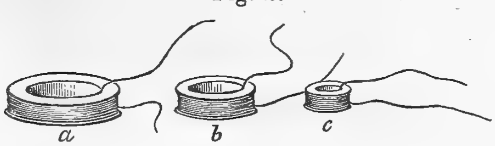
nated by the names of coil No. 1, coil No. 2, &c.; also of several coils of long wire; and these, to distinguish them from the ribands, will be called helix No. 1, helix No. 2, &c.

6. Coil No. 1 is formed of thirteen pounds of copper plate, one inch and a half wide and ninety-three feet long. It is well covered with two coatings of silk, and was generally used in the form represented in Fig. 1, which is that of a flat spiral sixteen inches in diameter. It was however sometimes formed into a ring of larger diameter, as is shown in Fig. 4, Section III.

7. Coil No. 2 is also formed of copper plate, of the same width and thickness as coil No. 1. It is, however, only sixty feet long. Its form is shown at *b*, Fig. 1. The opening at the centre is sufficient to admit helix No. 1. Coils No. 3, 4, 5, 6, &c. are all about sixty feet long, and of copper plate of the same thickness, but of half the width of coil No. 1.

8. Helix No. 1 consists of sixteen hundred and sixty yards of copper wire, $\frac{1}{49}$th of an inch in diameter. No. 2, of nine hundred and ninety yards; and No. 3, of three hundred and fifty yards, of the same wire. These helices are shown in Fig. 2, and are so adjusted in size as to fit into each other; thus forming one long helix of three thousand yards: or, by using them separately, and in different combinations, seven helices of different lengths. The wire is covered with cotton thread, saturated with beeswax, and between each stratum of spires a coating of silk is interposed.

Fig. 2.



a represents helix No. 1, *b* helix No. 2, *c* helix No. 3.

9. Helix No. 4 is shown at *a*, Fig. 4, Section III.; it is formed of five hundred and forty-six yards of wire, $\frac{1}{49}$th of an inch in diameter, the several spires of which are insulated by a coating of cement. Helix No. 5 consists of fifteen hundred yards of silvered copper wire, $\frac{1}{125}$th of an inch in diameter, covered with cotton, and is of the form of No. 4.

10. Besides these I was favoured with the loan of a large spool of copper wire, covered with cotton, $\frac{1}{16}$th of an inch in diameter, and five miles long. It is wound on a small axis of iron, and forms a solid cylinder of wire, eighteen inches long, and thirteen in diameter.

11. For determining the direction of induced currents, a magnetiz-

ing spiral was generally used, which consists of about thirty spires of copper wire, in the form of a cylinder, and so small as just to admit a sewing needle into the axis.

12. Also a small horseshoe is frequently referred to, which is formed of a piece of soft iron, about three inches long, and $\frac{3}{8}$ths of an inch thick; each leg is surrounded with about five feet of copper bell wire. This length is so small, that only a current of electricity of considerable quantity can develope the magnetism of the iron. The instrument is used for indicating the existence of such a current.

13. The battery used in most of the experiments is shown in Fig. 1. It is formed of three concentric cylinders of copper, and two interposed cylinders of zinc. It is about eight inches high, five inches in diameter, and exposes about one square foot and three quarters of zinc surface, estimating both sides of the metal. In some of the experiments a larger battery was used, weakly charged, but all the results mentioned in the paper, except those with a Cruickshank trough, can be obtained with one or two batteries of the above size, particularly if excited by a strong solution. The manner of interrupting the circuit of the conductor by means of a rasp, *b*, is shown in the same Figure.

SECTION I.

Conditions which influence the induction of a Current on itself.

14. The phenomenon of the spiral conductor is at present known by the name of the induction of a current on itself, to distinguish it from the induction of the secondary current, discovered by Dr Faraday. The two, however, belong to the same class, and experiments render it probable that the spark given by the long conductor is, from the natural electricity of the metal, disturbed for an instant by the induction of the primary current. Before proceeding to the other parts of these investigations, it is important to state the results of a number of preliminary experiments, made to determine more definitely the conditions which influence the action of the spiral conductor.

15. When the electricity is of low intensity, as in the case of the thermo-electrical pile, or a large single battery weakly excited with dilute acid, the flat riband coil No. 1, ninety-three feet long, is found to

give the most brilliant deflagrations, and the loudest snaps from a surface of mercury. The shocks, with this arrangement, are, however, very feeble, and can only be felt in the fingers or through the tongue.

16. The induced current in a short coil, which thus produces deflagration, but not shocks, may, for distinction, be called one of quantity.

17. When the length of the coil is increased, the battery continuing the same, the deflagrating power decreases, while the intensity of the shock continually increases. With five riband coils, making an aggregate length of three hundred feet, and the small battery, Fig. 1, the deflagration is less than with coil No. 1, but the shocks are more intense.

18. There is, however, a limit to this increase of intensity of the shock, and this takes place when the increased resistance or diminished conduction of the lengthened coil begins to counteract the influence of the increasing length of the current. The following experiment illustrates this fact. A coil of copper wire $\frac{1}{16}$th of an inch in diameter, was increased in length by successive additions of about thirty-two feet at a time. After the first two lengths, or sixty-four feet, the brilliancy of the spark began to decline, but the shocks constantly increased in intensity, until a length of five hundred and seventy-five feet was obtained, when the shocks also began to decline. This was then the proper length to produce the maximum effect with a single battery, and a wire of the above diameter.

19. When the intensity of the electricity of the battery is increased, the action of the short riband coil decreases. With a Cruickshank's trough of sixty plates, four inches square, scarcely any peculiar effect can be observed, when the coil forms a part of the circuit. If however the length of the coil be increased in proportion to the intensity of the current, then the inductive influence becomes apparent. When the current, from ten plates of the above mentioned trough, was passed through the wire of the large spool (10), the induced shock was too severe to be taken through the body. Again, when a small trough of twenty-five one-inch plates, which alone would give but a very feeble shock, was used with helix No. 1, an intense shock was received from the induction, when the contact was broken. Also a slight shock in this arrangement is given when the contact is formed, but it is very feeble

in comparison with the other. The spark, however, with the long wire and compound battery is not as brilliant as with the single battery and the short riband coil.

20. When the shock is produced from a long wire, as in the last experiments, the size of the plates of the battery may be very much reduced, without a corresponding reduction of the intensity of the shock. This is shown in an experiment with the large spool of wire (10). A very small compound battery was formed of six pieces of copper bell wire, about one inch and a half long, and an equal number of pieces of zinc of the same size. When the current from this was passed through the five miles of the wire of the spool, the induced shock was given at once to twenty-six persons joining hands. This astonishing effect placed the action of a coil in a striking point of view.

21. With the same spool and the single battery used in the former experiments, no shock, or at most a very feeble one, could be obtained. A current, however, was found to pass through the whole length, by its action on the galvanometer; but it was not sufficiently powerful to induce a current which could counteract the resistance of so long a wire.

22. The induced current in these experiments may be considered as one of *considerable intensity*, and *small quantity*.

23. The form of the coil has considerable influence on the intensity of the action. In the experiments of Dr Faraday, a long cylindrical coil of thick copper wire, inclosing a rod of soft iron, was used. This form produces the greatest effect when magnetic reaction is employed; but in the case of simple galvanic induction, I have found the form of the coils and helices represented in the figures most effectual. The several spires are more nearly approximated, and therefore they exert a greater mutual influence. In some cases, as will be seen hereafter, the ring form, shown in Fig. 4, is most effectual.

24. In all cases the several spires of the coil should be well insulated, for although in magnetizing soft iron, and in analogous experiments, the touching of two spires is not attended with any great reduction of action; yet in the case of the induced current, as will be shown in the progress of these investigations, a single contact of two spires is sometimes sufficient to neutralize the whole effect.

25. It must be recollected that all the experiments with these coils and helices, unless otherwise mentioned, are made without the reaction of iron temporarily magnetized; since the introduction of this would, in some cases, interfere with the action, and render the results more complex.

SECTION II.

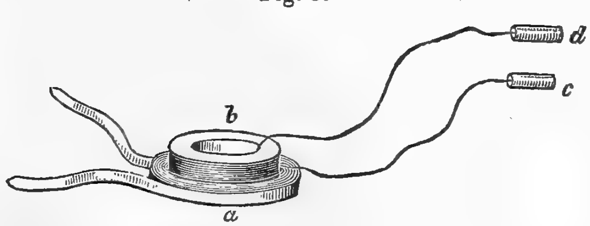
Conditions which influence the production of Secondary Currents.

26. The secondary currents, as it is well known, were discovered in the induction of magnetism and electricity, by Dr Faraday, in 1831. But he was at that time urged to the exploration of new, and apparently richer veins of science, and left this branch to be traced by others. Since then, however, attention has been almost exclusively directed to one part of the subject, namely, the induction from magnetism, and the perfection of the magneto-electrical machine. And I know of no attempts, except my own, to review and extend the purely electrical part of Dr Faraday's admirable discovery.

27. The energetic action of the flat coil, in producing the induction of a current on itself, led me to conclude that it would also be the most proper means for the exhibition and study of the phenomena of the secondary galvanic currents.

28. For this purpose coil No. 1 was arranged to receive the current from the small battery, and coil No. 2 placed on this, with a plate of glass interposed to insure perfect insulation; as often as the circuit of No. 1 was interrupted, a powerful secondary current was induced in No. 2. The arrangement is the same as that exhibited in Fig. 3, with the exception that in this the compound helix is represented as receiving the induction, instead of coil No. 2.

Fig. 3.



a represents coil No. 1, *b* helix No. 1, and *c*, *d*, handles for receiving the shock.

29. When the ends of the second coil were rubbed together, a spark was produced at the opening. When the same ends were joined by

the magnetizing spiral (11), the inclosed needle became strongly magnetic. Also when the secondary current was passed through the wires of the iron horseshoe (12), magnetism was developed; and when the ends of the second coil were attached to a small decomposing apparatus, of the kind which accompanies the magneto-electrical machine, a stream of gas was given off at each pole. The shock, however, from this coil is very feeble, and can scarcely be felt above the fingers.

30. This current has therefore the properties of one of moderate intensity, but considerable quantity.

31. Coil No. 1 remaining as before, a longer coil, formed by uniting Nos. 3, 4 and 5, was substituted for No. 2. With this arrangement, the spark produced when the ends were rubbed together, was not as brilliant as before; the magnetizing power was much less; decomposition was nearly the same, but the shocks were more powerful, or, in other words, the intensity of the induced current was increased by an increase of the length of the coil, while the quantity was apparently decreased.

32. A compound helix, formed by uniting Nos. 1 and 2, and therefore containing two thousand six hundred and fifty yards of wire, was next placed on coil No. 1. The weight of this helix happened to be precisely the same as that of coil No. 2, and hence the different effects of the same quantity of metal in the two forms of a long and short conductor, could be compared. With this arrangement the magnetizing effects, with the apparatus before mentioned, disappeared. The sparks were much smaller, and also the decomposition less, than with the short coil; but the shock was almost too intense to be received with impunity, except through the fingers of one hand. A circuit of fifty-six of the students of the senior class, received it at once from a single rupture of the battery current, as if from the discharge of a Leyden jar weakly charged. The secondary current in this case was one of small quantity, but of great intensity.

33. The following experiment is important in establishing the fact of a limit to the increase of the intensity of the shock, as well as the power of decomposition, with a wire of a given diameter. Helix No. 5, which consists of wire only $\frac{1}{125}$th of an inch in diameter, was placed

on coil No. 2, and its length increased to about seven hundred yards. With this extent of wire, neither decomposition nor magnetism could be obtained, but shocks were given of a peculiarly pungent nature; they did not however produce much muscular action. The wire of the helix was further increased to about fifteen hundred yards; the shock was now found to be scarcely perceptible, in the fingers.

34. As a counterpart to the last experiment, coil No. 1 was formed into a ring of sufficient internal diameter to admit the great spool of wire (11), and with the whole length of this (which, as has before been stated, is five miles) the shock was found so intense as to be felt at the shoulder, when passed only through the forefinger and thumb. Sparks and decomposition were also produced, and needles rendered magnetic. The wire of this spool is $\frac{1}{16}$th of an inch thick, and we therefore see from this experiment, that by increasing the diameter of the wire, its length may also be much increased, with an increased effect.

35. The fact (33) that the induced current is diminished by a further increase of the wire, after a certain length has been attained, is important in the construction of the magneto-electrical machine, since the same effect is produced in the induction of magnetism. Dr Goddard of Philadelphia, to whom I am indebted for coil No. 5, found that when its whole length was wound on the iron of a temporary magnet, no shocks could be obtained. The wire of the machine may therefore be of such a length, relative to its diameter, as to produce shocks, but no decomposition; and if the length be still further increased, the power of giving shocks may also become neutralized.

36. The inductive action of coil No. 1, in the foregoing experiments, is precisely the same as that of a temporary magnet in the case of the magneto-electrical machine. A short thick wire around the armature gives brilliant deflagrations, but a long one produces shocks. This fact, I believe, was first discovered by my friend Mr Saxton, and afterwards investigated by Sturgeon and Lentz.

37. We might, at first sight, conclude, from the perfect similarity of these effects, that the currents which, according to the theory of Ampere, exist in the magnet, are like those in the short coil, of great

quantity and feeble intensity; but succeeding experiments will show that this is not necessarily the case.

38. All the experiments given in this section have thus far been made with a battery of a single element. This condition was now changed, and a Cruickshank trough of sixty pairs substituted. When the current from this was passed through the riband coil No. 1, no indication, or a very feeble one, was given of a secondary current in any of the coils or helices, arranged as in the preceding experiments. The length of the coil, in this case, was not commensurate with the intensity of the current from the battery. But when the long helix, No. 1, was placed instead of coil No. 1, a powerful inductive action was produced on each of the articles, as before.

39. First, helices No. 2 and 3 were united into one, and placed within helix No. 1, which still conducted the battery current. With this disposition a secondary current was produced, which gave intense shocks but feeble decomposition, and no magnetism in the soft iron horseshoe. It was therefore one of intensity, and was induced by a battery current also of intensity.

40. Instead of the helix used in the last experiment for receiving the induction, one of the coils (No. 3) was now placed on helix No. 1, the battery remaining as before. With this arrangement the induced current gave no shocks, but it magnetized the small horseshoe; and when the ends of the coil were rubbed together, produced bright sparks. It had therefore the properties of a current of quantity; and it was produced by the induction of a current, from the battery, of intensity.

41. This experiment was considered of so much importance, that it was varied and repeated many times, but always with the same result; it therefore establishes the fact *that an intensity current can induce one of quantity*, and, by the preceding experiments, the converse has also been shown, that *a quantity current can induce one of intensity*.

42. This fact appears to have an important bearing on the law of the inductive action, and would seem to favour the supposition that the lower coil, in the two experiments with the long and short secon-

dary conductors, exerted the same amount of inductive force, and that in one case this was expended (to use the language of theory) in giving a great velocity to a small quantity of the fluid, and in the other in producing a slower motion in a larger current; but in the two cases, were it not for the increased resistance to conduction in the longer wire, the quantity multiplied by the velocity would be the same. This, however, is as yet a hypothesis, but it enables us to conceive how intensity and quantity may both be produced from the same induction.

43. From some of the foregoing experiments we may conclude, that the quantity of electricity in motion in the helix is really less than in the coil, of the same weight of metal; but this may possibly be owing simply to the greater resistance offered by the longer wire. It would also appear, if the above reasoning be correct, that to produce the most energetic physiological effects, only a small quantity of electricity, moving with great velocity, is necessary.

44. In this and the preceding section, I have attempted to give only the general conditions which influence the galvanic induction. To establish the law would require a great number of more refined experiments, and the consideration of several circumstances which would affect the results, such as the conduction of the wires, the constant state of the battery, the method of breaking the circuit with perfect regularity, and also more perfect means than we now possess of measuring the amount of the inductive action; all these circumstances render the problem very complex.

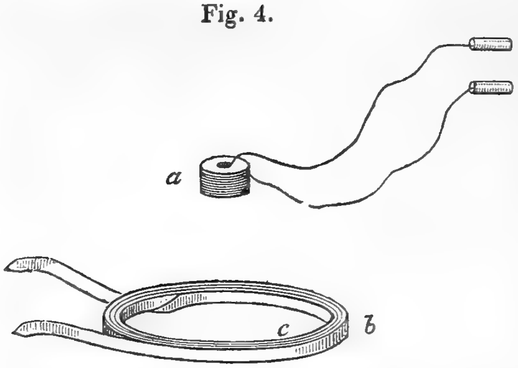
SECTION III.

On the Induction of Secondary Currents at a distance.

45. In the experiments given in the two preceding Sections, the conductor which received the induction, was separated from that which transmitted the primary current by the thickness only of a pane of glass; but the action from this arrangement was so energetic, that I was naturally led to try the effect at a greater distance.

46. For this purpose coil No. 1 was formed into a ring of about two

Fig. 4.



a represents helix No. 4, *b* coil No. 1, in the form of a ring.

feet in diameter, and helix No. 4 placed as is shown in the figure. When the helix was at the distance of about sixteen inches from the middle of the plane of the ring, shocks could be perceived through the tongue, and these rapidly increased in intensity as the helix was lowered, and when it reached the plane of the ring they were quite severe. The effect, however, was still greater, when the helix was moved from the centre to the inner circumference, as at *c*: but when it was placed without the ring, in contact with the outer circumference, at *b*, the shocks were very slight; and when placed within, but its axis at right angles to that of the ring, not the least effect could be observed.

47. With a little reflection, it will be evident that this arrangement is not the most favourable for exhibiting the induction at a distance, since the side of the ring, for example, at *c*, tends to produce a current revolving in one direction in the near side of the helix, and another in an opposite direction in the farther side. The resulting effect is therefore only the difference of the two, and in the position as shown in the figure; this difference must be very small, since the opposite sides of the helix are approximately at the same distance from *c*. But the difference of action on the two sides constantly increases as the helix is brought near the side of the ring, and becomes a maximum when the two are in the position of internal contact. A helix of larger diameter would therefore produce a greater effect.

48. Coil No. 1 remaining as before, helix No. 1, which is nine inches in diameter, was substituted for the small helix of the last experiment, and with this the effect at a distance was much increased. When coil No. 2 was added to coil No. 1, and the currents from two small batteries sent through these, shocks were distinctly perceptible through the tongue, when the distance of the planes of the coils and the three helices, united as one, was increased to thirty-six inches.

49. The action at a distance was still further increased by coiling the long wire of the large spool into the form of a ring of four feet in diameter, and placing parallel to this another ring, formed of the four ribands of coils No. 1, 2, 3 and 4. When a current from a single battery of thirty-five feet of zinc surface was passed through the riband conductor, shocks through the tongue were felt when the rings were separated to the distance of four feet. As the conductors were approximated, the shocks became more and more severe; and when at the distance of twelve inches, they could not be taken through the body.

50. It may be stated in this connection, that the galvanic induction of magnetism in soft iron, in reference to distance, is also surprisingly great. A cylinder of soft iron, two inches in diameter and one foot long, placed in the centre of the ring of copper riband, with the battery above mentioned, becomes strongly magnetic.

51. I may perhaps be excused for mentioning in this communication that the induction at a distance affords the means of exhibiting some of the most astonishing experiments, in the line of *physique amusante*, to be found perhaps in the whole course of science. I will mention one which is somewhat connected with the experiments to be described in the next section, and which exhibits the action in a striking manner. This consists in causing the induction to take place through the partition wall of two rooms. For this purpose coil No. 1 is suspended against the wall in one room, while a person in the adjoining one receives the shock, by grasping the handles of the helix, and approaching it to the spot opposite to which the coil is suspended. The effect is as if by magic, without a visible cause. It is best produced through a door, or thin wooden partition.

52. The action at a distance affords a simple method of graduating the intensity of the shock in the case of its application to medical purposes. The helix may be suspended by a string passing over a pulley, and then gradually lowered down towards the plane of the coil, until the shocks are of the required intensity. At the request of a medical friend, I have lately administered the induced current precisely in this way, in a case of paralysis of a part of the nerves of the face.

53. I may also mention that the energetic action of the spiral con-

ductors enables us to imitate, in a very striking manner, the inductive operation of the magneto-electrical machine, by means of an uninterrupted galvanic current. For this purpose it is only necessary to arrange two coils to represent the two poles of a horseshoe magnet, and to cause two helices to revolve past them in a parallel plane. While a constant current is passing through each coil, in opposite directions, the effect of the rotation of the helices is precisely the same as that of the revolving armature in the machine.

54. A remarkable fact should here be noted in reference to helix No. 4, which is connected with a subsequent part of the investigation. This helix is formed of copper wire, the spires of which are insulated by a coating of cement instead of thread, as in the case of the others. After being used in the above experiments, a small discharge from a Leyden jar was passed through it, and on applying it again to the coil, I was much surprised to find that scarcely any signs of a secondary current could be obtained.

55. The discharge had destroyed the insulation in some part, but this was not sufficient to prevent the magnetizing of a bar of iron introduced into the opening at the centre. The effect appeared to be confined to the inductive action. The same accident had before happened to another coil of nearly the same kind. It was therefore noted as one of some importance. An explanation was afterwards found in a peculiar action of the secondary current.

SECTION IV.

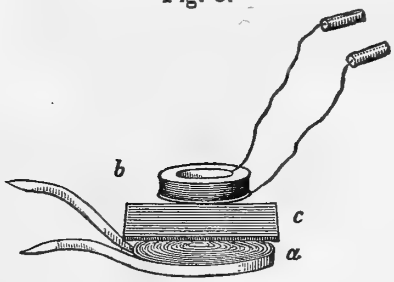
On the Effects produced by interposing different Substances between the Conductors.

56. Sir H. Davy found, in magnetizing needles by an electrical discharge, that the effect took place through interposed plates of all substances, conductors and nonconductors.* The experiment which I have given in paragraph 51 would appear to indicate that the inductive action which produces the secondary current might also follow the same law.

* Philosophical Transactions, 1821.

57. To test this the compound helix was placed about five inches above coil No. 1, Fig. 5, and a plate of sheet iron, about $\frac{1}{10}$th of an inch thick, interposed. With this arrangement no shocks could be obtained; although, when the plate was withdrawn, they were very intense.

Fig. 5.



a represents coil No. 1, *b* helix No. 1, and *c* an interposed plate of metal.

58. It was at first thought that this effect might be peculiar to the iron, on account of its temporary magnetism; but this idea was shown to be erroneous by substituting a plate of zinc of about the same size and thickness. With this the screening influence was exhibited as before.

59. After this a variety of substances was interposed in succession, namely, copper, lead, mercury, acid, water, wood, glass, &c.; and it was found that all the perfect conductors, such as the metals, produced the screening influence; but nonconductors, as glass, wood, &c., appeared to have no effect whatever.

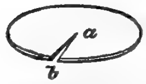
60. When the helix was separated from the coil by a distance only equal to the thickness of the plate, a slight sensation could be perceived even when the zinc of $\frac{1}{10}$th of an inch in thickness was interposed. This effect was increased by increasing the quantity of the battery current. If the thickness of the plate was diminished, the induction through it became more intense. Thus a sheet of tinfoil interposed produced no perceptible influence; also four sheets of the same were attended with the same result. A certain thickness of metal is therefore required to produce the screening effect, and this thickness depends on the quantity of the current from the battery.

61. The idea occurred to me that the screening might, in some way, be connected with an instantaneous current in the plate, similar to that in the induction by magnetic rotation, discovered by M. Arago. The ingenious variation of this principle by Messrs Babbage and Herschell, furnished me with a simple method of determining this point.

62. A circular plate of lead was interposed, which caused the induction in the helix almost entirely to disappear. A slip of the metal

was then cut out in the direction of a radius of the circle, as is shown in Fig. 6. With the plate in this condition, no screening was produced; the shocks were as intense as if the metal were not present.

Fig. 6.

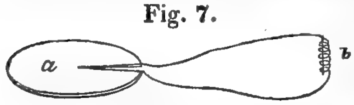


a represents a lead plate, of which the sector *b* is cut out.

63. This experiment however is not entirely satisfactory, since the action might have taken place through the opening of the lead; to obviate this objection, another plate was cut in the same manner, and the two interposed with a glass plate between them, and so arranged that the opening in the one might be covered by the continuous part of the other. Still shocks were obtained with undiminished intensity.

64. But the existence of a current in the interposed conductor was rendered certain by attaching the magnetizing spiral by means of two wires to the edge of the opening in the circular plate, as is shown in Fig. 7. By this arrangement the latent current was drawn out, and its direction obtained by the polarity of a needle placed in the spiral at *b*.

Fig. 7.



a represents a lead plate, *b* the magnetizing spiral.

65. This current was a secondary one, and its direction, in conformity with the discovery of Dr Faraday, was found to be the same as that of the primary current.

66. That the screening influence is in some way produced by the neutralizing action of the current thus obtained, will be clear, from the following experiment. The plate of zinc before mentioned, which is nearly twice the diameter of the helix, instead of being placed between the conductors, was put on the top of the helix, and in this position, although the neutralization was not as perfect as before, yet a great reduction was observed in the intensity of the shock.

67. But here a very interesting and puzzling question occurs. How does it happen that two currents, both in the same direction, can neutralize each other? I was at first disposed to consider the phenomenon as a case of real electrical interference, in which the impulses succeed each other by some regular interval. But if this were true the effect should depend on the length and other conditions of the current in the interposed conductor. In order to investigate this, several modifications of the experiments were instituted.

68. First a flat coil (No. 3) was interposed instead of the plates. When the two ends of this were separated, the shocks were received as if the coil were not present; but when the ends were joined, so as to form a perfect metallic circuit, no shocks could be obtained. The neutralization with the coil in this experiment was even more perfect than with the plate.

69. Again, coil No. 2, in the form of a ring, was placed not between the conductors, but around the helix. With this disposition of the apparatus, and the ends of the coil joined, the shocks were scarcely perceptible, but when the ends were separated, the presence of the coil has no effect.

70. Also when helix No. 1 and 2 were together submitted to the influence of coil No. 1, the ends of the one being joined, the other gave no shock.

71. The experiments were further varied by placing helix No. 2 within a hollow cylinder of sheet brass, and this again within coil No. 2 in a manner similar to that shown in Fig. 12, which is intended to illustrate another experiment. In this arrangement the neutralizing action was exhibited, as in the case of the plate.

72. A hollow cylinder of iron was next substituted for the one of brass, and with this also no shocks could be obtained.

73. From these experiments it is evident that the neutralization takes place with currents in the interposed or adjoining conductors of all lengths and intensities, and therefore cannot, as it appears to me, be referred to the interference of two systems of vibrations.

74. This part of the investigation was, for a time, given up almost in despair, and it was not until new light had been obtained from another part of the inquiry, that any further advances could be made towards a solution of the mystery.

75. Before proceeding to the next Section, I may here state that the phenomenon mentioned, paragraph 54, in reference to helix No. 4, is connected with the neutralizing action. The electrical discharge having destroyed the insulation at some point, a part of the spires would thus form a shut circuit, and the induction in this would counteract the action in the other part of the helix; or, in other words, the helix

was in the same condition as the two helices mentioned in paragraph 70, when the ends of the wire of one were joined.

76. Also the same principle appears to have an important bearing on the improvement of the magneto-electrical machine: since the plates of metal which sometimes forms the ends of the spool containing the wire, must necessarily diminish the action, and also from experiment of paragraph 72 the armature itself may circulate a closed current which will interfere with the intensity of the induction in the surrounding wire. I am inclined to believe that the increased effect observed by Sturgeon and Calland, when a bundle of wire is substituted for a solid piece of iron, is at least in part due to the interruption of these currents. I hope to resume this part of the subject, in connection with several other points, in another communication to the Society.

77. The results given in this Section may, at first sight, be thought at variance with the statements of Sir H. Davy, that needles could be magnetized by an electrical discharge with conductors interposed. But from his method of performing the experiment, it is evident that the plate of metal was placed between a straight conductor and the needle. The arrangement was therefore similar to the interrupted circuit in the experiment with the cut plate (62), which produces no screening effect. Had the plate been curved into the form of a hollow cylinder, with the two ends in contact, and the needle placed within this, the effect would have been otherwise.

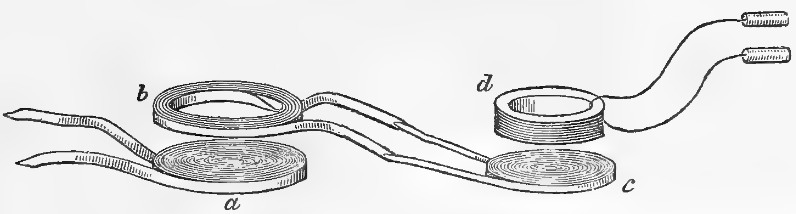
SECTION V.

On the Production and Properties of induced Currents of the Third, Fourth and Fifth order.

78. The fact of the perfect neutralization of the primary current by a secondary, in the interposed conductor, led me to conclude that if the latter could be drawn out, or separated from the influence of the former, it would itself be capable of producing a new induced current in a third conductor.

79. The arrangement exhibited in Fig. 8 furnishes a ready means of

Fig. 8.



a coil No. 1, *b* coil No. 2, *c* coil No. 3, *d* helix No. 1.

testing this. The primary current, as usual, is passed through coil No. 1, while coil No. 2 is placed over this to receive the induction, with its ends joined to those of coil No. 3. By this disposition the secondary current passes through No. 3; and since this is at a distance, and without the influence of the primary, its separate induction will be rendered manifest by the effects on helix No. 1. When the handles *a*, *b* are grasped a powerful shock is received, proving the induction of a tertiary current.

80. By a similar but more extended arrangement, as shown in Fig. 9, shocks were received from currents of a fourth and fifth order; and with a more powerful primary current, and additional coils, a still greater number of successive inductions might be obtained.

81. The induction of currents of different orders, of sufficient intensity to give shocks, could scarcely have been anticipated from our previous knowledge of the subject. The secondary current consists, as it were, of a single wave of the natural electricity of the wire, disturbed but for an instant by the induction of the primary; yet this has the power of inducing another current, but little inferior in energy to itself, and thus produces effects apparently much greater in proportion to the quantity of electricity in motion than the primary current.

82. Some difference may be conceived to exist in the action of the induced currents, and that from the battery, since they are apparently different in nature; the one consisting, as we may suppose, of a single impulse, and the other of a succession of such impulses, or a continuous action. It was therefore important to investigate the properties of these currents, and to compare the results with those before obtained.

83. First, in reference to the intensity, it was found that with the

small battery a shock could be given from the current of the third order to twenty-five persons joining hands; also shocks perceptible in the arms were obtained from a current of the fifth order.

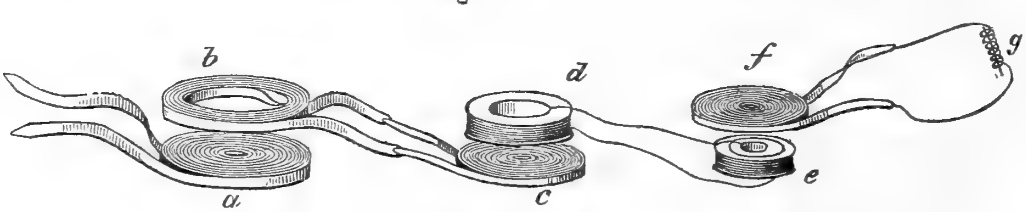
84. The action at a distance was also much greater than could have been anticipated. In one experiment shocks from the tertiary current were distinctly felt through the tongue, when helix No. 1 was at the distance of eighteen inches above the coil transmitting the secondary current.

85. The same screening effects were produced by the interposition of plates of metal between the conductors of the different orders, as those which have been described in reference to the primary and secondary currents.

86. Also when the long helix is placed over a secondary current generated in a short coil, and which is therefore, as we have before shown, one of quantity, a tertiary current of intensity is produced.

87. Again, when the intensity current of the last experiment is passed through a second helix, and another coil is placed over this, a quantity current is again produced. Therefore in the case of these currents, as in that of the primary, a *quantity current can be induced from one of intensity, and the converse.* By the arrangement of the apparatus as shown in Fig. 9, these different results are exhibited at once. The induction from coil No. 3 to helix No. 1 produces an intensity current, and from helix No. 2 to coil No. 4 a quantity current.

Fig. 9.

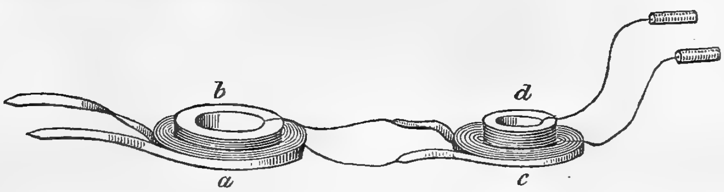


a coil No. 1, *b* coil No. 2, *c* coil No. 3, *d* helix No. 1, *e* helix No. 2 and 3, *f* coil No. 4, and *g* magnetizing spiral.

88. If the ends of coil No. 2, as in the arrangement of Fig. 8, be united to helix No. 1 instead of coil No. 3, no shocks can be obtained; the quantity current of coil No. 2 appears not to be of sufficient intensity to pass through the wire of the long helix.

89. Also, no shocks can be obtained from the handles attached to

Fig. 10.



a coil No. 2, *b* helix No. 1, *c* coil No. 3, and *d* helix No, 2.

helix No. 2, in the arrangement exhibited in Fig. 10. In this case the quantity of electricity in the current from the helix appears to be too small to produce any effect, unless its power is multiplied by passing it through a conductor of many spires.

90. The next inquiry was in reference to the direction of these currents, and this appeared important in connection with the nature of the action. The experiments of Dr Faraday would render it probable, that at the beginning and ending of the secondary current, its induction on an adjacent wire is in contrary directions, as is shown to be the case in the primary current. But the whole action of a secondary current is so instantaneous, that the inductive effects at the beginning and ending cannot be distinguished from each other, and we can only observe a single impulse, which, however, may be considered as the difference of two impulses in opposite directions.

91. The first experiment happened to be made with a current of the fourth order. The magnetizing spiral (11) was attached to the ends of coil No. 4, Fig. 9, and by the polarity of the needle it was found that this current was in the same direction with the secondary and primary currents.* By a too hasty generalization, I was led to conclude, from this experiment, that the currents of all orders are in the same direction as that of the battery current, and I was the more confirmed in this from the results of my first experiments on the currents of ordinary electricity. The conclusion, however, caused me much useless labour and perplexity, and was afterwards proved to be erroneous.

92. By a careful repetition of the last experiment, in reference to

* It should be recollected that all the inductions which have been mentioned were produced at the moment of breaking the circuit of the battery current. The induction at the formation of the current is too feeble to produce the effects described.

each current, the important fact was discovered, that *there exists an alternation in the direction of the currents of the several orders, commencing with the secondary.* This result was so extraordinary, that it was thought necessary to establish it by a variety of experiments. For this purpose the direction was determined by decomposition, and also by the galvanometer, but the result was still the same; and at this stage of the inquiry I was compelled to the conclusion that the directions of the several currents were as follows:

Primary current,.	+
Secondary current, ...	+
Current of the third order, ...	—
Current of the fourth order, ...	+
Current of the fifth order, ...	—

93. In the first glance at the above table, we are struck with the fact that the law of alternation is complete, except between the primary and secondary currents, and it appeared that this exception might possibly be connected with the induced current which takes place in the first coil itself, and which gives rise to the phenomena of the spiral conductor. If this should be found to be *minus*, we might consider it as existing between the primary and secondary, and the anomaly would thus disappear. Arrangements were therefore made to fully satisfy myself on this point. For this purpose the decomposition of dilute acid and the use of the galvanometer were resorted to, by placing the apparatus between the ends of a cross wire attached to the extremities of the coil, as in the arrangement described by Dr Faraday (ninth series); but all the results persisted in giving a direction to this current the same as stated by Dr Faraday, namely, that of the primary current. I was therefore obliged to abandon the supposition that the anomaly in the change of the current is connected with the induction of the battery current on itself.

94. Whatever may be the nature or causes of these changes in the direction, they offer a ready explanation of the neutralizing action of the plate interposed between two conductors, since a secondary current is induced in the plate; and although the action of this, as has been shown, is in the same direction as the current from the battery, yet it

tends to induce a current in the adjacent conducting matter of a contrary direction. The same explanation is also applicable to all the other cases of neutralization, even to those which take place between the conductors of the several orders of currents.

95. The same principle explains some effects noted in reference to the induction of a current on itself. If a flat coil be connected with the battery, of course sparks will be produced by the induction, at each rupture of the circuit. But if in this condition another flat coil, with its ends joined, be placed on the first coil, the intensity of the shock is much diminished, and when the several spires of the two coils are mutually interposed by winding the two ribands together into one coil, the sparks entirely disappear in the coil transmitting the battery current, when the ends of the other are joined. To understand this, it is only necessary to mention that the induced current in the first coil is a true secondary current, and it is therefore neutralized by the action of the secondary in the adjoining conductor; since this tends to produce a current in the opposite direction.

96. It would also appear from the perfect neutralization which ensues in the arrangement of the last paragraph, that the induced current in the adjoining conductor is more powerful than that of the first conductor; and we can easily see how this may be. The two ends of the second coil are joined, and it thus forms a perfect metallic circuit; while the circuit of the other coil may be considered as partially interrupted, since to render the spark visible the electricity must be projected, as it were, through a small distance of air.

97. We would also infer that two contiguous secondary currents, produced by the same induction, would partially counteract each other. Moving in the same direction, they would each tend to induce a current in the other of an opposite direction. This is illustrated by the following experiment: helix No. 1 and 2 were placed together, but not united, above coil No. 1, so that they each might receive the induction; the larger was then gradually removed to a greater distance from the coil, until the intensity of the shock from each was about the same. When the ends of the two were united, so that the shock would pass through the body from the two together, the effect was apparently less than with one helix alone. The result, however, was

not as satisfactory as in the case of the other experiments; a slight difference in the intensity of two shocks could not be appreciated with perfect certainty.

SECTION VI.

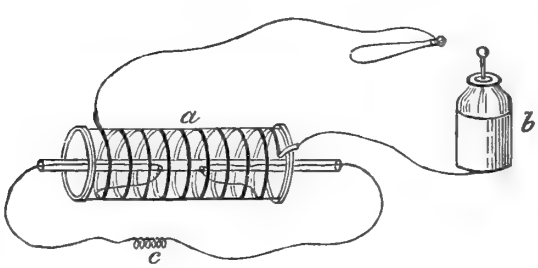
The production of induced Currents of the different Orders from ordinary Electricity.

98. Dr Faraday, in the ninth series of his researches, remarks, that "the effect produced at the commencement and the end of a current (which are separated by an interval of time when that current is supplied from a voltaic apparatus) must occur at the same moment when a common electrical discharge is passed through a long wire. Whether if it happen accurately at the same moment they would entirely neutralize each other, or whether they would not still give some definite peculiarity to the discharge, is a matter remaining to be examined."

99. The discovery of the fact that the secondary current, which exists but for a moment, could induce another current of considerable energy, gave some indication that similar effects might be produced by a discharge of ordinary electricity, provided a sufficiently perfect insulation could be obtained.

100. To test this a hollow glass cylinder, Fig. 11, of about six inches in diameter, was prepared with a narrow riband of tinfoil, about thirty feet long, pasted spirally around the outside, and a similar riband of the same length, pasted on the inside; so that the corresponding spires of the two were directly opposite each other. The ends of the inner spiral passed out of the cylinder through a glass tube, to prevent all direct communication between the two. When the ends of the inner riband were joined by the magnetizing spiral (11), containing a needle, and a discharge from a half gallon jar sent through

Fig. 11.



a glass cylinder, *b* Leyden jar, *c* magnetizing spiral.

the outer riband, the needle was strongly magnetized in such a manner as to indicate *an induced current through the inner riband in the same direction as that of the current of the jar.* This experiment was repeated many times, and always with the same result.

101. When the ends of one of the ribands were placed very nearly in contact, a small spark was perceived at the opening, the moment the discharge took place through the other riband.

102. When the ends of the same riband were separated to a considerable distance, a larger spark than the last could be drawn from each end by presenting a ball, or the knuckle.

103. Also if the ends of the outer riband were united, so as to form a perfect metallic circuit, a spark could be drawn from any point of the same, when a discharge was sent through the inner riband.

104. The sparks in the two last experiments are evidently due to the action known in ordinary electricity by the name of the lateral discharge. To render this clear, it is perhaps necessary to recall the well known fact, that when the knob of a jar is electrified positively, and the outer coating in connection with the earth, then the jar contains a small excess of positive electricity beyond what is necessary to perfectly neutralize the negative surface. If the knob be put in communication with the earth, the extra quantity, or the free electricity, as it is sometimes called, will be on the negative side. When the discharge took place in the above experiments, the inner riband became for an instant charged with this free electricity, and consequently threw off from the outer riband, by ordinary induction, the sparks described. It therefore became a question of importance to determine, whether the induced current described in paragraph 100 was not also a result of the lateral discharge, instead of being a true case of a secondary current analogous to those produced from galvanism. For this purpose the jar was charged, first with the outer coating in connection with the earth, and again with the knob in connection with the same, so that the extra quantity might be in the one case *plus* and in the other *minus*; but the direction of the induced current was not affected by these changes; it was always the same, namely, from the positive to the negative side of the jar.

105. When, however, the quantity of free electricity was increased, by connecting the knob of the jar with a globe about a foot in diameter, the intensity of magnetism appeared to be somewhat diminished, if the extra quantity was on the negative side; and this might be expected, since the free electricity, in its escape to the earth through the riband, in this case would tend to induce a feeble current in the opposite direction to that of the jar.

106. The spark from an insulated conductor may be considered as consisting almost entirely of this free or extra electricity, and it was found that this was also capable of producing an induced current, precisely the same as that from the jar. In the experiment which gave this result, one end of the outer riband of the cylinder (100) was connected with the earth, and the other caused to receive a spark from a conductor fourteen feet long, and nearly a foot in diameter. The direction of the induced current was the same as that of the spark from the conductor.

107. From these experiments it appears evident that the discharge from the Leyden jar possesses the property of inducing a secondary current precisely the same as the galvanic apparatus, and also that this induction is only so far connected with the phenomenon of the lateral discharge as this latter partakes of the nature of an ordinary electrical current.

108. Experiments were next made in reference to the production of currents of the different orders by ordinary electricity. For this purpose a second cylinder was prepared with ribands of tinfoil, in a similar manner to the one before described. The two were then so connected that the secondary current from the first would circulate around the second. When a discharge was passed through the outer riband of the first cylinder, a tertiary current was induced in the inner riband of the second. This was rendered manifest by the magnetizing of a needle in a spiral joining the ends of the last mentioned riband.

109. Also by the addition, in the same way, of a third cylinder, a current of the fourth order was developed. The same result was likewise obtained by using the arrangement of the coils and helices shown in Fig. 9. For these experiments, however, the coils were furnished

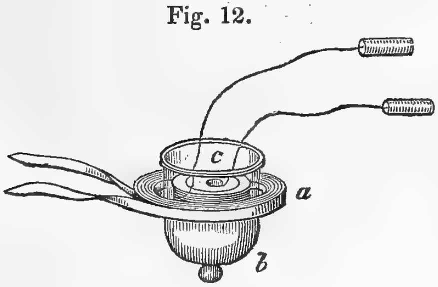
with a double coating of silk, and the contiguous conductors separated by a large plate of glass.

110. Screening effects precisely the same as those exhibited in the action of galvanism were produced by interposing a plate of metal between the conductors of different orders, Figures 8 and 9. The precaution was taken to place the plate between two frames of glass, in order to be assured that the effect was not due to a want of perfect insulation.

111. Also analogous results were found when the experiments were made with coils interposed instead of plates, as described in paragraph 68. When the ends of the interposed coils were separated, no screening was observed, but when joined, the effect was produced. The existence of the induced current, in all these experiments, was determined by the magnetism of a needle in a spiral attached to one of the coils.

112. Likewise shocks were obtained from the secondary current by an arrangement shown in Fig. 12. Helices No. 2 and No. 3 united are put within a glass jar, and coil No. 2 is placed around the same. When the handles are grasped, a shock is felt at the moment of the discharge, through the outer coil. The shocks, however, were very different in intensity with different discharges from the jar. In some cases no shock was received, when again, with a less charge, a severe one was obtained. But these irregularities find an explanation in a subsequent part of the investigation.

Fig. 12.



a coil No. 2, *b* an inverted bell glass, *c* helices No. 2 and 3.

113. In all these experiments, the results with ordinary and galvanic electricity are similar. But at this stage of the investigation there appeared what at first was considered a remarkable difference in the action of the two. I allude to the direction of the currents of the different orders. These, in the experiments with the glass cylinders, instead of exhibiting the alternations of the galvanic currents (92), were all in the same direction as the discharge from the jar, or, in other words, they were all *plus*.

114. To discover, if possible, the cause of this difference, a series of experiments was instituted; but the first fact developed, instead of affording any new light, seemed to render the obscurity more profound. When the directions of the currents were taken in the arrangement of the coils (Fig. 9) the discrepancy vanished. *Alternations were found the same as in the case of galvanism.* This result was so extraordinary that the experiments were many times repeated, first with the glass cylinders, and then with the coils; the results, however, were always the same. The cylinders gave currents all in one direction; the coils in alternate directions.

115. After various hypotheses had been formed, and in succession disproved by experiment, the idea occurred to me that the direction of the currents might depend on the distance of the conductors, and this appeared to be the only difference existing in the arrangement of the experiments with the coils and the cylinders.* In the former the distance between the ribands was nearly one inch and a half, while in the latter it was only the thickness of the glass, or about $\frac{1}{20}$th of an inch.

116. In order to test this idea, two narrow slips of tinfoil, about twelve feet long, were stretched parallel to each other, and separated by thin plates of mica to the distance of about $\frac{1}{50}$th of an inch. When a discharge from the half gallon jar was passed through one of these, an induced current in the same direction was obtained from the other. The ribands were then separated, by plates of glass, to the distance of $\frac{1}{20}$th of an inch; the current was still in the same direction, or *plus.* When the distance was increased to about $\frac{1}{8}$th of an inch, no induced current could be obtained; and when they were still further separated the current again appeared, but was now *found to have a different direction, or to be minus.* No other change was observed in the direction of the current; the intensity of the induction decreased as the ribands were separated. The existence and direction of the current, in this experiment, were determined by the polarity of the needle in the spiral attached to the ends of one of the ribands.

* This idea was not immediately adopted, because I had previously experimented on the direction of the secondary current from galvanism, and found no change in reference to distance.

117. The question at this time arose, whether the direction of the current, as indicated by the polarity of the needle, was the true one, since the magnetizing spiral might itself, in some cases, induce an opposite current. To satisfy myself on this point a series of charges, of various intensity and quantity, from a single spark of the large conductor to the full charge of nine jars, were passed through the small spiral, which had been used in all the experiments, but they all gave the same polarity. The interior of this spiral is so small, that the needle is throughout in contact with the wire.

118. The fact of a change in the direction of the induced current by a change in the distance of the conductors, being thus established, a great number and variety of experiments were made to determine the other conditions on which the change depends. These were sought for in a variation of the intensity and quantity of the primary discharge, in the length and thickness of the wire, and in the form of the circuit. The results were, however, in many cases, anomalous, and are not sufficiently definite to be placed in detail before the Society. I hope to resume the investigation at another time, and will therefore at present briefly state only those general facts which appear well established.

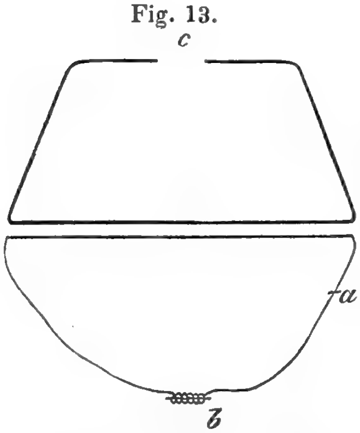
119. With a single half gallon jar, and the conductors separated to a distance less than $\frac{1}{20}$th of an inch, the induced current is always in the same direction as the primary. But when the conductors are gradually separated, there is always found a distance at which the current begins to change its direction. This distance depends certainly on the amount of the discharge, and probably on the intensity; and also on the length and thickness of the conductors. With a battery of eight half gallon jars, and parallel wires of about ten feet long, the change in the direction did not take place at a less distance than from twelve to fifteen inches, and with a still larger battery and longer conductors, no change was found, although the induction was produced at the distance of several feet.

120. The facts given in the last paragraph relate to the inductive action of the primary current; but it appears from the results detailed in paragraphs 110 and 114, that the currents of all the other orders also change the direction of the inductive influence with a change of

the distance. In these cases, however, the change always takes place at a very small distance from the conducting wire; and in this respect the result is similar to the effect of a *primary current* from the discharge of a small jar.

121. The most important experiments, in reference to distance, were made in the lecture room of my respected friend Dr Hare of Philadelphia, with the splendid electrical apparatus described in the Fifth Volume (new series) of the Transactions of this Society. The battery consists of thirty-two jars, each of the capacity of a gallon. A thick copper wire of about $\frac{1}{10}$th of an inch in diameter and eighty feet in length, was stretched across the lecture room, and its ends brought to the battery, so as to form a trapezium, the longer side of which was about thirty-five feet. Along this side a wire was stretched of the ordinary bell size, and the extreme ends of this joined by a spiral, similar to the arrangement shown in Fig. 13. The two wires were at first placed within the distance of about an inch, and afterwards constantly separated after each discharge of the whole battery through the thick wire. When a break was made in the second wire at *a*, no magnetism was developed in a needle in the spiral at *b*, but when the circuit was complete, the needle at each discharge indicated a current in the same direction as that of the battery. When the distance of the two wires was increased to sixteen inches, and the ends of the second wire placed in two glasses of mercury, and a finger of each hand plunged into the metal, a shock was received. The direction of the current was still the same, but the magnetism not as strong as at a less distance.

Fig. 13.



c place of the battery, *b* spiral.

122. The second wire was next arranged around the other, so as to enclose it. The magnetism by this arrangement appeared stronger than with the last; the direction of the current was still the same, and continued thus, until the two wires were at every point separated to the distance of twelve feet, except in one place where they were obliged to be crossed at the distance of seven feet, but here the wires were

made to form a right angle with each other, and the effect of the approximation was therefore (46) considered as nothing. The needle at this surprising distance was tolerably strongly magnetized, as was shown by the quantity of filings which would adhere to it. The direction of the current was still the same as that of the battery. The form of the room did not permit the two wires to be separated to a greater distance. The whole length of the circuit of the interior large wire was about eighty feet; that of the exterior one hundred and twenty. The two were not in the same plane, and a part of the outer passed through a small adjoining room.

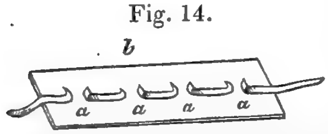
123. The results exhibited in this experiment are such as could scarcely have been anticipated by our previous knowledge of the electrical discharge. They evince a remarkable inductive energy, which has not before been distinctly recognized, but which must perform an important part in the discharge of electricity from the clouds. Some effects which have been observed during thunder storms, appear to be due to an action of this kind.

124. Since a discharge of ordinary electricity produces a secondary current in an adjoining wire, it should also produce an analogous effect in its own wire; and to this cause may be now referred the peculiar action of a long conductor. It is well knowm that the spark from a very long wire, although quite short, is remarkably pungent. I was so fortunate as to witness a very interesting exhibition of this action during some experiments on atmospheric electricity made by a committee of the Franklin Institute, in 1836. Two kites were attached, one above the other, and raised with a small iron wire in place of a string. On the occasion at which I was present, the wire was extended by the kites to the length of about one mile. The day was perfectly clear, yet the sparks from the wire had so much projectile force (to use a convenient expression of Dr Hare) that fifteen persons joining hands and standing on the ground, received the shock at once, when the first person of the series touched the wire. A Leyden jar being grasped in the hand by the outer coating, and the knob presented to the wire, a severe shock was received, as if by a perforation of the glass, but which was found to be the result of the sudden and intense induction.

125. These effects were evidently not due to the accumulated intensity at the extremities of the wire, on the principles of ordinary electrical distribution, since the knuckle required to be brought within about a quarter of an inch before the spark could be received. It was not alone the quantity, since the experiments of Wilson prove that the same effect is not produced with an equal amount of electricity on the surface of a large conductor. It appears evidently therefore a case of the induction of an electrical current on itself. The wire is charged with a considerable quantity of feeble electricity, which passes off in the form of a current along its whole length, and thus the induction takes place at the end of the discharge, as in the case of a long wire transmitting a current of galvanism.

126. It is well known that the discharge from an electrical battery possesses great divellent powers; that it entirely separates, in many instances, the particles of the body through which it passes. This force acts, in part, at least, in the direction of the line of the discharge, and appears to be analogous to the repulsive action discovered by Ampere, in the consecutive parts of the same galvanic current. To illustrate this, paste on a piece of glass a narrow slip of tinfoil, cut it through at several points, and loosen the ends from the glass at the places so cut. Pass a discharge through the tinfoil from about nine half gallon jars; the ends, at each separation, will be thrown up, and sometimes bent entirely back, as if by the action of a strong repulsive force between them. This will be understood by a reference to Fig. 14; the ends are shown bent back at *a*, *a*, *a*, *a*. In the popular experiment of the pierced card, the bur on each side appears to be due to an action of the same kind.

Fig. 14.



b glass plate; *a*, *a*, *a*, *a*, openings in tinfoil.

127. It now appears probable, from the facts given in paragraphs 119 and 120, that the table in paragraph 92 is only an approximation to the truth, and that each current from galvanism, as well as from electricity, first produces an inductive action in the direction of itself, and that the inverse influence takes place at a little distance from the wire.

128. To test this the compound helix was placed on coil No. 1, to

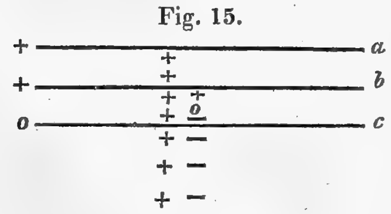
receive the induction, and its ends joined to those of the outer riband of tinfoil of the glass cylinder, while the magnetizing spiral was attached to the ends of the inner riband. A feeble tertiary current was produced by this arrangement, which in two cases gave a polarity to the needle indicating a direction the same as that of the primary current. In other cases the magnetism was either imperceptible or *minus*. With an arrangement of two coils of wires around two glass cylinders, one within the other, the same effect was produced. The magnetism was less when the distance of the two sets of spires was smaller, indicating, as it would appear, an approximation to a position of neutrality. These results are rather of a negative kind, yet they appear to indicate the same change with distance in the case of the galvanic currents, as in that of the discharge of ordinary electricity. The distance however at which the change takes place would seem to be less in the former than in the latter.

129. There is a perfect analogy between the inductive action of the primary current from the galvanic apparatus and of that from the larger electrical battery. The point of change, in each, appears to be at a great distance.

130. The neutralizing effect described in Section IV. may now be more definitely explained by saying that when a third conductor is acted on at the same time by a primary and secondary current (unless it be very near the second wire) it will fall into the region of the *plus* influence of the former, and into that of the *minus* influence of the latter; and hence no induction will be produced.

131. This will be rendered perfectly clear by Fig. 15, in which *a* represents the conductor of the primary current, *b* that of the secondary, and *c* the third conductor. The characters + + +, &c., beginning at the middle of the first conductor and extending downwards, represent the constant *plus* influence of the primary current, and those + 0 — —, &c., beginning at the second conductor, indicate its inductive influence as changing with the distance. The third conductor, as is shown by the figure, falls in the *plus* region of the primary current, and in the *minus* region of the secondary, and

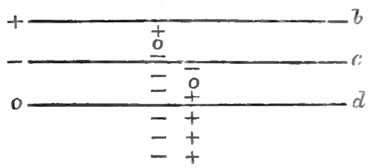
Fig. 15.



hence the two actions neutralize each other, and no apparent result is produced.

132. Fig. 16 indicates the method in which the neutralizing effect is produced in the case of the secondary and tertiary currents. The wire conducting the secondary current is represented by *b*, that conducting the tertiary by *c*, and the other wire, to receive the induction from these, by *d*. The direction of the influence, as before, is indicated by + 0 — —, &c., and the third wire is again seen to be in the *plus* region of the one current, and in the *minus* of the other. If, however, *d* is placed sufficiently near *c*, then neutralization will not take place, but the two currents will conspire to produce in it an induction in the same direction. A similar effect would also be produced were the wire *c*, in Fig. 15, placed sufficiently near the conductor *b*.

Fig. 16.



133. Currents of the several orders were likewise produced from the excitation of the magneto-electrical machine. The same neutralizing effects were observed between these as in the case of the currents from the galvanic battery, and hence we may infer that also the same alternations take place in the direction of the several currents.

134. In conclusion, I may perhaps be allowed to state, that the facts here presented have been deduced from a laborious series of experiments, and are considered as forming some addition to our knowledge of electricity, independently of any theoretical considerations. They appear to be intimately connected with various phenomena, which have been known for some years, but which have not been referred to any general law of action. Of this class are the discoveries of Savary, on the alternate magnetism of steel needles, placed at different distances from the line of a discharge of ordinary electricity,* and also the magnetic, screening influence of all metals, discovered by Dr Snow Harris of Plymouth.† A comparative study of the phenomena observed by these distinguished *savants*, and those given in this paper, would probably

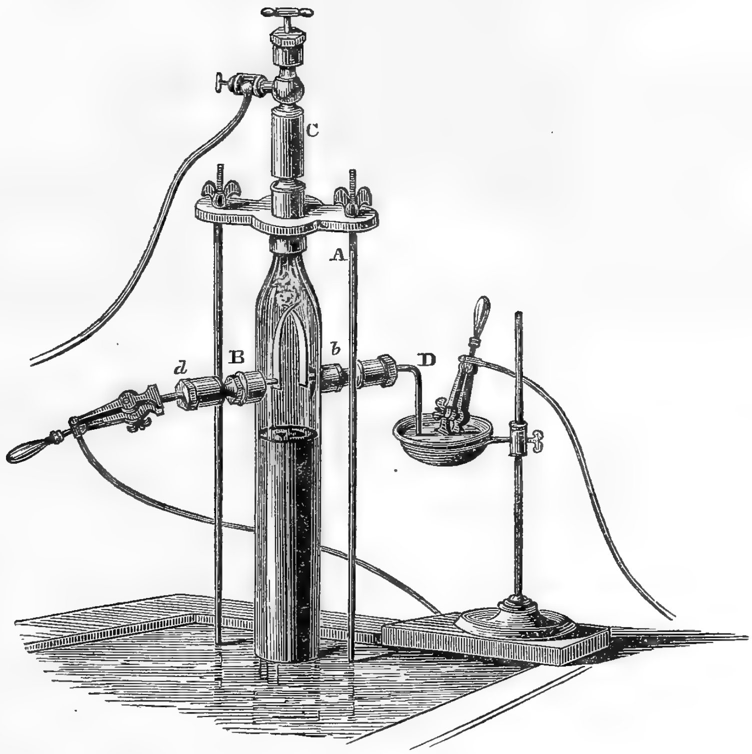
* Annales de Chimie et de Physique, 1827.

† Philosophical Transactions, 1831.

lead to some new and important developments. Indeed every part of the subject of electro-dynamic induction appears to open a field for discovery, which experimental industry cannot fail to cultivate with immediate success.

NOTE.

On the evening of the meeting at which my investigations were presented to the Society, my friend, Dr Bache of the Girard College, gave an account of the investigations of Professor Ettingshausen of Vienna, in reference to the improvement of the magneto-electric machine, some of the results of which he had witnessed at the University of Vienna about a year since. No published account of these experiments has yet reached this country, but it appears that Professor Ettingshausen had been led to suspect the development of a current in the metal of the keeper of the magneto-electric machine, which diminished the effect of the current in the coil about the keeper, and hence to separate the coil from the keeper by a ring of wood of some thickness, and afterwards, to prevent entirely the circulation of currents in the keeper, by dividing it into segments, and separating them by a non-conducting material. I am not aware of the result of this last device, nor whether the mechanical difficulties in its execution were fully overcome. It gives me pleasure to learn that the improvements, which I have merely suggested as deductions from the principles of the interference of induced currents (76), should be in accordance with the experimental conclusions of the above named philosopher.



ARTICLE X.

Engraving and Description of an Apparatus for the Decomposition and Recomposition of Water, employed in the Laboratory of the Medical Department of the University of Pennsylvania. By R. Hare, M. D., Professor of Chemistry. Read December 7, 1838.

HAVING to illustrate the decomposition and recomposition of water to a class of between three and four hundred pupils, I have found it expedient to exhibit the process on an extensive scale.

For many years I have employed a glass tube, of about an inch and a half in bore, and about two feet in height.

The tube (A), which I have used for three years past, has been furnished with two tubulures (B, *b*), about three inches below the upper extremity, where it converges to an apex, having an aperture not larger than a goose quill. Upon this apex there is an iron cap, in which a female screw is wrought so as to allow a large iron valve cock (C) to be screwed to it.

Upon the tubulures also iron caps are cemented, which are so wrought as, with the aid of appropriate screws, to constitute stuffing boxes.

Through each of these a platina rod (D, *d*) is introduced, and fastened to plates of platina, to act as "*electrodes*," agreeably to the language of the celebrated Faraday.

The tube being supported over the mercurial cistern, by means of a communication with an air pump, through the valve cock and flexible leaden pipe, the bore of the tube is exhausted of air, so as to cause the mercury to take its place.

The mercury is so far displaced by a solution of borax, consisting of equal parts of water and saturated solution of that salt, as to sink the surface of the column of metal in the tube about an inch or more below the "electrodes." The projecting end of one of the rods (D, *d*), to the other ends of which the "electrodes" are severally attached, is bent at right angles outside of the tube, so as to enter some mercury in an iron capsule, supported purposely at a proper height, and communicating with one end of my deflagrator of an hundred pairs of Cruickshank plates of about eight inches by fourteen. Of course the rod of the other electrode must have a communication with the other end of the deflagrator. Under these circumstances, if the circuit be completed by throwing the acid on the plates of the deflagrator, a most rapid evolution of hydrogen and oxygen will ensue in consequence of the decomposition of the water, so that within a few seconds, several cubic inches of gas will be collected.

The action being now suspended by throwing the acid off the plates, and the foam being allowed to subside, the resulting gaseous mixture may be ignited, and of course condensed, by completing the circuit again as at first, and at the same time causing the ends of the "electrodes" to come into contact with each other, and thus to produce a spark.

This contact is effected by causing a very slight movement in the rod, bent at right angles, and entering the mercury in the iron capsule. Of course the process may be repeated as often as can be reasonably desired.

ARTICLE XI.

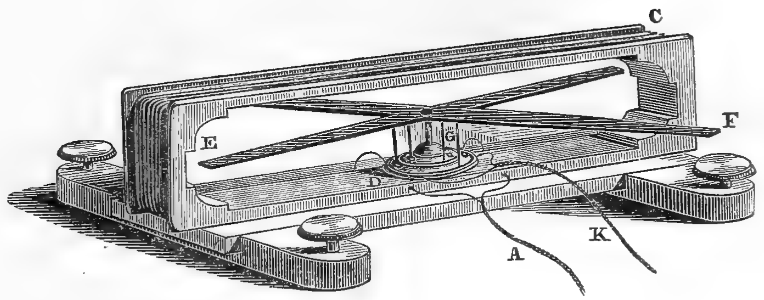
Improved Process for obtaining Potassium. By Robert Hare, M. D., Professor of Chemistry in the University of Pennsylvania. Read December 7, 1838.

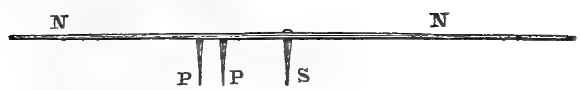
In evolving potassium, agreeably to Brunner's plan, I have substituted for the luting usually employed to protect the iron bottle, a cylinder of iron, which is made to surround the bottle; also a disk of the same metal, of a diameter and thickness equal to that of the cylinder.

The disk is supported by bricks of Kaolin. The bottle being vertical, the blast acts more equably on the surface of the iron, and the operator can, by additional fuel, protect any part from that undue exposure, to which the under surface is always liable, when the bottle is horizontal.

The potassium is received into an iron tube, of which the bore is two inches in diameter. This tube screws at one end into the bottle, and at the other is closed by a perforated plug, terminating in a small orifice. To this a leaden tube is fitted, which is so adjusted by bending, as to cause the vapour resulting from the burning of the gas, to go into the ash-hole. By these means the hydrogen, being ignited as soon as it comes over, serves as an index of the success and progress of the process. In this way no resort to naphtha is in the first instance necessary. The potassium is extricated from the tube by cooling it by affusion of water, detaching it from the bottle, and then closing the end thus exposed by a cap, in which a suitable conical female screw is wrought.

The part of the tube containing the potassium is then made in a vertical position to occupy the axis of a cylindrical furnace, the end terminating, as above mentioned, in a tapering plug, being lowermost, and projecting below the bottom of the furnace. Before the temperature reaches redness, globules of the metal begin to descend; but to extricate the last portion, a white heat is requisite. The potassium may be received in bottles, kept full of hydrogen by a constant current, or in naphtha. The first portion, which descends before the temperature is high, can be more easily received without naphtha than the latter portion.





ARTICLE XII.

Engraving and Description of a Rotatory Multiplier, or one in which one or more Needles are made to revolve by a Galvanic Current. By R. Hare, M. D., Professor of Chemistry in the University of Pennsylvania. Read December 7, 1838.

The preceding engraving represents a rotatory galvanometer, or multiplier, which I contrived in November 1836, and which must have value as an addition to the amusing, if not to the useful implements of science. It is well known that by passing a temporary discharge through the coil of a multiplier, the needle may be made to perform a revolution, whereas if the current be continuously applied, the movement is checked as soon as the situation of the poles is reversed. To produce a permanent motion, the discharge must be allowed to take place only when the poles are in a favourable position, relatively to the excited coil. This object I attained by means of two pins, descending from the needle perpendicularly, so as to enter two globules of mercury, communicating, on one side, with a galvanic pair, on the other with the coil of the multiplier. In the next place, by winding over the first coil, another of similar length, but in a direction the opposite of that in which the first coil was wound, I was enabled, by two other globules, situated so as to communicate severally with the lower ends of the pins, at the opposite side from that on which the first mentioned globules were, to cause an impulse at every semi-revolution.

The one coil being wound to the right, the other to the left, the alternate effect of each upon the needle was similar in opposite parts of the orbits described by the pins. Lastly, a second needle, furnished with pins in like manner, being fastened at right angles to the first, so as to form with it a cross, as represented in the engraving, each needle is made to receive two impulses during every revolution. Hence one of Danell's sustaining batteries, as made by Newman, is quite adequate to cause a revolution as rapid as consistent with a due degree of stability in the mercurial globules employed.

One end of each coil, by means of the branching wire A, communicates with one pole of the galvanic pair; the other ends of the coils terminate in mercurial globules contained in cavities on opposite sides of the wooden disc G, upon the centre of which the spindle of the magnetic needle rests. The branches of the wire K proceeding from the other galvanic pole, terminate in globules situated in the vicinity of those above mentioned, so that as the needles revolve, the pins proceeding therefrom perpendicularly may touch a pair of the globules first on one side and then on the other. Whenever this contact takes place, the circuit is completed, and a discharge is effected through one or the other of the coils of the multiplier.

Supposing E and F to be north poles, a discharge through one of the coils will cause E to move off a quarter of a circle, or more. As this ensues, the pins of F will come in contact with the globules which those of E touched before. Of course F will be propelled so as to cause the pins of E to reach the pair of globules at G, which, completing the circuit of a coil wound in a way the opposite of that first mentioned, concurs with that coil in its influence, so as to promote the rotation previously induced. The same result ensues when the pins proceeding from F come in contact with the globules situated at G, and when E returns to its original starting point. It follows that by a repetition of the process the galvanic action is sustained. The phenomenon is as well illustrated by employing the single needle, N, N, as by two, but the most pleasing and energetic effect is produced by the crossed needles. In this simple form the spindle on which the needle rests and revolves is represented at S; the pins at P, P. Each coil, consisting of copper bell wire, is about thirty feet in length, and is contained in the groove C. The frame of the multiplier is constructed of mahogany and is levelled by the milled headed screws, on the ends of which it is supported.

ARTICLE XIII.

Contributions to the Geology of the Tertiary formations of Virginia. —Second Series. By William B. Rogers, Professor of Natural Philosophy in the University of Virginia, and Henry D. Rogers, Professor of Geology and Mineralogy in the University of Pennsylvania. Read March 1, 1839.

GEOLOGY OF THE PENINSULA BETWEEN THE POTOMAC AND RAPPAHANNOCK RIVERS.

THE portion of the state referred to under this head, embraces the counties of Lancaster, Northumberland, Richmond, Westmoreland and King George, together with the eastern part of Stafford county, thus including the district usually denominated the Northern Neck, and extending some distance beyond it to the west.

This area forms the northern portion of the tertiary region of Virginia, presenting extensive deposits of each of the two subordinate divisions of the tertiary formation, which were described in our former paper as occupying the tidewater districts of the state. The more recent of these subordinate formations, the *meiocene*, or middle tertiary, extends from near the bay shore, westward, over the larger portion of the peninsula; while the older, or *eocene* deposit, occupies the remaining area on the west. The precise boundaries of these formations, as recently determined, will be hereafter described.

Topographical Features.

The general aspect of the peninsula, and more especially of the four eastern counties, is that of a nearly level plane, maintaining an average elevation of from sixty to seventy feet above the tide. This plane, gently furrowed by numerous ravines, subordinate to the creeks and inlets indenting the peninsula, frequently subsides to a lower level, in approaching the rivers on either side. The wide *bench* thus formed, sometimes extends in a direction parallel to the river for a distance of several miles, presenting an unvarying uniformity of elevation, and reaching nearly to the water's edge. A third, and lower plane frequently intervenes between the river bank and the table land above described, but in many cases this *terraced* configuration of the surface is not observed, and the high and precipitous cliffs which rise very near the water's edge, retain the general level of the inland portion of the peninsula. Although the usual elevation of this district is such as above described, at several points a far higher level is attained. The ridge which forms the water shed of the streams flowing into the Potomac and Rappahannock, approaching very near to the former, constitutes, in some places, the river bank. At these points it attains an unusual elevation, towering, as at Stratford and Chantilly, to a height of about one hundred feet above the water's edge, and affording from its summit an extensive and enchanting view of the noble river which laves its base, of the cultivated farms around, and of the cliffs on the opposite, or Maryland side of the Potomac. At Sprize Hill, about four and a half miles from Smith's Point, the ridge bends round to the south, and continues for some distance in a direction across the peninsula, preserving an elevation of about sixty feet. Its declivity on the east forms an abrupt termination of the higher level of the neck, between which and the bay shore is an extensive flat, of from two to four miles in width, rarely rising beyond the height of ten feet above the level of the tide, and in some places so low as to be occasionally overflowed.

The western portion of the peninsula, though still, in the main, presenting a similar uniformity of surface, is somewhat more abruptly furrowed. This inequality, increasing as we proceed further to the west, becomes quite conspicuous at the Paspitansy hills, in King George, and in the neighbouring parts of Stafford county, adjacent to the line of secondary sandstone, which forms the western limit of the tertiary formation.

The material forming the superficial strata, in the lower portion of the peninsula, is usually a mixture of sand and clay, in a state of minute subdivision, and more or less tinged with the oxide of iron. Sometimes this is intermixed with small gravel, of a ferruginous appearance, but it rarely contains pebbles or boulders of any notable dimensions. The diluvial matter assumes a coarser texture, as we proceed westward, presenting, when denuding forces have not removed the superficial beds, alternate strata of sand and pebbles, the latter varying from a half inch to several inches in diameter. In many places these boulders, derived in great part from the neighbouring beds of sandstone, are strewed profusely over the surface, and, together with the superficial layers of white and siliceous sand, render the soils of the higher portions of this district comparatively unproductive. While upon the lower levels, contiguous to the large rivers, or their tributaries, the beds of marl, and their associated sands and clays, mingling their fertilizing materials with the soil, have contributed to impart to it a far higher agricultural value.

Of the Limits of the Meiocene and Eöcene Districts of the Peninsula.

Bounded on the west by the secondary sandstone, before referred to, the eocene formation extends eastward for some distance down the neck, until at length, with a very gentle eastern dip, it disappears below the level of the tide. The most eastern points in which it continues visible, are here regarded as forming the boundary of the formation towards the east, and the district included between a line traced through these points and its boundary to the west, is, for convenience sake, designated as the Eocene district; although, at some places within its confines, as in the peninsula of the James and York rivers, beds of meiocene occur overlying the eocene.

In tracing the boundary of the eocene and meiocene marls, as exposed in the neck, several localities, marking the eastern termination of the former deposit, were carefully inspected in the anticipation of discovering beds of meiocene shells above them, or immediately beyond them to the east. It was found, however, that strata of clay, lying adjacent to the eocene on this side, occupied an interval in which fossils of neither of these formations could be distinctly found; and that still further on, the beds of the meiocene came in view. This intervening tract, as seen upon the Potomac and Rappahannock, is flat and low.

Without, then, pretending to an exact delineation of the boundary in question, which, from the nature of the case, would be impracticable, it will be sufficient for the present to consider it as coincident with a right line, connecting the mouth of Chingoteague creek on the Rappahannock, with Mathias's Point upon the Potomac. A brief account of the character and situation of the strata, as observed at these two points, will serve to illustrate the propriety of fixing upon them as its termination.

To the west of the mouth of Chingoteague creek, for a distance of more than half a mile, the north bank of the Rappahannock has an average height of about fifteen feet above the river. At its upper end this bank consists of a stratum of the green sand marl, extending to the height of twelve feet above the water line, upon which reposes a layer of diluvial sand and clay, about three feet in thickness. In approaching the creek, the level of the marl stratum is observed steadily to decline, while the thickness of the incumbent bed augments until, at a point within two hundred yards of the mouth of the creek, the former entirely disappears below the level of the river. At this point the diluvial capping is about fourteen feet in thickness, consisting of a layer of sand and pebbles about seven feet thick, resting upon a stratum of whitish clay, which reaches to the water line.

The eocene character of these subjacent beds is unequivocally marked. At the base of the bank a dark greenish layer presents itself, rising to the height of five or six feet, containing numerous impressions of the eocene *Carditas*, and other shells of a brownish colour. Over this is a layer of a lighter hue, containing bands of white calcareous matter, obviously the remains of shells.

To the east of Chingoteague creek the bank preserves its former height for about three-fourths of a mile; after this it becomes much depressed, and continues to be low for some distance down the river.

Here no trace of fossils of either the eocene or meiocene period could be discovered, the bank consisting exclusively of diluvial sand and gravel. But still further down the river, beds of the latter are observed, and these continue, at intervals, to near the extremity of the peninsula.

An equally marked termination of the eocene is presented in the neighbourhood of Mathias's Point, on the Potomac. At Woodstock, about one-third of a mile above the Point, the cliffs rise to the height of from forty to fifty feet, exhibiting an exposure of the eocene strata, reaching to a distance of nearly twenty-five feet above the surface of the river. The lower bed, about eight or nine feet thick, is rich in the fossils characteristic of the eocene, but the layer, incumbent on this, though filled with ferruginous impressions of shells, retains none of the shells in an unchanged condition. The bed of reddish clay which forms the upper portion of the bank, is separated from the strata just described by a thin band of ferruginous gravel and sandstone, such as is frequently seen occupying a similar position on the Pamunky and in other localities.

Above this place, on the adjacent estate called "Borodino," the residence of Mr Parke, the banks, after sinking to a level with the flats, again rise, with some abruptness, to an elevation of from forty to sixty feet. The lower stratum of the marl, containing shells in considerable number, is here but little raised above the level of the water. A layer deeply tinged with green sand, and blotched with oxide of iron, rests on this to the height of from four to five feet. Another, but not fossiliferous bed, belonging to the same series, reposes upon the latter, but the piles of fallen earth at present preclude an accurate examination of its character and extent. Still further westward, at "Albion," the estate of Mr Mason, the fossiliferous eocene strata vary from four to seven feet in height above the river, and are overlaid by heavy beds of whitish and mottled clay. Strata recur, at intervals, in ascending the river, rising to greater elevations, and presenting a greater abundance and variety of fossils as we proceed.

Below Woodstock the banks gradually decline, and on the side of a little creek or gut between this and Mathias's Point, the eocene strata entirely disappear. To the east of this creek and at the Point, the banks rise to twenty or twenty-five feet, and consist of yellowish and reddish clays, containing no trace of the green sand or fossils of the eocene. Still further down, the cliffs are replaced by a low and retiring shore, beyond which the beds of meiocene marl first come in view.

It is obvious from these details, that the eastern limit of the eocene is marked on both rivers by the occurrence of a region of like geological and topographical features, immediately east of it, and by great simirity in the arrangement and composition of the contiguous strata. As on the James and Pamunky rivers, as well as in the district of which we are now treating, the eocene is skirted on the east by a level and comparatively low district, comprising only beds of sand and clay, destitute of fossils. It would seem a probable conclusion that these barren strata mark the period of disturbance which terminated the epoch of the eocene deposits, a period attended with such important changes in the condition of the neighbouring seas, as to destroy all, or nearly all, the species of shell fish then inhabiting them, and to adapt their waters to that multitude of new species which were brought to light in the succeeding epoch of the meiocene.

Between the two points thus fixed upon as the extremities of the eastern boundary of the eocene in the neck, several intermediate localities have been marked, but from the obscurity of the exposures, no very certain indication could be derived as to the precise figure of the boundary line, in the intervening space. There is little doubt, however, that it will be found to depart but in a very slight degree from the right line connecting the two points above described.

The *western boundary of the eocene* remains next to be described. In drawing the line of demarcation here, as in the former case, a few well determined points are relied upon for fixing its general direction, and the intervening irregularities are not attempted to be laid down. Indeed the absence of any satisfactory exposures of the strata, throughout a distance sometimes of several miles, renders this the only method of proceeding at present practicable.

The guiding points, in fixing the western limits of the eocene in the peninsula, are:

First, The mouth of Massaponax river, in Spotsylvania county.

Second, The plantations of Mr Bowen and Dr Welford, in Stafford county, opposite to Fredericksburg, somewhat more than a mile from the town.

Third, A locality near, but a little east of Stafford.

Fourth, A point on Acquia creek, about one mile below the mouth of Auston's Run.

Fifth, A point on the Potomac, between Cook's Landing and the mouth of Meadow Branch.

An inflected line, passing through these points, will present a close approach to the actual boundary of the eocene, in this portion of the state.

On the west side of the mouth of Massaponax, the freestone, which constitutes so valuable and interesting a feature in the geology of this district, terminates, and at a short distance below, eocene strata come distinctly into view. Where the main road leading down the Rappahannock crosses the Massaponax, the greenish yellow bed, which frequently forms the highest stratum of the eocene, may be plainly discerned in the hill side, its clayey texture turning off the water, which makes its escape along its upper surface.

On Snow creek, on the edge of Spotsylvania county, and less than a mile to the east of Massaponax, several extensive exposures of the eocene occur. Near the point at which the road before mentioned crosses the creek, a bank of from thirty to forty feet in height exhibits the following series:

1. A dark bluish green stratum, containing a little sulphate of lime, a considerable proportion of green sand, and a great many shells, among which are eocene *Cardita* (*planicosta?*), *Cytherea ovata* (*nobis*), *Turritella Mortoni.*

2. Stratum of greenish yellow, and somewhat micaceous clay, containing some sulphate of lime, and a little sulphate of iron, or copperas.

3. Stratum of a yellowish brown mixture of clay and sand, with ferruginous markings, indicating the former places of shells. This contains a small amount of sulphate of lime.

4. An upper bed of diluvial sand and gravel.

On the same stream, nearer the river, and at the base of the first low grounds, another exposure occurs, which, from the peculiar condition of the fossils it contains, merits a description in this place. The strata are follows:

1. A layer, consisting of common and green sand, the latter in remarkably large grains, and amounting to more than twenty per cent of the whole. A striking feature in this stratum is the immense number of fossils, principally *Cytherea ovata* (*nobis*) and *Turritella Mortoni*, which it contains in the modified condition before described. The shelly matter has almost entirely disappeared, and its place is now occupied by oxide of iron, of a deep brown colour, presenting the most perfect casts, both of the interior and exterior of the shells. This bed contains a notable proportion of green sand, a little mica, and some sulphate of lime and of iron. Its thickness is about eight feet.

2. A stratum of yellowish white sand, variegated with numerous bright yellow blotches, faintly representing the figures of the shells which they have replaced. These blotches are principally composed of oxide of iron. The chief material of this bed is common siliceous sand, containing a few scattered granules of green sand. Its thickness is about twenty feet.

3. Diluvium, containing coarse gravel, and some large pebbles.

The localities in Stafford, opposite to Fredericksburg, forming one of the landmarks of the eocene, above enumerated, are situated near a branch of Claiborne's Run, on a meadow. On Mr Bowen's place a pit has been dug, in which the following strata are exposed:

1. A bed consisting of green sand mingled with common sand, being the upper layer of the eocene, and, as might be expected, containing no shells.

2. Two feet of sand and pebbles, mostly of white quartz.

3. Six feet of yellowish and reddish clay.

At Dr Wellford's, about one-third of a mile distant from the former, a bed of sand and clay, of six feet thickness, is first penetrated. Beneath this is found a band of iron sandstone, six inches thick, and immediately below this the upper stratum of the eocene.

At the other points above enumerated, exposures of considerable extent occur, chiefly differing from the foregoing in the larger amount of calcareous matter which they present, and in the usual presence of shell rock in one or more of the strata. At an inconsiderable distance to the west of these points, the beds of freestone make their appearance.

On the Accakuk, near Mr Brookes's, the eocene and sandstone are seen at very contiguous points, both presenting exposures of considerable extent. The marl here consists chiefly of shells, imbedded in a dark olive brown clay, containing a portion of green sand. The shells are chiefly *Cytherea?* and *Ostrea sellæformis*, with a few *Cardita planicosta?* At Mrs Roll's, on Acquia creek, about two miles below the mouth of Auston's Run, the marl is finely exposed, in an abrupt cliff. Here fine specimens of *Turritella Mortoni*, *Cytherea ovata* (*nobis*), *Crassatella* (*nobis*), *Ostrea sellæformis*, may be readily procured. The material in which they are imbedded is a friable mixture of sand and clay, of a light yellowish brown colour, blended with green sand, in granules of unusually large size.

In thus drawing an outline of what may be termed the western coast of the eocene formation, it is necessary to remark that the peculiar irregularities observed at several points in the line of actual boundary, will occasion considerable discrepancies between it and the line above described.

Besides such flexures as may have originally existed in this line at the period of the deposition of the eocene, great additional irregularities must have been produced by the destructive agencies which subsequently operated. The region in which the freestone and eocene formations are brought together, is marked by the effects of violent diluvial action. Coarse gravel, pebbles and boulders bestrew the surface, and mingle to considerable depths with the sandy strata usually found upon the heights. Deep and precipitous ravines, connected with the valleys of the creeks leading into the Potomac, attest the energy and extent of the aqueous forces once operating over this region, while the confused mixture of materials, by which the usual upper stratum of the eocene is often seen to be replaced, indicates the power of the denuding and transporting agencies to which that formation must at one time have been exposed. It is thus that many places within the general confines of the eocene, bared of their former covering, now merely expose the underlying beds of freestone, while at other points, not immediately in the line of the violent action of the diluvial wave or current, the incumbent beds of marl remain in place.

Moreover, there is reason to believe that the sandstone is spread out towards the east, below the eocene strata, and that its depth alone conceals it generally from the view. Where, therefore, in consequence of some local irregularity of its surface, it was less deeply buried, we might naturally expect, even at some distance within the confines of the eocene, to see its upper stratum exposed to day. Accordingly, at some points a good deal eastward of the line of boundary, we meet with very distinct exposures of this rock. Of this a good example is presented at Gray's mill, on Muddy creek, near the Rappahannock, where, in a ravine by the road side, may be seen the blue and ferruginous material of the marl, while upon the other side of the road is a ledge of coarse, soft and whitish sandstone, over which the mill-stream flows.

Arrangement and Composition of the Meiocene Strata of the Peninsula.

The strata composing the meiocene, in this portion of the state, are in general analogous, in arrangement and materials, to those of the same formation in the peninsula of the York and James rivers, as described in our former communication.

The two interesting general facts of the occurrence of the bluish marls low down in the series, and the presence of a thin band of ferruginous rock or clay on the top of the marl, and between it and the diluvial strata, are not less distinctly observable here than in the region formerly referred to. Indeed, so uniform is this position of the band of iron rock, in regard to the beds of marl, that the discovery of this material, at any point, would furnish strong grounds for believing that the fossiliferous strata existed at some depth beneath.

In general, the blue marl is observed to be the richest in fossils, and is hence found most available in agriculture. In many places, however, especially towards the eastern termination of the peninsula, the shells occur in sand and clay of various shades of yellow and brown, in sufficient proportions to form highly valuable marls.

The fragmentary rock, consisting of broken shells, cemented by carbonate of lime, sometimes partially crystallized, and the white, pulverulent and chalk marls, are found in extensive beds on Curratoman river and Carter's creek, west of the termination of the higher level of the neck.

In general, the upper beds of the meiocene, in this district, are destitute of fossils, though full of their casts and impressions. These strata, consisting, for the most part, of light coloured sandy clays, frequently of great depth, are distinguished by a sulphurous smell, and an acid and somewhat styptic flavour. They rarely contain any considerable amount of carbonate of lime, presenting, in its stead, variable and sometimes valuable proportions of the sulphate, together with sulphate of iron, sulphate of alumina, free sulphuric acid, sulphur, and sometimes even an appreciable quantity of sulphate of magnesia.

The acidity of these clays is often sufficient to make a pungent impression on the tongue, and their sulphur is distinctly recognized by the characteristic odour they exhale, especially when gently warmed. In many localities the gypsum occurs in crystals of sufficient magnitude to be readily separated by the fingers, and sometimes even in the attractive form of transparent sellenite; but its more usual condition is that of delicate silken crystals, distributed through the mass, and visible only upon close and attentive inspection. The sulphates of iron and alumina are occasionally observed in the form of an efflorescence, upon the surface of the strata, and the gypsum likewise presents itself, under similar circumstances, as a white incrustation. Minute, silvery scales of mica are met with in nearly every stratum, but abound most in those of a bluish or greenish tinge.

The fossil impressions contained in these beds are, in general, beautifully distinct, and appertain to all the species of shells which are found in perfect condition in the subjacent strata. In some cases the overlying band of iron stone is not less richly fraught with them than the layers beneath, and from its hardness and insolubility, has preserved the most delicate markings of the shells in all their original sharpness. In many localities the impressions of the fossils in the clay or sand are beautifully bronzed by a thin film of oxide of iron, which has taken the place of the material of the shell; but in others a vacancy seems to exist in the space originally occupied by the calcareous matter, so that the interior casts of the fossils, formed of the general substance of the bed, may often be extracted in great numbers in a perfect condition.

In the blue marl, as well as other strata containing fossils, in the neck, there is often present a notable proportion of green sand, and at some localities of the meiocene this material is found mingled pretty largely with common sand and clay, in strata in which no fossils can be found.

Besides the overlying band of ferruginous rock before described, there occurs, in some places in the neck, another similar stratum, nearly on the top of the diluvium. This, of course, presents no marks of organic remains, and is generally but an aggregation of coarse gravel and sand, cemented by ferruginous matter.

Description of some of the more interesting Localities in the Meiocene District of the Peninsula.

To give clearer conceptions of the arrangement and character of the strata, of which a general sketch has just been presented, a detailed account of them, as exhibited at several of the more important localities in the Neck, will now be introduced. Details of this description, whilst they furnish the scientific inquirer at a distance with that precise information in regard to the geological structure of the region which he is chiefly interested to obtain, are not unattended with advantages of a more practical kind, by affording to all who are directly interested in the resources of a district, an easy mean of examining them for themselves.

Stratford and Chantilly Cliffs.

These noted cliffs, situated in Westmoreland county, extend along the Potomac for several miles, on both sides of the mouth of Chantilly creek, rising, in some places, to an elevation of about one hundred feet, and in others subsiding to lower levels, or sinking, for a short space, into the ordinary river flats. At a point a little above the mouth of the creek, what are properly termed the *Stratford cliffs* begin. Thence they continue up the Potomac, with but little interruption, for about four miles. For some distance from their lower termination, they present the following order of strata.

1. At the base, and extending to the height of from fifty to seventy

feet, a stratum of blue sandy clay, containing impressions of shells of several different kinds, among which the *Pecten Madisonius*, *Venus mercenaria*, *Venus cortinaria* (*nobis*), and *Mactra modicella* are the most frequent. Upon the face of this clay, especially where it projects from the general cliff, a copious efflorescence of sulphate of iron is usually found, imparting a greenish yellow colour to the surface. At other more retiring parts of the cliff, a white, and somewhat granular coating of sulphate of lime, is equally abundant, and small silken crystals of this substance are generally disseminated through the materials of the stratum. On the surface of this bed delicate crystals of sulphate of magnesia may likewise be discerned. This stratum is overlaid by a band of indurated ferruginous clay, approaching to the hardness of rock, and filled with a material closely resembling pipe-stem ore. This is about two feet thick. Next above is a stratum consisting alternately of sand and ferruginous mottled clay, extending to a height of about forty feet; and lastly, is a layer of diluvial gravel, covered with a shallow soil.

Further up the river the cliffs attain a greater elevation, being in some places about one hundred feet in height. Here the same strata occur, and in the same order as before. Proceeding still higher up the river, a band of shells makes its appearance upon the face of the cliff, at a height of about fifteen feet above the water. This rises, as we ascend the river, with a gentle inclination, until at its northern extremity it is fifty or sixty feet above the beach. The width of this band is about five feet, and its length, though not without occasional interruptions, about one and a half miles.

The material of this stratum is a bluish sandy clay, very similar to that before described, but containing no appreciable amount of the various sulphates observed to be present in the former. The shells are very numerous and perfect. Among them are vast numbers of the *Perna maxillata*, of small size, as well as *Turritella plebeia*, *Mactra modicella*, &c., with an occasional *Arca idonea*, and other larger shells. Above this bed is a heavy stratum of clay, of a mottled appearance, and higher still, and distant about twenty feet from the former, a second fossiliferous layer, of a lighter colour, and containing fewer shells.

Among the various substances found in the strata of these cliffs, especially towards the lower extremity, are to be enumerated distinct and beautifully compact lignite and fibrous carbonate of lime. The latter is found in the interstices of a yellowish clay, forming the stratum next beneath the diluvium, and is sometimes in sufficient quantity to render the clay quite calcareous.

An average specimen of the blue marl, from the lower of the two strata just described, yielded in the one hundred grains forty-four and three-tenths grains of carbonate of lime; from the upper only twenty-one grains.

The Chantilly cliffs, situated below the mouth of the creek of the same name, adjoining the ancient residence of Richard Henry Lee, and about two miles further down the river than those of Stratford, may be regarded as a continuation of the former, having the same average elevation, and being composed of very similar materials. At this point, however, the fossiliferous stratum has much greater thickness, sometimes reaching from the water's edge to a height of nearly twenty-five feet. A less proportion of the *Perna* is presented in this bed, which principally consists of *Mactras*, and other small bivalves, together with several species of *Pectens*. The beach is strewed with fragments of ferruginous sandstone, which have fallen from the upper portion of the cliff, where a band of this material overlies the shelly strata of the meiocene. These masses exhibit the impressions of *Pectens* and other shells, beautifully clear and sharp.

An interesting illustration of the fertilizing properties of some of the materials composing the Stratford and Chantilly cliffs is deserving of mention in this place. Zones of vegetation, consisting of clover, together with scattered locust trees, may be observed at the proper season extending to a great distance along the face of the cliffs, marking distinctly the limits of the marl or gypseous clay, and rarely encroaching upon the other strata. Even where the surface is almost vertical, this beautiful drapery is retained.

Bank of the Potomac, below the Mouth of Lower Machodoc River, in Westmoreland County.

At Cole's Point, situated on the south side of the mouth of the Lower Machodoc, commences a low bank, which is prolonged for about one and a half miles down the river, at a pretty uniform elevation of fourteen feet. A few paces below the Point, the following strata occur.

1. A layer two feet thick, consisting of a bright yellow mixture of sand and clay, abounding in shells of various kinds, among which are *Perna maxillata*, *Ostrea compressirostra*, *Venus mercenaria*, *V. cortinaria*, *V. paphia*, *Isocardia fraterna*, *Pecten Madisonius*, *P. Jeffersonius*, *Pectunculus pulvinatus*, *Corbula inequale* and *Turritella variabilis.*

2. Next a layer six feet thick, composed of mottled ferruginous sand, with a small admixture of clay, containing no shells, but abundant markings, as if shells had once been present in great numbers.

3. A band of iron sandstone, three inches thick; and

4. A dark mould, extending to the top.

In proceeding down the Potomac, the yellow marl is seen gradually rising higher in the bank. A stratum of blue marl lying beneath it next comes in view, and this continues along the base of the bank, extending some distance out upon the beach, until the shore sinks into a low sandy flat at Ragged Point.

The Rappahannock cliffs, in Richmond county, nearly opposite to Westmoreland C. H., extend along the river for about four miles, at an average elevation of from forty to sixty feet. Throughout this long range of strata, but little variety is presented. Beds of sandy clay, of various shades of yellow, brown and greenish blue, extend from the water's edge to within a few feet of the top of the bank. In general, the first thirty feet consist of a dark greenish blue mixture of sand and clay, above which is a layer, six feet thick, of similar material, of a brown colour; next a band of twelve inches of a ferruginous aspect, and over all a stratum of light coloured flaky clay, coated with a yellowish and white incrustation of sulphate of lime. Fossils are rare in any of these beds, but multitudes of their casts and impressions may be found. These embrace a great variety of the smaller shells, some of them of species not frequently met with. Spiculæ of gypsum are distributed in the body of the clay, and are particularly numerous upon the surface and in the hollow of the casts, which in general are painted over with the brown oxide of iron. In many places sulphate of iron and sulphate of alumina effloresce upon the surface, and sulphur is distinctly indicated.

Irregular nodules of ferruginous clay are found imbedded in the other materials, presenting the curious feature of a crystalline nucleus, consisting of pure selenite. In some portions of the cliff these crystals are of considerable size, arranged in their usual starlike form, and so abundant as to suggest the utility of employing these clays in the agriculture of the neighbouring parts of the neck. An average specimen, taken from a part of the cliff where a similar material was quite abundant, afforded by analysis, in the one hundred grains, ten grains of sulphate of lime.

Banks of the Rappahannock above the Mouth of Curratoman River, Lancaster County.

In proceeding down the river from the neighbourhood of Belmont, the residence of Dr Jones, about eight miles above the mouth of Curratoman, the cliffs, for some distance, present heavy beds of clay and sand, overlaid by the ordinary diluvium, and resting upon a stratum of soft ferruginous sandstone, graduating into a sandy clay, and sometimes a yellowish sand, mottled with ferruginous spots. Following these strata for a distance of one and a half miles, we meet with a rocky layer, consisting entirely of shells, converted into brown oxide of iron, situated at the base of the cliff. This continues in the same direction for a distance of one and a quarter miles. The following is the order of the strata composing the bank at a point near its eastern termination:

1. Beneath the base of the cliff, as it is exposed, and also underlying the beach sand, is a blue marl, containing numerous shells, and having a sensible amount of green sand. These shells are chiefly the *Perna*, different species of *Venus*, *Natica* and *Oliva*.

2. Running along the base of the bank, the ferruginated, shelly rock above described, four feet in thickness, and containing the same fossils as the stratum beneath.

3. Five feet of sand, with ferruginous blotches and streaks.

4. Six feet of diluvium.

Below this, and within a short distance of the Curratoman, marl beds occur below the level of the flats, consisting chiefly of a peculiar variety of the *Ostrea Virginica*,* of which a similar deposit exists on the opposite side of the Rappahannock. It is distinguished by the length and depth of the channel of the hinge in the valve, and the large angular pivot-like protuberance in the other, as well as by the general elongated form of the shell.

Bank of the Rappahannock from near Cherry Point to Musqueto Point, Lancaster County.

At about one mile above *Cherry Point*, at Mr Palmer's, the bank consists of the following strata:

1. Forming the base of the cliff, and extending up about three feet is a blue clay marl, containing a great many shells. This layer reaches to some depth below, and extends out beneath the sand of the beach.
2. A bed of chocolate coloured clay, imbedding a vast number of the variety of *Ostrea Virginica*, previously described. This is three feet in thickness.
3. A bed of partially decomposed *Serpula*, containing few other fossils, one foot thick.
4. A layer of ferruginous sandstone, in bands, alternating with thin seams of sand. Three feet thick.
5. Ten feet of diluvium.

The above strata, in the order just described, continue down the river for the distance of half a mile, appearing to dip gently towards the bay. The marl is then lost for about two and a half miles, after which it reappears, at intervals, as far down as Musqueto Point. Here the country becomes a sandy flat, and so continues to the bay shore. In the interval of two and a half miles, where no marl is seen, the cliffs, which are from twenty to thirty feet in height, consist at the base of blue clay, containing impressions of shells; above this of ferru-

* The variety here referred to has not been found at any other points in the meiocene district but those above enumerated, a circumstance which, together with its close resemblance to the edible *Ostrea Virginica* of the coast, and its place of deposit being so near the extremity of the peninsula, would favour the idea of its belonging either to the modern period, or to a more recent tertiary epoch than the meiocene. This view, however, can scarcely be reconciled with the fact that the shell in question occurs beneath, and associated with, the usual fossils of the meiocene, and that the latter have been found in several places beneath the surface of the flats, still nearer to the bay shore.

ginous sandstone, or of ferruginous sand and clay; the whole covered with a bed of diluvium.

Near the end of this line a blackish, clayey substance rises into view, from the base of the cliff, underlying the blue clay above mentioned. This gradually becomes more exposed upon the bank, until it attains the height of four feet, after which it slowly sinks, and is again lost. The marl now makes its appearance, consisting of a blue clay, with little sand, and multitudes of shells. This reaches along the bank for about four hundred yards, when it is succeeded by a shell rock, in which the shelly fragments are almost completely replaced by brown oxide of iron. This continues to near the end of the bank, which now subsides into the flat, extending from Musqueto Point to Windmill Point, on the bay shore.

Locality one and a half Miles east of Lancaster Court House—Mr Benjamin Walker's.

This exposure, which is in a ravine on the ridge of the neck, presents the following strata:

1. A bed of blue marl, containing great numbers of shells, many of which are of the larger species. The depth of this stratum is not known.

2. A similar stratum of a rather lighter colour, and containing chiefly the small shells. Three feet thick.

3. A layer of ferruginous matter, abounding in the casts and impressions of shells. These casts are usually found in the interior of spheroidal nodules or geodes of oxide of iron, and consist of this oxide, replacing the shelly matter, and covered with a beautiful shining covering of the carbonate or velvet iron ore. This bed is four feet thick, and reaches to the surface.

Locality four Miles south west from Northumberland Court House—Mr George Booth's.

This exposure is in a hollow, about twenty-five feet below the level of the ridge. The strata are:

1. A layer of greenish blue marl, containing a notable amount of green sand, in spots and blotches, and sometimes almost unmixed with other materials. This stratum has been penetrated five or six feet, and is supposed to extend to a much greater depth. The shells

are in a state of remarkably perfect preservation, and present an unusual variety of species, belonging to the genera *Venus*, *Pecten*, *Pectunculus*, *Mactra*, *Crassatella*, *Astarte*, *Ostrea*, *Corbula*, *Turritella*, *Oliva*, *Fissurella*, and others. Their interior is chiefly filled with the green sand.

2. A layer of ferruginous sandstone; and
3. A stratum of diluvium.

Locality at Cockle-Shell Branch, Northumberland County.

Here the strata are:

1. A bed of marl, consisting of common sand mixed with green sand, and containing a large number of shells.
2. A layer of a bright green indurated sandy clay, approaching to the hardness of rock, and containing innumerable impressions of *Venericardia granulata*, *Pectunculus pulvinatus* and *P. subovatus*, and other shells of rare delicacy and beauty, but entirely devoid of the shells themselves.
3. A bed of common sand, largely mixed with green sand.
4. A layer of sandy clay, with markings resembling shells.
5. Diluvium.

Locality two and a half Miles above the Mouth of Hull's Creek, Northumberland County.

1. At the base of the steep bank of the creek, and within a few inches of the water's edge, occurs a ledge of ferruginous rock, containing an immense number of shells, closely cemented together, as well as the casts of similar fossils. These are chiefly *Perna max.*, *Venus* and *Pecten*. This ledge is two feet thick.
2. A stratum of yellowish sandy clay, of the same thickness, abounding in *Perna max.*, in a very friable condition.
3. A light blue marbled clay, ten feet.
4. Coarse diluvium.

The foregoing detailed account of various localities in the neck will, it is hoped, give a correct idea of the generally prevailing order and fossil contents of the meiocene strata in this district, and at the same time exemplify the principal varieties presented in them, as regards the nature of the earthy materials, including the shells, or their casts, as well as the conditions of the fossils themselves. Of the numerous other localities which have been minutely explored, embracing almost every exposure of the meiocene in the peninsula, it is therefore needless to give any description in this place.

In the extensive area of flats already described as reaching from the foot of the ridge of which Sprize Hill is the northern end, to the bay shore, beds of marl have hitherto been disclosed only at a few points. On the land of W. Tomlin, Esq., near Kilmarnock, blue and yellow marls have been found in several places, a few feet beneath the general level of the flat, and it is particularly worthy of remark that the fossils furnished by these shallow diggings are those usually found in the meiocene of the neck, such as *Ostrea compressirostra*, *Pectunculus pulvinatus* and *P. subovatus*, *Mactra modicella*, &c., thus indicating the prolongation of the meiocene strata to the very extremity of the peninsula.

Of the Fossils of the Marl.

The shells enclosed in these strata are usually in good preservation, though generally so friable as readily to fall to pieces when spread upon the ground. They are commonly found in groups or colonies, and frequently throughout an extensive exposure only one or two species can be met with. This is strikingly the case with the beds containing *Perna*, of which a fine example is presented in the Stratford cliffs, as formerly described. It is perhaps still more remarkable of certain strata of blue marl, found on the Potomac, at the point above named; upon the Rappahannock in several places, and at some localities in the interior. This marl presents a beautiful aggregation of very perfect small shells (*Mactra modicella*), bound together by a rather tenacious blue clay, and rarely exhibits a specimen of any other species.

The shells most usually presented in the marl beds of the neck are as follows:

Pecten Jeffersonius, scallop.
" *Madisonius*, "
Ostrea compressirostra, marl oyster.
Ostrea Virginica, marl oyster, of small size and different shape.
Crassatella Marylandica, marl oyster.
" *melina*.
Mactra delumbis.
" *confraga*.
" *modicella*.
Chama corticosa.
" *congregata*.
Pectunculus subovatus.
" *pulvinatus*.
Perna maxillata.
Isocardia fraterna.
Artemis acetabulum.
Arca idonea.
" *stillicidium*.
" *centenaria*.
" *incile*.
Venus mercenaria.
" *deformis*.
" *cortinaria*.
Astarte undulata.
" *vicina*.
Venericardia granulata.
Fusus quadricostatus.
" *parilis*.
Fulgur carica.
Turritella ter-striata.
" *alticosta*.
" *plebeia*.
Serpula granifera.
Crepidula costata.
Buccinum laqueatum.

Arrangement and Composition of the Eocene Strata of the Peninsula.

But little uniformity prevails in the arrangement of these beds, as observed at different localities. In general, the lowest stratum of the series is of a dark greenish blue colour, and those which lie above it have various shades of yellow, greenish gray and brown. In many instances the upper stratum is devoid of shells, but replete with their casts and impressions. Frequently it is more or less impregnated with sulphates of lime, iron and alumina, which impart to it a styptic or astringent flavour, and with a small amount of sulphur, recognized by the odour it exhales when heated. All these ingredients, however, enter into the lower beds, though in less proportion, and are not excluded from strata containing shells. A thin band of ferruginous gravel, sometimes partially cemented, frequently overlies these beds, and forms the boundary between them and the meiocene.

We thus see a striking correspondence in the situation and condition of these and the upper meiocene strata, and we infer that chemical agencies of a like nature have operated upon both.

Localities on the Potomac.

Extensive and valuable exposures of the eocene are met with on this river. These strata first show themselves a little above the mouth of Acquia creek, and continue, with but few considerable interruptions, as far as the eastern boundary of this deposit, at Mathias's Point.

Throughout much of this distance a portion of the marl has the character of a hard rock, of a yellowish white or greenish gray appearance, abounding in shells and their impressions. The lighter coloured variety is always more or less specked with green sand, in rather large granules, and the darker contains this substance in larger quantity, uniformly diffused throughout the mass. The material enclosing the fossils, or their casts, consists largely of carbonate of lime, acting, apparently, as a cement. This rock may therefore be regarded as an eocene limestone.

At a point about a quarter of a mile below the mouth of Acquia creek, the cliff, having a height of forty feet, exposes the following strata:

1. From the water to the height of twelve feet is a yellowish gray marl, specked with green sand, and abounding in shells, chiefly *Cytherea ovata* (*nobis*) and *Crassatella* (*nobis*).

2. A ledge of rock, three feet in thickness, closely resembling the marl in colour and composition.

3. A layer of sandy clay, of a sulphur colour, containing shells, principally *Turritella Mortoni*. This is five feet thick.

4. A stratum of yellowish clay enclosing impressions of *Turritella*, &c., and impregnated with the sulphates. This is twenty feet thick.

About midway between the mouths of Acquia and Potomac creeks, the bank has an elevation of about fourteen feet, and consists of:

1. A layer of dark greenish blue marl, very remarkable for the multitude of shells, principally *Crassatella* (*nobis*), which it contains. This rises only one foot above the water.

2. A bed of shell rock, resembling the stratum beneath, but very hard. One and a quarter feet thick.

3. A layer of yellow sandy clay, containing *Turritella Mortoni*, and other shells. This is at least seven feet in thickness, and is capped by a thin stratum of yellow clay.

In proceeding downwards, the shell rock, dipping gently to the east, becomes lower in the bank, and at length disappears near the mouth of Potomac creek. The bluish marl continuing beneath, first passes out of view.

The greenish blue marl again comes in view at the landing on the south side of Potomac creek, and still further down, at about half a mile below the mouth of Paspitansy creek, the bank of the Potomac presents:

1. A stratum of this dark coloured marl, seven feet thick, containing some green sand and numerous shells, chiefly *Turritella Mortoni*, *Crassatella* (*nobis*) and *Ostrea*.

2. A bed of yellowish and reddish clay, thirteen feet thick.

A little below this point a ledge of the shell rock makes its appearance in the bank, and continues, with but little interruption, down the river for several miles.

At some points, two of these ledges are seen, one near the water level, and one at a considerable height on the face of the bank. This rock is replete with fossils and their casts, and consists, in large part, of carbonate of lime. In the same bank the marl is seen in the softer condition, and of both the yellowish and greenish blue varieties, overlaid by a stratum of the gypseous and acid clay. Among the interesting fossils here found, are two beautiful species of *Cucullæa.*

At the Eagle's Nest and Mount Stuart, about three miles above Boyd's Hole, the eocene strata are well exposed for some distance along the river bank.

At the former locality, the banks, which are from twenty to twenty-five feet in height, are composed of two strata, the lower, which is about twelve feet thick, consisting of dark bluish clay and sand strongly imbued with copperas and containing a little gypsum, and the upper of coarse ferruginous sand and gravel. A few hundred yards below this point a thin layer, containing fossils, comes in view, about midway between the top and bottom of the bank, and as we proceed down the river this shelly stratum expands in thickness, its upper boundary continuing horizontal, while its lower limit approaches the level of the beach. At a point about four hundred yards below the beginning of this layer the strata are as follows:

1. Blue clay, one foot in thickness.

2. Shelly stratum, seven feet thick, indurated in some places so as to form a rock. This abounds in fossils, among which *Carditas* are most numerous.

3. Blue clay, containing copperas, and showing ferruginous stains. Three feet thick.

4. Clay and sand, in part diluvial. Seventeen feet thick.

For upwards of half a mile below this the bank presents the same series, the marl occasionally, at base, a stratum from four to seven feet thick, consisting of blue clay, sometimes fossiliferous and sometimes without shells, covered by a bed of ferruginous sand and clay, of varying thickness.

At Boyd's Hole the shelly stratum is not seen, but further down, especially at Albion, and the other localities near Mathias's point, before described, it again makes its appearance in the cliffs (and furnishes marls of a very useful quality).

On the Rappahannock, opposite Port Royal, at H. L. Carter's, and other localities on and near this river, the eocene occurs under circumstances very similar to those which have been described. In the interior of the peninsula these strata are revealed in many places at the bottoms of the deep ravines, and in general consist of the dark greenish blue stratum, containing shells, overlaid by a bed of the gypseous and copperas clays. Frequently, however, only this latter bed is exposed in these situations, and some digging becomes necessary to reach the layer containing shells.

Towards the western limits of the eocene, the shell rock very frequently presents itself, and, together with the other strata of the formation, generally attains a greater height than in the localities further to the east.

ARTICLE XIV.

Contributions to the Geology of the Tertiary Formations of Virginia. —Second Series—Continued: Being a Description of several Species of Meiocene and Eocene Shells, not before described. By William B. Rogers, Professor of Natural Philosophy in the University of Virginia, and Henry D. Rogers, Professor of Geology and Mineralogy in the University of Pennsylvania. Read March 3, 1837.

Turritella fluxionalis.

Specific character.—Shell elongated, turrited, whorls about twelve, slightly convex, subcarinated at base, longitudinally striated with five principal hardly granulated revolving striæ, the lowest being double, between these are very fine ones, most numerous towards the base of the whorl. Very obtuse nearly obsolete transverse striæ give to the principal longitudinal stria a sub-granulated undulation. Aperture sub-quadrangular. Length, one inch and two-tenths.

Locality, Williamsburg and the neighbourhood, in the meiocene of eastern Virginia.

Description.—This delicately striated shell has two of its finer class of lines separating the two stronger threads of the first, or carinal stria, about six of them between this and the second, about five between the second and third, either two or three between the third and fourth, one between the fourth and fifth, and from the fifth or uppermost to the top of the whorl about two more occur. It is the most convex in its whorls of all our meiocene *Turritellæ*, if we except the *T. variabilis*, and from this it may readily be distinguished by the greater number, delicacy and remoteness of its principal longitudinal striæ.

Cytherea lenticularis. Plate XXVIII., fig. 1.

Specific character.—Shell large, depressed, discoidal, rather thick, length nearly equal to the breadth; transversely striated; lunule long, ovate, obscurely defined by a very faint impressed line; umbones rather depressed; beaks small, hardly recurved; teeth straight, divergent; cavity of the shell not deep; margin entire. Diameter about two inches.

Locality, eastern Virginia, in the eocene, where it is a common species.

Remarks.—From the extreme friability of this shell it has been impossible, hitherto, to procure a perfect specimen. It differs from all the *Cythereæ* of our American eocene beds in its nearly orbicular form, and in its slight degree of inflation. The insulated tooth of the right valve is long, straight, and not much elevated. The anterior cardinal tooth in the same valve is slightly bifid. The striæ upon the surface of the disc are almost obsolete, where decay has not removed the external laminæ. The small incurvation in the beaks distinguishes it from *C. Poulsonii* of Conrad (*C. globosa*, Lea), to which species it bears some resemblance.

*Cucullea onochela.** Plate XXVIII., fig. 2.

Specific character.—Shell ovate, subtrigonal, subcordate, oblique, the anterior margin nearly straight, inequilateral, inequivalve, thick, ponderous, globose; longitudinal costæ numerous, depressed and flat, upon the left valve obsolete; transverse striæ minute, obscure, except near the inferior margin; hinge line very straight; umbones not very pro-

* From its resemblance to an ass's hoof.

minent; beaks small, slightly incurved, and not distant. Length equal to the breadth, three inches.

Locality, western part of the peninsula of the Potomac and Rappahannock, Virginia, in the eocene.

Description.—Alternate longitudinal striæ, very obscure and delicate, divide many of the costæ along the centre, and throw them, especially next the anterior side, into pairs. The beak has four-sevenths of the length of the hinge on its posterior side. This species may be known from the *C. incerta* of Deshayes by its much greater size, its less quadrangular form, by the greater number of its lateral teeth, and the less incurvation of its beaks. It is not less readily distinguished from *C. gigantea*, a species prevailing in the same beds with it, by its less width, compared to its height, by the less obliquity and greater length of its posterior margin, by the beaks being less remote and less incurved, and by the shell being smaller, but materially thicker, and more inflated near the base. A prominent feature is the great inflation of the valves, especially towards their base. The hinge is well marked by from four to five lateral teeth, next the posterior side, and from three to four next the anterior, all being slightly curved, striated by deep irregular grooves on their sides, and of nearly equal obliquity. The central longitudinal teeth are numerous, irregular, and slightly oblique. The area of the ligament is nearly a segment of a circle, the straight hinge line being the chord; its surface is marked by about six deep, rather waved grooves. The right valve is the largest, overlapping the left on the lower margin, which is moderately crenulated in both. In the cabinet of the Academy of Natural Sciences of Philadelphia there are, besides three large casts of *C. gigantea*, two apparently of the present species, somewhat larger than the shell now described. These latter, I have satisfied myself, belong to *C. onochela*, as an internal cast of this made in wax is precisely like them, though very different from the casts of *C. gigantea*.

Cucullea transversa. Plate XXIX., fig. 1.

Specific character.—Shell subovate, subtrapeziform, oblong, oblique, inequilateral, inequivalve; longitudinal striæ numerous and delicate, the alternate ones nearly obsolete, dividing the costæ into pairs; transverse striæ very minute; hinge straight, area of ligament narrow, with from three to four furrows; beaks small, somewhat incurved, and not distant. Length four-fifths of the breadth, but these proportions variable.

Locality, King George county, Virginia, in the eocene, near the Potomac river.

Description.—The division of the costæ into pairs, the great obliquity of the posterior margin, and its great breadth, are among the characteristics of this shell. The area of the ligament rises from the hinge at a more obtuse angle next the anterior side than at the posterior, so that it curves upon an axis not coincident with the hinge line. The transverse lateral teeth are very slightly oblique, they are on the anterior side three, and on the posterior four; fine acute grooves or striæ mark both sides of these teeth. The central longitudinal teeth are few, irregular and rather oblique. The anterior and inferior margins of the right valve, especially, are strongly crenulated on the inner edge. The anterior muscular impression is subtriangular and depressed, the posterior one is nearly rectangular, the inner angle being a little elevated. Shell moderately thick.

Venericardia ascia. Plate XXIX., fig. 2.

Specific character.—Shell subovate, subcordate, not thick; costæ much depressed except on the beak; about thirty; transverse striæ numerous from the margin to the umbones, nearly obliterating some of the longitudinal sulci; lunule profound, subcordate, triangular and equilateral; anterior muscular impression rather remote from the hinge; cardinal teeth arcuated, oblique; inferior and posterior margins crenulated. Length, three inches two-tenths; breadth, three inches six-tenths.

Locality, King George county, Virginia, near the Potomac, in the eocene.

Remarks.—This shell can be confounded only with the *V. planicosta*, to which it is possible we ought to refer it as a variety.. They are readily distinguished, however, by the greater length and curvature of the whole anterior margin, especially the portion along the ligament; the hinge is broader and longer, and the teeth are less prominent and more arcuated; the muscular impression, on the anterior side, is further from the hinge; and the whole valve is wider, flatter and thinner. These differences, with the flatness of the costæ, appear to warrant us in regarding this shell as a distinct species from *Venericardia planicosta.* That shell also is found in the eocene of Virginia, but usually not in the same bed with *V. ascia.*

Cardium quadrans. Plate XXX., fig. 1.

Specific character.—Shell subtrapeziform, oblique, inequilateral, posteriorly much expanded, compressed anteriorly; thin and fragile; longitudinally ribbed, costæ about thirty-five, broad, depressed, and slightly convex; transverse striæ somewhat coarse or squamose near the margin. Umbones small, beaks incurved, lunule long; posterior cardinal tooth small, and of nearly uniform breadth, posterior lateral tooth large; margin crenulated by distinct but not deep undulations. Length, three inches seven-tenths; breadth, two inches eight-tenths.

Locality, eastern Virginia, meiocene.

Remarks.—Owing to the extremely friable state in which this fossil is found, and to its being associated with *C. magnum* and *C. laqueatum,* its fragments have passed for these species; but its trapezoidal form, and the great width and depression of the longitudinal costæ, show a strong contrast to the *laqueatum,* while, in addition, its less size and less inflation prove it different from the *magnum.*

The great expansion of the posterior slope into an almost auriculated margin, is highly distinctive of it as a new species.

Crassatella capri-cranium. Plate XXX., fig. 2.

Specific character.—Shell ovate, oblong, compressed, sub-rostrate, rather thin, with coarse, obtuse, transverse wrinkles, and fine transverse striæ; a prominent sinus extends from the beak to the anterior termination of the inferior margin; truncated anteriorly, at a right angle to the base; margin slightly concave at the lunule, which is deep, wide and ovate; inferior margin delicately crenulated within. Length, one inch four-tenths; breadth, two inches two-tenths.

Locality, peninsula, between the Potomac and Rappahannock rivers, in Virginia, in the eocene.

Remarks.—This species may readily be distinguished from the *C. melina*, which it somewhat resembles, by its less thickness, and by the crenulation on its inner margin, but especially by its different outline being much more contracted on its anterior side.

Fasciolaria rhomboidea. Plate XXX., fig. 3.

Specific character.—Shell turrited, fusiform, and nearly smooth, greatest dilatation about the middle, spire conical, whorls convex, with longitudinal, obsolete or interrupted striæ, the lower seven or eight upon the body whorl, and those upon the upper whorls, being distinct and slightly undulated. On the body whorl are ten or eleven very faint, brown, narrow, longitudinal lines, three of which are traceable upon the spire. Transverse striæ, distinct, moderately distant, and arcuated. Aperture a little less than two-thirds the length of the shell, columella arcuated, plicated with three very oblique folds, the middle one the most elevated, labium delicately striated within the edge, beak slightly recurved. Length, two inches four-tenths; breadth, one inch two-tenths.

Locality, Surrey county, Virginia, meiocene.

Description.—This is a thin shell, though not difficult to procure entire. From the *F. mutabilis*, the only other species of our tertiary, it will readily be known by the greater length and arcuation of its beak, by its less regularly fusiform outline, and by the difference in the number of its whorls, and of the plications on the columella. The high preservation of the specimen from which the description has been taken, permits us to trace upon its whorls its longitudinal coloured bands, affording a very interesting specific character.

DESCRIPTION OF THE PLATES.

PLATE XXVI.

Figure 1. *Turritella ter-striata.*
Figure 2. *Turritella quadri-striata.*
Figure 3. *Natica perspectiva.*
Figure 4. *Fissurella catilliformis.*
Figure 5. *Arca protracta.*
Figure 6. *Lucina speciosa.*
Figure 7. *Venus cortinaria.*

PLATE XXVII.

Figure 1. *Ostrea sinuosa.*
Figure 2. *Cytherea ovata.*

PLATE XXVIII.

Figure 1. *Cytherea lenticularis.*
Figure 2. *Cucullea onochela.*

PLATE XXIX.

Figure 1. *Cucullea transversa.*
Figure 2. *Venericardia ascia.*

PLATE XXX.

Figure 1. *Cardium quadrans.*
Figure 2. *Crassatella capri-cranium.*
Figure 3. *Fasciolaria rhomboidea.*

ARTICLE XV.

Report of the Committee on the Solar Eclipse of May 14 *and* 15, 1836. *Read July* 19, 1839.

The committee on Astronomical Observations, to whom were referred several communications relative to the Solar Eclipse of May 14 and 15, 1836, respectfully report:

That the American observations, as far as received, on whose accuracy sufficient reliance may be placed, are the following, and are given in mean time of the places of observation.

No.	Observer.	Place of Observation.	Latitude.	Longitude W. of Greenwich.	Phase.	Mean Time of Observation.
				h. m. s.		*d. h. m. s.*
1	F. R. Hassler	Washington	38° 53′ 12″·7	5 8 7·00	Begin.	14 18 53 58·0
2					End.	21 20 8·0
3	J. Gummere	Haverford	40 1′ 12″·0	5 1 15·00	B	19 3 24·5
4					E	21 31 47·0
5	C. Wistar	Germantown	40 1′ 59″·0	5 0 41·70	B	19 3 55·5
6					E	21 32 49·5
7	I. Lukens	"	"	"	B	19 3 54·5
8					E	21 32 44·5
9	T. M'Euen	Philadelphia	39 56′ 57″·6	5 0 41·33	B	19 3 38·0
10					E	21 32 38·1
11	W. H. C. Riggs	"	"	"	B	19 3 50·0
12					E	21 32 26·5
13	S. C. Walker	"	39 56′ 54″·0	5 0 40·01	B	19 3 40·2
14					E	21 32 43·7

No.	Observer.	Place of Observation.	Latitude.	Longitude W. of Greenwich.	Phase.	Mean Time of Observation.
				h. m. s.		d. h. m. s.
15	Dr Patterson	Philadelphia	39 56′ 57″·0	5 0 38·88	B	14 19 3 45·8
16					E	21 32 38·3
17	S. Sellers	"	39 57′ 5″·5	5 0 39·05	B	19 3 41·0
18					E	21 32 34·0
19	A. Ferguson	West Hills	40 48′ 49″·2	4 53 44·80	B	19 12 48·5
20					E	21 43 40·0
21	A. Holcomb	Southwick	42 0′ 41″·0	4 51 15·00	B	19 17 52·2
22					E	21 49 20·1
23	R. T. Paine	Providence	41 49′ 39″·3	4 45 39·68	B	19 23 3·2
24					E	21 57 9·0
25	W. C. Bond	Dorchester	42 19′ 15″·0	4 44 17·29	B	19 25 34·5
26					E	21 59 56·6
27	A. Lang.	St Croix	17 44′ 32″·0	4 18 44·00	B	19 3 57·5
28					E	21 44 2·5

The correction of the chronometers, at Philadelphia, was determined by a twenty inch Jones's transit instrument, with high and low stars. The corrections of the deviations of the instrument were computed, and applied. Eastern and western altitudes of the sun were measured by two observers, with different sextants.

This eclipse was more extensively observed in this country than any of the preceding eclipses. Its principal phases had been announced for a great number of places, by a member of this committee, Robert Treat Paine, Esq., in the American Almanac for 1836. Equations for the times of the principal phases, (on the method of Woolhouse,) for places near Philadelphia, by another member of the committee, Mr Sears C. Walker, had been published in the April number of the Journal of the Franklin Institute. Preliminary computations and formulæ for its principal phases for European observatories had appeared in the *Berliner Jahrbuch*, and more particularly in the Nautical Almanac, by Mr Woolhouse. The central and annular path of this eclipse traversed England and Germany. The weather in the United States was unusually fine. In England and Germany the fairness of the weather was such, that few disappointments were experienced by observers situated in its annular path. It was however rainy in Bohemia and Bavaria. In Prussia, Poland and Austria, the weather was generally fine. Northward of Germany the weather was unfavourable. In consequence of the extent of the civilized nations traversed by this eclipse, and of the atmospheric circumstances favourable in the main, it is believed to have furnished a greater number of observations, for geographical and physical purposes, than any other eclipse on record, not excepting the memorable total eclipse of September 7, 1820. The number of spots on the sun's disc was unusually great. The position of these spots, relative to the sun's centre, was carefully determined by Dr Peters, from Schumacher's observations at Altona, on the morning and afternoon of the 15th, with a twelve inch Ertel's equatorial. The times of their contact with, and total obscuration by the moon's limb, were extensively observed, and are placed on record. It does not however appear that any important consequences have yet been derived from this kind of observations. The details of the circumstances of this eclipse are given in full in the 13th and 14th volumes of Schumacher's Astronomische Nachrichten, and in the 10th volume of the Memoirs of the Royal Astronomical Society of London. Among the papers on this subject, the committee would mention, with particular approbation, that of Bessel, No. 320 Astr. Nachr.; of Rumker, No. 319; and of Dr Peters, No. 326; as also Bailey's paper, in the Memoirs of the Royal Astronomical Society, vol. 10, a copy of which (the gift of the author) is placed in the archives of this Society. A reprint of a part of Bailey's paper was exceedingly useful in directing the attention of observers to the remarkable phenomena of the annular eclipse of September 18, 1838. In anticipation of a more full report on the eclipse of 1838, the committee would here remark the fortunate circumstance of the attention of observers being thus directed to these singular appearances; and that the presence in the same building of telescopes of equal optical capacity, furnished with screen glasses of different colours, and their use by the same observer interchangeably, have shown that these remarkable appearances may be modified, if not wholly changed, by the nature of the medium through which they are beheld. The committee indulge a hope that this subject will receive particular attention in future central eclipses, and that the records of the past will be searched into, by those who are possessed of the means, in order to show how far the discrepancies of former observations may be explained by the effect of the screen glass used. In the paper of Professor Bessel, above referred to, are given the analytical formulæ, perhaps the most perfect yet furnished, for the reduction of observations of a solar eclipse for geographical purposes. In Dr Peters's paper, Bessel's method has been applied to the European observations of this eclipse; below will be given the result of an application of the same to the American observations, by Mr Walker. The committee notice, with pleasure, the adoption of these formulæ, in making announcements of solar eclipses, in the *Berliner Jahrbuch* for 1840, by which nearly one half the labour of an isolated computation will be saved. The committee have also to acknowledge, on behalf of the Society, the receipt, through the attentions of Mr A. D. Bache, of a valuable paper on the solar eclipse of the 3d and 4th of March 1840, by Mr C. Rumker, director of the Hamburg observatory. This present was accompanied with a circular, requesting a communication of the American observations of the solar eclipse of May 14, 1836, of which the European ones had been already reduced by that distinguished astronomer, and published in No. 319 of the Astr. Nachr.

A copy of the American observations was furnished to Mr Rumker, through Mr John Vaughan, by a member of this committee. In return for this, the Society has received from Mr Rumker the paper read at their last meeting, which the committee recommend for publication among the documents connected with this eclipse.

It would have been highly acceptable to the committee, had Mr Rumker resolved the equations of condition, which he has obtained, in order to afford to the Society all the advantages which this eclipse is capable of furnishing, for geographical purposes. In the absence of such a result, the committee have appended the computations of Mr Walker, in which the longitudes derived from Rumker's equations of condition are compared with those formerly obtained by Mr Walker, from the same observations, reduced by Bessel's method, using chiefly Peters's co-ordinates and corrections of the tabular elements. The circumstance noticed by Mr Rumker, that the coefficients of the corrections of the moon's latitude and parallax, are affected with opposite signs in the European and American observations, is one of great importance, inasmuch as it facilitates the determination of the latter, and thus affords a rare comparison with the results of meridian altitudes of the moon in *northern*, contrasted with those made in *southern* parallels of terrestrial latitude. The value of $d\,\varpi$, or the correction of Burckhardt's constant of parallax, as found by Mr Walker, is $+ 1''\cdot516$. Burckhardt's constant is $57'\ 0''\cdot5$, making, when this correction is applied, $57'\ 2''\cdot0$. It appears from Mr Henderson's memoir on the Constant Quantity of the Moon's Equatorial Horizontal Parallax, (see Memoirs of the Royal Astronomical Society, vol. 10, p. 294,) in which he has discussed an extensive series of meridian observations of 1832 and 1833, with mural circles, at Greenwich, Cambridge and the Cape of Good Hope, that the value of this constant is $57'\ 1''\cdot8$.

It is seldom that solar eclipses have been accurately observed over a portion of the earth's surface large enough to admit of the coefficient of parallax thus changing its sign; occultations of planets and stars of the first magnitude can hardly be expected to furnish equations of condition capable of determining the constant of the moon's parallax with precision. The difficulty of locating observers at convenient places for this purpose, and the uncertainty concerning the precise instant of an immersion or emersion at the moon's bright limb, must continue to furnish obstacles nearly insuperable. The importance, therefore, of Mr Rumker's paper is much enhanced by the rare opportunity which it affords. For the purpose of comparison, the principal values of the moon's horizontal equatorial parallax, yet obtained, are here collected together. They are found chiefly in Mr Henderson's Memoir. They are as follows:

$57'\ 0''\cdot00$	Burg, from Laplace's formulæ, moon's mass $\frac{1}{68\cdot5}$ of the earth's.
$57'\ 1''\cdot00$	Burg, in his lunar tables.
$57'\ 0''\cdot50$	Burckhardt, from Laplace's theory.
$57'\ 0''\cdot90$	Damoiseau, from the same, using for moon's mass $\frac{1}{74}$.
$57'\ 3''\cdot10$	Plana, *Theorie de la Lune*, using for moon's mass $\frac{1}{87}$.
$57'\ 2''\cdot00$	Henderson, from the same, using $9''\cdot25$ for the coefficient of lunar nutation, which gives, for moon's mass, $\frac{1}{79\cdot9}$.
$57'\ 4''\cdot60$	La Caille } From European observations compared with those of La Caille, at the Cape of Good Hope.
$57'\ 3''\cdot70$	Laland }
$57'\ 6''\cdot00$	Du Sejour }

57′ 2″·64 Olufsen, from the same, using compression $\frac{1}{302\cdot02}$.

57′ 2″·76 Henderson, from the same, using compression $\frac{1}{300}$.

57′ 1″·80 Henderson, as above mentioned, from meridian observations at the Cape and at Greenwich and Cambridge, in 1832 and 1833. This result depends upon an assumed compression, $\frac{1}{300}$, and gives the moon's mass $\frac{1}{78\cdot9}$, and the coefficient of lunar nutation 9″·28.

57′ 0″·43 De Ferrer, from fifteen occultations with meridian observations, and six corresponding occultations.

57′ 2″·00 S. C. Walker, from Rumker's computations of the eclipse of May 14 and 15, 1836, compression $\frac{1}{302\cdot78}$.

R. M. PATTERSON,
S. C. WALKER,
R. T. PAINE,
ANDREW TALCOTT,
} *Committee.*

Letter of Mr Charles Rumker to Mr John Vaughan, Librarian of the American Philosophical Society at Philadelphia.

Observatory, Hamburg, March 27, 1839.

Sir:

I have to apologize for the delay of the calculation of the valuable American observations of the Solar Eclipse of May 15, 1836, and have now the pleasure of sending you them, together with those of a number of European ones, that have partly been communicated to me since. On account of the opposite parallaxes and latitudes of the moon, her elements might, by a comparison of the American observations with the European ones, be correctly determined. I have used in the calculation, moon's latitude at mean noon at Greenwich, = 19′ 43·″17, N., ☾'s sem. = 14′ 50·″4, ☉'s semidiameter = 15′ 48·″4, which is founded partly upon a comparison of all the observations, partly upon actual measurement of breadth of the ☉'s illuminated disc at the time of the greatest obscuration, and finally, upon a comparison of the calculation at places situate upon the borders of the annulus, with the observations made there.

Your most obedient servant,

CHARLES RUMKER.

P.S. The calculations of the true ecliptic conjunction, as well as of the coefficients of the corrections of semidiameters, ☾'s lat. and par. have been carefully revised, so that I believe this collection of observations to be useful for determining the errors of the lunar elements. Particularly, I think that the annular observations, where the signs of the moon's apparent latitude change, deserve some attention.

The weather was not favourable, at Hamburg, for observing the solar eclipse of March 15, 1839, but at Rostock, in latitude 54° 5′ 45″ N. and longitude 39° 20′ east of Paris, it was observed by Professor Karsten.

B.	4^h	16^m	19^s ·19,	mean time		H. Karsten.
E.	4	54	8 ·69,	"	"	H. Karsten.
E.	4	54	8 ·29,	"	"	Dr Walter.

America. Mean Time 14th May 1836.

Place of Observation and Observer.	Latitude, and Longitude + west of Greenwich.	Mean Time of Observation.	Mean Time of Conjunction.	d ☉ + ☾	d Lat. ☾	d Parr.
		h. m. s.	h. m. s.			
Washington, F. R. Hassler.	Lat. 38° 52′ 44″	B. 18 53 58·0	20 58 56·5	+ 2·6845	+ 1·5754	+ 0·2166
	Long. + 5h 8m 8s·6	E. 21 20 8·0	20 58 44·0	— 2·1753	— 0·0438	+ 0·8496
Haverford, John Gummere.	Lat. 40° 1′ 12″	B. 19 3 24·5	21 5 53·9	+ 2·6811	+ 1·5697	+ 0·1731
	Long. 5h 1m 15s	E. 21 31 47·0	21 5 41·4	— 2·1753	— 0·0316	+ 0·7576
Germantown, C. Wistar.	Lat. 40° 2′ 40″	B. 19 3 55·5	21 6 25·7	+ 2·6763	+ 1·5578	+ 0·1805
	Lon. a few secs. east of State House, Phil.	E. 21 32 49·5	21 6 23·6	— 2·1751	— 0·0239	+ 0·7460
Germantown, Isaiah Lukens.	Lat. 40° 2′ 40″	B. 19 3 54·5	21 6 24·79	+ 2·6764	+ 1·5580	+ 0·1804
	Lon. a few secs. east of State House, Phil.	E. 21 32 44·5	21 6 20·18	— 2·1752	— 0·0245	+ 0·7468
Philadelphia, T. M'Euen.	2s 8 west State H.	B. 19 3 38·0	21 6 21·5	+ 2·6741	+ 1·5577	+ 0·1848
	Lat. 39° 56′ 59″	E. 21 32 38·1	21 6 22·68	— 2·1751	— 0·0201	+ 0·7472
Philadelphia, W. H. C. Riggs.	2s·8 west State H.	B. 19 3 50·0	21 6 34·59	+ 2·6725	+ 1·5549	+ 0·1833
	Lat. 39° 56′ 59″	E. 21 32 26·5	21 6 14·21	— 2·1752	— 0·0216	+ 0·7491
Philadelphia, S. C. Walker.	1s west of State H.	B. 19 3 40·9	21 6 23·82	+ 2·6741	+ 1·5576	+ 0·1850
	Lat. 39° 56′ 54″	E. 21 32 44·1	21 6 28·55	— 2·1752	— 0·0193	+ 0·7463

Place of Observation and Observer.	Latitude and Longitude + west of Greenwich.	Mean Time of Observation.	Mean Time of Conjunction.	d ☉ + ☾	d Lat. ☾	d Parr.
America—continued.						
		h. m. s.	h. m. s.			
Philadelphia, R. M. Patterson.	0s·12 east of St. H.	B. 19 3 45·8	21 6 29·87	+ 2·6732	+ 1·5561	+ 0·1861
	Lat. 39° 56′ 58″	E. 21 32 38·3	21 6 22·58	− 2·1752	− 0·0201	+ 0·7473
Philadelphia, S. Sellers.	In Merid. of St. H.	B. 19 3 41·0	21 6 24·31	+ 2·6740	+ 1·5574	+ 0·1850
	Lat. 39° 57′ 5″	E. 21 32 34·0	21 6 19·34	− 2·1752	− 0·0209	+ 0·7480
West Hills, H. Ferguson.	Lat. 40° 48′ 49″·2	B. 19 12 48·5	21 13 38·8	+ 2·6576	+ 1·5292	+ 0·1674
	Long. 4h 53m 45s	E. 21 43 40·0	21 13 7·5	− 2·1751	− 0·0018	+ 0·6590
Southwick, Mass. A. Holcomb.	Lat. 41° 59′ 0″	B. 19 17 52·2	21 15 57·9	+ 2·6738	+ 1·5572	+ 0·0940
	Long. 4h 51m 13s·3	E. 21 49 20 1	21 15 45·0	− 2·1752	− 0·0222	+ 0·6132
Denmark. Mean Time 15th May.						
Apenrade, Hansen.	Lat. 55° 2′ 57″	B. 2 40 36·8	2 45 14·37	+ 2·1840	+ 0·2605	− 1·2345
		B.A. 4 0 4·8	2 44 52·2	+ 2·2260	+ 0·4730	− 1·6780
	Long. − 37m 45s	E.A. 4 4 23·8	2 44 52·8	− 2·1834	− 0·1912	− 1·3315
Copenhagen, Pedersen.	Lat. 55° 40′ 53″	B. 2 55 52·8	2 57 28·93	+ 2·1876	+ 0·2378	− 1·3140
		B.A. 4 15 53·2	2 57 13·8	∝	∝	∝
	Long. − 50m 20s	E. 5 59 32·9	2 57 11·0	− 2·1757	− 0·0121	− 1·5950
Tondern, Petersen.		B. 2 37 15·1	2 42 34·9	+ 2·1839	+ 0·2009	− 1·5974
	Lat. 54° 56′ 16″·1	B.A. 3 57 26·88	2 42 34·68	+ 2·1793	+ 0·1357	− 1·4900
	Long. − 4m 18s·6	E.A. 4 1 48·1	2 42 34·2	− 2·1797	+ 0·1421	− 1·5065
		E. 5 14 51·12	2 42 31·3	− 2·1775	+ 0·0903	− 1·6404
Germany.						
Altona, Schumacher.	Lat. 53° 32′ 45″	B. 2 43 50·75	2 46 51·02	+ 2·1776	+ 0·1137	− 1·2233
	Long. − 39m 46s·6	E. 5 21 23·15	2 46 52·3	− 2·1810	+ 0·1523	− 1·7162
Berlin, Encke.	Lat. 52° 31′ 13″·5	B. 3 2 43·8	3 0 41·3	+ 2·1751	+ 0·0451	− 1·2833
	Long. − 53m 35s·5	E. 5 37 31·9	3 0 45·1	− 2·1820	+ 0·1670	− 1·7661
Bern, Treschel.	Lat. 46° 57′ 6″	B. 2 37 8·6	2 37 17·63	+ 2·1962	+ 0·2997	− 1·0900
	Long. − 29m 46s	E. 5 16 48·26	2 36 43·36	− 2·2468	+ 0·5608	− 2·1640

Germany—continued.

Place of Observation and Observer.	Latitude and Longitude + west of Greenwich.	Mean Time of Observation.	Mean Time of Conjunction.	d ☉ + ☾	d Lat. ☾	d Parr.
		h. m. s.	h. m. s.			
Bremen, Clüver.	Lat. 53° 4′ 36″	B. 2 38 7·0	2 42 13·38	+ 2·1764	+ 0·0883	— 1·1902
	Long. — 35m 15s·9	E. 5 16 56·9	2 42 14·8	— 2·1850	+ 0·1998	— 1·7406
Bremerhaven, Thulesius.	Lat. 53° 32′ 31″	B. 2 37 27	2 41 58·7	+ 2·1783	+ 0·1264	— 1·6614
	Long. — 34m 19s·6	E. 5 15 27	2 41 24·17	— 2·1821	+ 0·1678	— 1·7163
Brussels, Quetelet.	Lat. 50° 50′ 39″	B. 2 16 0·5	2 24 35·66	+ 2·1750	— 0·0300	— 1·0509
	Long. — 17m 29s	E. 4 59 47·3	2 24 33·9	— 2·2058	+ 0·3635	— 1·8432
Gera, Engelhardt and Metz.	Lat. 50° 32′ 56″	B.				
	Long. — 48m 2s·5	E. 5 33 43	2 55 23·9	— 2·1926	+ 0·2724	— 1·8530
Braunsberg,		B. 3 33 40·41	3 26 41·39	+ 2·1807	+ 0·1779	— 1·4430
	Lat. 54° 23′ 9″	B.A. 4 49 23·64	3 26 20·02	+ 3·1550	+ 2·2853	— 2·8270
Feldt.	Lon. — 1h 19m 17s·94	E.A. 4 52 34·25	3 26 28·16	— 2·9450	— 1·9856	— 0·4588
		E. 6 1 40·11	3 26 20·16	— 2·1756	— 0·0069	— 1·5115
Hamburg, Rumker.	Lat. 53° 33′ 7″	B. 2 44 2·2	2 47 0·54	+ 2·1776	+ 0·1135	— 1·2240
	Long. — 39m 53s	E. 5 21 40·5	2 47 8·89	— 2·1810	+ 0·1526	— 1·7156
Hamburg, Peters.	Lat. 53° 33′ 7″	B. 2 44 7·4	2 47 5·7	+ 2·1776	+ 0·1135	— 1·2240
	Long. — 39m 53s	E. 5 21 30·5	2 46 59·5	— 2·1810	+ 0·1521	— 1·7156
Hanover, Lahmeier.	Lat. 52° 22′ 20″	B. 2 43 49·04	2 46 6·69	+ 2·1750	+ 0·0415	— 1·2012
	Long. — 38m 58s	E. 5 21 48·73	2 45 56·43	— 2·1866	+ 0·2182	— 1·7780
Jena, Schroen.	Lat. 50° 56′ 19″	B.				
	Long. — 46m 15s	E. 5 31 35·0	2 53 28·45	— 2·1932	+ 0·2749	— 1·8501
Koenigsberg, Bessel.	Lat. 54° 42′ 50″	B. 3 36 19·18	3 29 6·63	+ 2·1825	+ 0·1857	— 1·4514
	Long. — 1h 22m 0s·5	E. 6 3 58·66	3 29 3·18	— 2·1759	— 0·0312	— 1·6147
Leipzig, Moebius.	Lat. 51° 20′ 14″	B.				
	Long. — 49m 31s·5	E. 5 34 46	2 56 47·88	— 2·1893	+ 0·2447	— 1·8300
Louvain, Crahay.	Lat. 50° 53′ 26″	B. 2 17 37·3	2 25 47·55	+ 2·1748	— 0·0289	— 1·0588
	Long. — 18m 47s	E. 5 0 52·6	2 25 33·6	— 2·2049	+ 0·3580	— 1·8418

Germany—continued.

Place of Observation and Observer.	Latitude, and Longitude + west of Greenwich.	Mean Time of Observation.	Mean Time of Conjunction.	d ☉ + ☾	d Lat. ☾	d Parr.
		h. m. s.	h. m. s.			
Manheim, Nicolai.	Lat. 49° 29′ 13″	B.				
	Long. — 33m 50s·8	E. 5 19 21·6	2 40 54·34	— 2·2110	+ 0·3940	— 1·9190
Neumuhlen, Zahrtmann.	Lat. 53° 32′ 42″	B. 2 43 54·4	2 46 54·4	+ 2·1775	+ 0·1128	— 1·2242
	Long. — 39m 42s·1	E. 5 21 20·6	2 46 49·9	— 2·1810	+ 0·1530	— 1·7165
Neustrelitz, Lorentz and Becker.	Lat. 53° 20′ 0″	B. 3 0 28·0	2 59 31·5	+ 2·1764	+ 0·0879	— 1·2840
	Long. — 52m 15s	E. 3 54 58	2 59 17·7	— 2·1799	+ 0·1287	— 1·7238
Rostock, Karsten.	Lat. 54° 5′ 45″	B. 2 54 43·1	2 55 31·8	+ 2·1788	+ 0·1297	— 1·2762
		B.A. 4 14 19·7	2 55 39·6	+ 2·4635	— 1·1568	— 1·6230
	Long. — 48m 41s	E.A. 4 17 58·2	2 55 35·3	— 2·6073	+ 1·4378	— 2·3242
		E. 5 29 58·2	2 55 28·0	— 2·1401	+ 0·0997	— 1·6856
Stettin, Dancke.	Lat. 53° 25′ 8″	B 3 7 51·7	3 5 21	+ 2·1772	+ 0·0997	— 1·3205
	Long. — 58m 16s	E. 5 41 16·3	3 5 21.9	— 2·1782	+ 0·1061	— 1·7150
Stralsund, Steinort.	Lat. 54° 19′ 0″	B. 2 59 44·2	2 59 38.2	+ 2·1803	+ 0·1556	— 1·3025
		B.A. 4 18 7·0	2 59 24·9	+ 2·1891	— 0·2469	— 1·3554
	Long. — 52m 48s	E.A. 4 22 26·6	2 59 28·2	— 2·2254	+ 0·4705	— 1·7530
		E. 5 33 49·2	2 59 25·8	— 2·1785	+ 0·0754	— 1·6694
Strassburg, Herrenschneider.	Lat. 48° 34′ 39″·7	B. 2 36 25·1	2 38 1·37	+ 2·1830	— 0·1911	— 1·1081
	Long. — 31m 0s	E. 5 16 44·9	2 37 48·6	— 2·2232	+ 0·4575	— 1·9562
Vienna, Littrow and Hallaschka.	Lat. 48° 12′ 35″	B.				
	Long. — 1h 5m 31s·9	E. 5 54 37·1	3 12 31·85	— 2·2050	+ 0·3591	— 2·1299
Wurzburg, Schoen.	Lat. 49° 56′ 16″	B. 2 47 4·0	2 46 54·4	+ 2·1773	— 0·1071	— 1·9804
	Long. — 39m 50s	E.				
Zeitz, J.	Lat. 51° 5′ 23″	B.				
	Long. — 48m 12s	E. 5 32 40	2 54 37·6	— 2·1911	+ 0·2602	— 1·8598

Place of Observation and Observer.	Latitude and Longitude + west of Greenwich.	Mean Time of Observation.	Mean Time of Conjunction.	d ☉ + ☾	d Lat. ☾	d Parr.
Great Britain.						
		h. m. s.	h. m. s.			
Camden Street, Camden, Shearmann.	Lat. 51° 32′ 26″	B. 1 51 4·67	2 6 52·14	+ 2·1752	+ 0·0435	— 0·9098
	Long. + 35s·5	E. 4 38 41·12	2 6 44·38	— 2·2065	+ 0·3680	— 1·7850
Edinburgh, Henderson.	Lat. 55° 57′ 20″	B.A. 2 57 20·77	1 54 11·76	+ 3·0694	+ 2·1662	— 2·3512
		E.A. 3 1 3·22	1 54 23·55	— 2·5243	— 1·2798	— 0·5166
	Long. + 12m 43s·6	E. 4 19 21·65	1 54 19·38	— 2·1799	+ 0·1352	— 1·1313
London, Fleet Street, W. Simms, Jun.	Lat. 51° 30′ 50″	B. 1 51 13·0	2 6 59·43	+ 2·1750	+ 0·04298	— 0·9514
	Long. + 25s.1	E. 4 38 47·0	2 6 47·2	— 2·2066	+ 0·3685	— 1·6165
Makerstown, Sir T. Brisbane.		B. 1 36 51·2	1 57 17·2	+ 2·1967	+ 0·3111	— 0·9999
	Lat. 55° 34′ 45″	B.A. 3 1 4·2	1 57 19·1	+ 2·2710	+ 0·6532	— 1·5558
	Long. + 10m 4s	E.A. 3 5 11·6	1 57 5·5	— 2·1870	— 0·2284	— 1·1635
		E. 4 23 0·6	1 57 4·0	— 2·1809	+ 0·1515	— 1·5579
North Shields, Lieut. Hopkins.	Lat. 55° 2′ 20″	B. 1 43 16	2 1 58·12	+ 2·1903	+ 0·2642	— 1·0070
	Long. + 5m 51s·13	E. 4 28 55	2 1 36·50	— 2·1827	+ 0·1759	— 1·5969
Ormskirk, Dawes.	Lat. 53° 34′ 18″	B. 1 34 43·12	1 55 32·28	+ 2·1832	+ 0·1947	— 0 9317
	Long. + 11m 36s	E. 4 23 42·02	1 55 38·93	— 2·1924	+ 0·2702	— 1·6614
Shooter's Hill, Simms and Gilby.	Lat. 51° 28′ 0″	B. 1 51 52·1	2 7 26·46	+ 2·1750	+ 0·0402	— 0·9538
	Long. — 14s.7	E. 4 39 20·1	2 7 26·7	— 2·2080	+ 0·3670	— 1·7831
Greenwich, Airy.	Lat. 51° 28′ 39″	B.				
	Long. 0m 0s	E. 4 39 12·32	2 7 4·62	— 2·2067	+ 0·3693	— 1.7880
Tranby, Cooper.	Lat. 53° 43′ 26″	B. 1 48 5·9	2 5 18·68	+ 2·1831	+ 0·1812	— 0·9926
	Long. + 1m 49s.4	E. 4 34 47·35	2 5 18·67	— 2·1801	+ 0·2426	— 1·6726
Poland.						
Warsaw, Baronowsky.	Lat. 52° 13′ 5″	B.				
	Long. — 1h 24m 9·7	E. 6 9 24·6	3 31 5·65	— 2 1773	+ 0·0841	— 1·7456
Spain.						
St Fernando, Cadiz, Cerquero, Montojo and Marquer.	Lat. 36° 27′ 43″	B. 1 26 32·53	1 42 29·99	+ 2·3756	— 0·9564	— 0·5994
	Long. — 24m 49s.1	E. 4 9 52·0	1 42 13·85	— 2·7473	+ 1·6775	— 2·1818

Note by the Committee.—The latitudes and longitudes of the American places of observation, reported by the committee, are the result of the most recent determinations, and differ, in some instances, from those furnished at an earlier date to Mr Rumker.

Letter of Mr Sears C. Walker.

Philadelphia, July 10, 1839.

To the Committee on Astronomical Observations.

Gentlemen:

Being desirous of deducing the longitudes of the American places of observation from Rumker's expressions for the mean time of conjunction, I have formed thirty-eight equations of condition, from the duration of the eclipse, by subtracting the expression of the conjunction-time derived from the end from that furnished by the beginning, and in a similar manner have obtained seven equations from the observed duration of the ring. Of the last I reject that which is derived from No. 44. I thus find by

			$\Delta(\odot-☽)$	$\Delta\beta$	$\Delta\pi$
No. (12) — No. (14);	0 =	— 1″·08	+ 0·0504	— 1·3730	— 0·3630
No. (41) — No. (18);	0 =	— 3 ·65	— 0·5063	— 0·8249	+ 0·5336
No. (33) — No. (35);	0 =	+ 7 ·60	+ 0·6563	— 1·8772	+ 0·3036

whence,

$$(a) \quad \ldots\ldots\ldots \quad \Delta\beta = 0{\cdot}7044 + 0{\cdot}0492 \times \Delta(\odot - ☽) + 0{\cdot}1163 \times \Delta\pi$$

Substituting this value in the seven equations of condition from the duration of the ring, we have from

No. (12);	$\Delta(\odot - ☽)^{(0)}$	=	+ 0″·030	+ 0·0606 × $\Delta\pi$
No. (14);	$\Delta(\odot - ☽)^{(I)}$	=	— 0 ·429	— 0·0569 × $\Delta\pi$
No. (33);	$\Delta(\odot - ☽)^{(II)}$	=	— 0 ·501	+ 0·0812 × $\Delta\pi$
No. (18);	$\Delta(\odot - ☽)^{(III)}$	=	+ 0 ·814	+ 0·2966 × $\Delta\pi$
No. (35);	$\Delta(\odot - ☽)^{(IV)}$	=	+ 0 ·869	— 0·0718 × $\Delta\pi$
No. (41);	$\Delta(\odot - ☽)^{(V)}$	=	+ 1 ·626	+ 0·2490 × $\Delta\pi$
No. (44);	$\Delta(\odot - ☽)^{(VI)}$	=	— 3 ·161	+ 0·0644 × $\Delta\pi$

Rejecting Nos. (41) and (44), which differ most from the mean, and taking the mean of the remaining numbers, there results,

$$(b) \quad \ldots\ldots \quad \begin{aligned} \Delta(\odot - ☽) &= +\,0''.1566 + 0.0619 \times \Delta\pi \\ \Delta\beta &= +\,0\,.7121 + 0.1193 \times \Delta\pi \end{aligned}$$

The sum of the equations Nos. (1) to (11), inclusive, rejecting Nos. (16) and (10) from the United States observations, give (*c*), and the equations from the European observations, rejecting Nos. (17), (18), (20) and (45) give (*d*), as follows:

$$(c) \;..\; 0 = 50''.86 + 43.6745 \times \Delta(\odot + ☽) + 14.2733 \times \Delta\beta - 5.1156 \times \Delta\pi$$

$$(d) \;..\; 0 = 113\,.19 + 101.1848 \times \Delta(\odot + ☽) - 5.1929 \times \Delta\beta + 13.7391 \times \Delta\pi$$

Equations (*b*), (*c*) and (*d*), give,

$$\begin{aligned} \Delta(\odot + ☽)^{(\text{I})} &= -\,1''.3972 + 0.0781 \times \Delta\pi \\ \Delta(\odot + ☽)^{(\text{II})} &= -\,1\,.0823 - 0.1297 \times \Delta\pi \end{aligned}$$

and,

$$\begin{aligned} \Delta(\odot + ☽) &= -\,1''.279 \\ \Delta(\odot - ☽) &= +\,0\,.250 \\ \Delta\beta &= +\,0\,.893 \\ \Delta\pi &= +\,1\,.516 \end{aligned}$$

But according to Rumker's letter,

$$\begin{aligned} \Delta'(\odot + ☽) &= -\,1''.000 \\ \Delta'(\odot - ☽) &= -\,2\,.000 \\ \Delta'\beta &= -\,7\,.630 \\ \Delta'\pi &= 0\,.000 \end{aligned}$$

whence, denoting by *d* the sum of the corrections respectively denoted by Δ and Δ', we have,

$$\begin{aligned} d(\odot + ☽) &= -\,2''.279 \\ d(\odot - ☽) &= -\,1\,.750 \\ d\beta &= -\,6\,.736 \\ d\pi &= +\,1\,.516 \end{aligned}$$

which are the most plausible values of the corrections of the tabular elements that I am able to deduce from Rumker's expressions for the conjunction-times. I have given the method of solution somewhat at length, in order that every one may judge whether other modes of combining together the equations of condition might not give more probable results.

With these corrections, and using the longitudes of observatories as given in Rumker's letter, the Greenwich mean time of conjunction is as follows:

		Conjunction-time. h.	m.	s.
By Altona,	Beg.	2	6	59·88
	End,			66·03
By Berlin,	B.			61·11
	E.			69·86
By Brussels,	B.			62·26
	E.			65·26
By Hamburg,	B.			65·58
	E.			71·52
By Hanover,	B.			64·12
	E.			58·73
By Konigsberg,	B.			61·30
	E.			62·99
By Ormskirk,	B.			64·25
	E.			75·46
By St Fernando,	B.			74·29
	E.			64·65
Mean of 16 results,		2	7	5·45

		Conjunction-time. h.	m.	s.
By Copenhagen,	B.	2	7	3·35
By Bremerhafen,	E.			4·91
By Manheim,	E.			3·81
By Edinburgh,	E.			4·18
By Greenwich,	E.			5·06
By Stettin,	B., E.			3·24
By Tranby,	B., E.			6.24
By Neumühlen,	B., E.			7·95
Mean of 8 results,		2	7	4·84
Mean of 24 results,		2	7	5·25

This conjunction-time gives the following longitudes from Greenwich, of the American places of observation; to which I have also appended the results which I have already published in the Journal of the Franklin Institute for August 1838, and which are obtained by using Bessel's method, with Peters's co-ordinates for the end, and mine for the beginning of the eclipse. The corrections of the tabular elements being those obtained by Dr Peters, viz., $\varepsilon = -3 \cdot'' 650$, $\zeta = -5 \cdot'' 472$, $\eta = 0$.

	Walker, from Rumker's Equations. h.	m.	s.	Walker, from Peters's Co-ordinates. h.	m.	s.
Washington Capitol,	5	8	13·83	5	8	13·45
Haverford school, Delaware Co., Pennsylvania,	5	1	16·53	5	1	15·05
Germantown, C. Wistar's private observatory,	5	0	40·61	5	0	40·94
Philadelphia State House,	5	0	38·89	5	0	39·60
West Hills, coast survey,	4	53	41·11	4	53	42·05
Southwick, Mass., A. Holcomb's private observatory,	4	51	12·89	4	51	13·25
Providence, Brown University,	not reduced.			4	45	38·33
Dorchester, Mass., W. C. Bond's private observatory,	"	"		4	44	16·92

Robert Treat Paine, Esq. has informed me that he has found the longitude of Brown University, Providence, $4h\ 45m\ 42 \cdot'' 03$, and that of Dorchester, $4h\ 44m\ 20'' \cdot 45$, from the observations of this eclipse, at these two places and at Greenwich. In making the computations he has used, $d\lambda = -3'' \cdot 60$, $d\beta = -7'' \cdot 63$, $d(\odot + \rightmoon) = -1'' \cdot 87$. The longitude of Providence from Boston is the same by both computations.

The mean time of the ecliptic conjunction, by the N. Almanac, is $2h\ 7m\ 0'' \cdot 3$; by observations as above, $2h\ 7m\ 5 \cdot 25s$; whence, $d\lambda = -2'' \cdot 276$.

The corrections, $d\lambda$, $d\beta$ and $d\varpi$, from R mker's equations, may readily be referred to the moon's orbit, and its secondaries, by means of formulæ derived from Airy's Table of Factors (Greenwich observations, 1836), and from Bessel's Theory of Equations, as follows:

$$\Delta\alpha = 15 \cdot \frac{S\Delta\lambda + Q\Delta\beta}{PS - QR}$$

$$\Delta\delta = \frac{R\Delta\lambda + P\Delta\beta}{PS - QR}$$

$$\varepsilon = \sin N \cos\delta\,\Delta\alpha + \cos N\,\Delta\delta$$

$$\zeta = -\cos N \cos\delta\,\Delta\alpha + \sin N\,\Delta\delta - \varkappa \cos\pi\,\Delta\pi$$

Where, from Peters's co-ordinates for $3h$ m. t., Berlin, and Airy's factors, we have,

$\varkappa = +0 \cdot 47147 = L \sin 1'' \operatorname{cosec} \pi$.

$L =$ least distance of centres on true orbit in seconds of arc.

$N = 70° 11' 10'' \cdot 4$ = moon's orbital angle.

$\alpha = 52\ 13\ 48'' \cdot 2$ = moon's true right ascension.

$\delta = +19\ 22\ 40'' \cdot 3$ = moon's true declination.

$\pi = 54\ 24'' \cdot 1$ = moon's horizontal equatorial parallax.

$P = +13'' \cdot 720$

$Q = -0'' \cdot 244$

$R = +3'' \cdot 470$

$S = +0'' \cdot 969$

Whence there results the following comparison:

From Rumker.	From Peters.
$\varepsilon = -2''\cdot934,$	$\varepsilon = -3''\cdot650$
$\zeta = -7\cdot198,$	$\zeta = -5\cdot472 - 0\cdot159 \times \eta'$
	$= -5\cdot750$

In which ε is the correction of the moon's tabular place on its orbit, and ζ on a secondary to its orbit.

Respectfully,

SEARS C. WALKER.

ARTICLE XVI.

Abstract of Meteorological Tables in the possession of the American Philosophical Society.

TABLE I.

Abstract of a Journal of the State of the Thermometer at Philadelphia, during the years 1758, 1759, 1767, 1768, 1769, 1770, 1771, 1772, 1773, 1774, 1775, 1776, 1777.

	Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Mean Annual Temp.
1758—Greatest Heat.	64°	47°	57°	74°	74°	85°	87°	85°	80°	73°	62°	47°	
Least Heat.	19	23	25	35	47	63	64	60	51	40	30	18	
Mean Heat.	37 ·2	32 ·2	38 ·6	53 ·3	63 ·5	72 ·1	75 ·7	71 ·3	64	56 ·7	44	34 ·5	53°·6
1759—Greatest Heat.	43	53	61	70	77	85	86	88	79	71	62	51	
Least Heat.	18	26	19	44	51	54	63	58	58	43	30	16	
Mean Heat.	30	38	41 ·4	49 ·4	52 ·4	71 ·6	73	69 ·7	65 ·2	55 ·3	46 ·4	30 ·4	52 ·7
1767—Greatest Heat.	51	53	63	69	78	86 ·5	84	86	76 ·5	74	68	52	
Least Heat.	12	15	13	42	45	63	63	63	50	38 ·5	32	18	
Mean Heat.	31 ·7	32 ·5	41	51	61 ·6	71 ·2	74	75 ·5	64 ·5	54	46 ·7	35 ·3	53 ·2
1768—Greatest Heat.	45	61	59	69	77	78	83	82	77	65 ·5	55	54	
Least Heat.	8	28	22	23	41 ·5	57	62	59	52	34	26	13	
Mean Heat.	28	46	39 ·5	46	59	68 ·6	71 ·5	65 ·7	64	50	42	37 ·7	51 ·5

	Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Mean Annual Temp.
1769—Greatest Heat.	47°·5	58°	70°	70°	74°	87°·5	88°·5	85°·5	78°	75°	56°	44.°5	
Least Heat.	17	8	18	32	41	50	67	63	50	33	19	14 ·5	
Mean Heat.	33	32	42	50	57	68	77	74	64	55	38	32	52°
1770—Greatest Heat.	46	57	53	75	77	85 ·5	87 ·5	88	74	70	63	47	
Least Heat.	11	14	23 ·5	22	39 ·5	58	58 ·5	54 ·5	52	30	26	20	
Mean Heat.	30 ·5	37 ·5	38 ·5	48 ·5	57 ·5	70	73 ·5	71 ·5	64	52 ·5	46 ·5	33 ·5	52
1771—Greatest Heat.	51 ·5	48 ·5	64	71	76	79	83	86	80	66	65	47	
Least Heat.	22	6	18	35 ·5	46	56	60	60	45	39	32	10	
Mean Heat.	36	29	41	53	58	67	71	73	63	53	48	30	51 ·8
1772—Greatest Heat.	46	64	47	68 ·5	76	83	87 ·5	84	81	66 ·5	63	49	
Least Heat.	18	12	11	34	44	51 ·5	63	60	47	42	27	22	
Mean Heat.	32 ·5	40 ·5	30	51	56	67	75	77 ·5	64	55 ·5	45 ·5	36 ·5	52 ·5
1773—Greatest Heat.	53 ·5	55	64	72	76 ·5	87 ·5	91 ·5	85	82	72	62	57	
Least Heat.	6			35	47	55	69	67 ·5	51	49	24	12	
Mean Heat.	32 ·6	33 ·7	42 ·1	52 ·2	62 ·7	73 ·4	79 ·6	76	63 ·9	58 ·2	42 ·2	39 ·9	54 ·7
1774—Greatest Heat.	43 ·5	49	65 ·5	80	81	82 ·5	85 ·5	85 ·5	84	74 ·5	64 ·5	64	
Least Heat.	7	8	29	34	44	54	63	60	46	42	24 ·5	17	
Mean Heat.	27	32 ·4	43 ·1	54 ·6	60 ·1	67 ·8	72 ·8	73 ·7	63 ·7	59 ·3	44 ·1	36 ·4	52 ·9
1775—Greatest Heat.	54	63	67	70	81	82	90	83	77	71	54	55	
Least Heat.	17	22	31	33 ·5	50 ·5	55 ·5	62	59	48	35 ·5	29	·3	
Mean Heat.	35 ·6	41 ·2	45 ·3	51 ·4	65 ·8	68 ·3	75 ·1	72 ·8	65 ·6	54 ·6	41 ·4	35 ·7	54 ·4
1776—Greatest Heat.	54	54	64	73	76	82	83	84	80	75	68	59	
Least Heat.	10	13	13	33	37	54	61	58	51	39	31	17	
Mean Heat.	32 ·7	34 ·2	42 ·2	51	59 ·9	69 ·9	74 ·2	72 ·8	67 ·3	55 ·9	46 ·3	35 ·3	53 ·4
1777—Greatest Heat.	53	46 ·5	62	73	76	83	81	90	79	72	56	48	
Least Heat.	14	13	8	34	45	55 ·5	61	62	45	33 ·5	22	6	
Mean Heat.	31	31 ·6	40 ·3	52 ·2	57 ·1	70 ·4	70 ·6	75 ·9	59 ·2	50	39 ·5	33 ·7	51

TABLE II.

Abstract of a Journal of the State of the Thermometer at Nazareth, Pennsylvania, during the years 1787, 1788, 1789 *and* 1790, *by Charles Gotthold Reichle.*

	Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Mean Annual Temp.
1787—Greatest Heat.	50°	48°	68°	77°	78°	89°	92°	90°	88°	72°	70°	52°	
Least Heat.	11	10	26	28	44	45	59	55	42	24	21	16	52°
1788—Greatest Heat.	44	50	60	79	88	90	90	88	88	76	76	62	
Least Heat.	8	·12	4	31	40	50	62	52	44	20	24	2	50
1789—Greatest Heat.	50	44	60	72	72	99	92	93	84	68	66	62	
Least Heat.	10	8	8	32	40	51	62	44	40	31	22	16	50
1790—Greatest Heat.	56	54	68	75	90	88	90	89	84	72	56	38	
Least Heat.	10	3	00	31	46	48	56	54	40	28	20	00	49

TABLE III.

Abstract of a Journal of the State of the Thermometer at Philadelphia, during the years 1829, 1830, 1831, 1832, 1833, 1834, 1835, 1836, 1837 *and* 1838, *by Thomas Hewson, M.D.*

	Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Mean Annual Temp.
1829—Greatest Heat.	51°	44°	63°	78°	88°	88°	88°	89°	85°	70°	60°	62°	
Least Heat.	7	8	24	34	44	56	56	60	44	32	24	25	
Mean Heat.	30	25	35	51	64	70	72	61	61	52	43	43	50°·7
1830—Greatest Heat.	51	50	66	78	78	80	90	86	83	70	65	60	
Least Heat.	10	10	20	33	44	53	60	58	44	46	36	8	
Mean Heat.	33	30	41	53	63	68	76	72	64	54	50	37	53 ·5
1831—Greatest Heat.	60	46	66	73	90	90	88	87	82	74	62	40	
Least Heat.	6	10	24	32	37	59	54	54	46	36	32	8	
Mean Heat.	27	27	44	51	62	72	74	74	64	55	42	23	51 · 2

	Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Mean Annual Temp.
1832—Greatest Heat	56°	62°	70°	78°	76°	88°	88°	84°	78°	75°	63°	52°	
Least Heat.	1	13	14	27	43	48	56	52	46	32	26	19	
Mean Heat.	31	33	41	48	58	68	70	70	63	54	44	37	51°·5
1833—Greatest Heat.	60	57	66	82	84	84	90	84	84	71	60	47	
Least Heat.	13	18	6	37	46	49	58	50	45	31	26	24	
Mean Heat.	35	33	33	55	64	66	73	69	65	53	42	35	52 ·0
1834—Greatest Heat.	58	64	72	80	84	89	93	88	84	78	54	51	
Least Heat.	12	21	23	30	31	49	60	57	40	32	30	9	
Mean Heat.	29	43	44	52	57	68	77	73	65	57	43	35	53 ·5
1835—Greatest Heat.	53	54	64	72	85	85	88	86	82	76	68	47	
Least Heat.	2	1	8	30	40	49	55	54	40	38	21	9	
Mean Heat.	32	27	39	49	60	69	73	69	59	56	45	31	50 ·75
1836—Greatest Heat.	44	44	50	74	84	88	89	82	84	72	66	56	
Least Heat.	6	1	16	27	40	47	56	50	40	23	28	8	
Mean Heat.	28	23	32	41	61	64	72	68	66	47	41	32	48 ·0
1837—Greatest Heat.	45	48	65	80	82	85	85	92	80	73	66	60	
Least Heat.	5	10	8	32	35	52	57	54	45	30	22	21	
Mean Heat.	25	32	39	45	60	64	71	70	61	53	49	35	50 ·8
1838—Greatest Heat.	60	52	63	74	84	90	94	93	84	72	68	46	
Least Heat.	16	9	18	28	40	54	65	57	46	37	16	12	
Mean Heat.	37	24	41	47	58	74	80	76	66	51	46	31	52 ·0

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—— Remarks on the Statistics and Political Institutions of the United States, with some Observations on the Ecclesiastical System of America, her Sources of Revenue, &c., by William G. Ouseley, Esq. Philadelphia. 1832.

—— Sketches, Historical and Topographical, of the Floridas, by James Grant Forbes. New York.

—— Remarks during a Journey through North America, in the years 1819, 1820 and 1821, by Adam Hodgson, Esq. New York. 1823.

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—— Statistics of South Carolina; a View of its Natural, Civil and Military History, by Robert Mills. Charleston. 1826.
—— The Oxford University Calendar, for 1838.
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Walleck (N., M.D.) Notes on the Drugs called Mishme, Teela and Padra Pest. Calcutta. 1836.
Walker (S. C.) Formula for the Announcement of the principal Phases of the Annular Eclipse of the Sun, September 18, 1838, by E. A. Kendall.
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Walker (Timothy.) Annual Discourse delivered by him before the Ohio Historical and Philosophical Society, at Columbus, December 23, 1837. Cincinnati. 1838.
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Warden (D. B.) Documents Statistiques sur la France, publiés par le Ministre du Commerce. Paris. 1835. 4to.
—— L'Art de vérifier les Dates, Vol. 10; Chronologie Hist. des Isles de l'Amerique, by the Marquis de Fortia. Paris. 1837.
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Ware (Henry, Jun.) Selections from the Works of Joseph Priestley, with a Memoir of his Life. Cambridge. 1834.
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White (D. A.) His Eulogy on the Life and Character of Nathaniel Bowditch, LL.D., F.R.S. Salem. 1838.
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Wines (E. C.) Plaza Universal de todas Ciencias y Artes. Por el Doctor C. Suarez de Figueroa. Perpignan. 1630.
Winthrop (A.) Letters from the English Kings and Queens to the Governors of the Colony of Connecticut, from 1635 to 1749, by R. R. Hinman, A.M. Hartford. 1836.
—— The Blue Laws of New Haven Colony, usually called the Blue Laws of Connecticut; Quaker Laws of Plymouth and Massachusetts, &c. Hartford. 1838.
Winthrop (Hon. T. L.) Joseph B. Felt on Massachusetts Currency. Boston. 1839.
Worcester (J. E.) American Almanac and Repository of Useful Knowledge for 1838, 1839, 1840. (The Astronomical part by Paine.)
Wyatt (T.) A Manual of Conchology, by Thomas Wyatt, A.M. New York. 1838.
Young (A.) A Discourse on the Life and Character of the Hon. Nathaniel Bowditch, LL.D., F.R.S. Boston. 1838.
Zecchinelli (G. M.) Sulle Rotture del Cuore. Padua. 1824.

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—— Memoria sopra alcuni passi d'Hyppocrate relative alle malattie del Cuore. Padua. 1831.

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Vandermaelen's Atlas of Europe, 165 sheets, subscribed for by some of the Members, and presented to the Society. Brussels. 1833.

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Dunglison (R.) New Remedies; the Method of preparing and administering them, with their Effects. Philadelphia. 1839. 12mo.

—— A new Dictionary of Medical Science, with a Vocabulary of Synonymes, in different Languages. 2d Ed. Philadelphia. 1839. 8vo.

—— Outlines of Physiology, with an Appendix on Phrenology, by P. M. Roget. American Ed. R. D. Editor.

—— An Appeal to the People of Pennsylvania, on the subject of an Asylum for the Insane Poor of Pennsylvania. 1838.

—— Human Physiology, illustrated by Engravings, with numerous Additions. 3d Ed. 2 Vols, 8vo. 1838.

—— Enactments by the Rectors and Visitors of the University of Virginia, constituting, &c., that Institution, with MS. corrections in the handwriting of Thomas Jefferson. Charlottesville. 1825.

Dunn (Nathan.) A Descriptive Catalogue of his Chinese Collection in the Museum in Philadelphia, descriptive of the Trade, Government, Customs and Manners of the Chinese. Philadelphia. 1839.

Du Ponceau (P. S.) A Military Map of Germany, 9 Sheets, and of the Northern part of Italy, in 4 Sheets, by M. Chauchard. Paris. 1791.

—— Caspipina's Letters on Various Subjects, to which is added the Life and Character of William Penn, by the Rev. Jacob Duché, who resided some time in Philadelphia, and left it at the time of the Revolution. Bath, Great Britain. 2 Vols, 12mo. 1777.

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Ingersoll (C. J.) The Journals of the State Convention of Pennsylvania, held for changing the Constitution, convened at Harrisburg the 2d of May 1837, adjourned to Philadelphia, Nov. 1837. 2 Vols. Also the Debates and Proceedings of the Convention, 13 Vols, ending February 22, 1838, containing the old Constitution and new one proposed, which was accepted by the people October 1838.

Kintzing (Wm.) Renati Descartes Meditationes de prima Philosophia. His adjunctæ sunt variæ Objectiones cum Responsionibus Oratoris. Amsilodanii. 1685.

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Mease (James, M.D.) Annals of the county of Tryon, New York, by William Campbell, New York. 1831. This work gives details of the sufferings of the People, from the combined forces of Tories and Indians, during the American War.

—— Archives of Useful Knowledge, 3 Vols, devoted to Commerce, Manufactures, Rural and Domestic Economy of the Useful Arts, of which he is the Author.

Medhurst (W. H.) An English and Japanese, and Japanese and English Vocabulary, compiled from native Works, by him. Batavia. 1830.

—— Translation of a Comparative Vocabulary of the Chinese, Corean and Japanese Languages, to which is added the Thousand Character Classic, in Chinese and Corean, by Philosinensis. Batavia. 1835.

—— A Copy of the new Version of the Chinese Testament, drawn up by himself and the Rev. Charles Gutzlaff.

—— Four Tracts in Malay.

Mercer (Hugh, Son of General Mercer, who fell at Princeton.) Received through the hands of Dr James Mease. The MS. Orderly Book of the American Army, under the immediate command of General Washington, from August 1777 to May 1778.

Stone (Lawson B.) A Collection of East India Tracts and Translations.

—— Malay. The Bible, Testament, Gospel of St John, and the favourite Story of Abdulla and Sabat.

—— Tamul Translation of the Romans, 16 Chapters.

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—— Japanese Testament, and Book of Genesis in Bengalee.

—— Ordoo Proverbs; Tract in Bugis, or Language of the Celebes.

—— The Acts in Arabic and Hinduwee.

—— MS. Copy of Credentials of Prince Raja-Laboo, deputed by the States of Sumatra to the Court of the Sultan on the Peninsula.

—— Malay MS., entitled the History of the Prophets.

DONATIONS FOR THE CABINET.

Andrews (W. W., American Consul at Malta.) A Case of interesting Minerals, from Sicily; also Organic remains from Malta.

Clemson (Thomas G.) Minerals taken by him from their respective Localities.

—— *In the Island of Cuba*, district Halguine, Rocks from the Silla de Gebara; Sulphuret of Copper, Iron Ore, Chromate of Iron, in large Masses, Oxide of Copper, from the vein and surface, from Sabana Mine.

Clemson (Thomas G.)—*continued.*

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—— *In Missouri.* Per-Oxide of Iron from the Iron Mountain, Sulphuret of Copper, Sulphuret of Lead, Carbonate of Lead.

—— *In New Jersey.* Sulphuret of Copper.

—— *In Alabama.* Bituminous Coal.

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Drayton (W. S.) MS. in the Pali sacred Language, on the Talipot leaves, used by the Siamese as paper.

—— A Specimen of Lycopodium Patescens relaxing and expanding when wet, and contracting again when it dries.

Drayton (Percival.) A Mummy of the Ibis, in an earthen Jar, like a Sugar-loaf, with small Models of Mummies, figured in the Second Vol. of Plates of the great work of the Egyptian Institute.

Gibson (Chief Justice of Pennsylvania.) His Bust, in Plaster.

Godon (Sylvanus.) An Indian Pipe, curiously wrought by the Indians of California.

Godon (V. L.—M.D.) A Mummy of the Ibis, in a Jar, from Egypt.

Hopkinson (Francis.) One of the Congress Chairs, used at the time independence was declared, on the 4th of July 1776. When Congress left Philadelphia it was placed in the Office of the Clerk of the District Court of the United States, and there remained; presented to the Society by the present Clerk, F. H.

Kane (J. K.) The Chair, with a Writing Table annexed, which Mr Jefferson had in Philadelphia in 1776, and on which he copied the Report of the Declaration of Independence, made to Congress, now in possession of the Society. From Philadelphia it was taken by Mr Jefferson to his residence, and after his death was taken by his daughter, Mrs Randolph, to Washington, and when she removed from thence was, at the request of Mr Kane, given to him and deposited with the Society.

Keating (W. H.) A Deposit of a considerable quantity of Mexican Antiquities.

Löwenstern (Isidore.) Two Austrian Silver Medals, viz., Convention Thaler of Francis 1st, and one of Ferdinand the 1st. One English Copper Coronation Medal of William the 4th, of Great Britain.

Lynah (James.) A large Collection of Copper Coins and Medals, collected by his grandfather, Charleston, S. C., with many curious Relics, &c.

Mease (James.) A Specimen of Augite, in Steatite, from Oxford, N. Hampshire.

Peale (Franklin.) Two Specimens of a new Mineral, found near Charlotte, N. Carolina, taken from a Dyke traversing the Granite of the Gold Region. Mr Featherstonhaugh proposed calling it Leopardite, from its Spots.

Physick (Philip.) A Theodolite which belonged to the old Proprietary family in Pennsylvania, and was used in their early Surveys.

Robertson (W. H.) A Stone Ball, one of Twenty-three, said to have been fired at the Boat in which Queen Mary and Douglas made their Escape from Loch Leven, and procured from a Fisherman, to whom Sir Walter Scott, some years before, suggested that if the Lake was ever lowered, they would be found near a spot marked out by him. The Lake having been subsequently lowered by the Proprietor, the Fisherman made the search, and found twenty-one of the Balls, with the Keys of the Castle. These are deposited in the Museum of the Edinburgh Antiquarian Society. The Twenty-second was found afterwards, and procured by Mr R. for our Cabinet.

Stone (L. B.) A Specimen of Pine Apple Hemp, made from the Stalk of the Pine Apple.

—— A Brush from Japan, made from the Fibres of the Cocoa-Nut.

Stone (Dexter.) Specimens of Flax and Hemp, prepared at the manufactory of Sands Olcott, in this city, by a Process and Machinery invented by him, so as to be spun by common Cotton Machinery. By this Process the rotting or hackling is not required, and all the fibres of Hemp or Flax are converted into yarn, of any required quality or fineness, at a Cost not materially differing from Cotton.

Storey (a Captain in the employ of Messrs Eyre & Massey, of Philadelphia, who in his name presented it to the Society.) A large Marine Cup, Gigantea Alcyona, obtained at Singapore, from its place in the Sea, at the depth of twelve fathoms. It is vulgarly called Neptune's Punch Bowl. Inside depth twenty-four inches, height, with the foot, or pedestal, thirty-five inches, diameter eighteen inches.

Taylor (R. C.) Chromate of Iron, found in large Masses in Cuba, near Gebara River. It is of the finest quality, and yields seventy-five per cent of the finest Chromate of Lead.

END OF VOL. VI.

ERRATA.

Page 35, *line* 9 *from top*, *for* Carry fork *read* Cany fork.

Page 48, *line* 15 *from top*, *for* 1837 *read* 1836.

Page 49, *line* 17 *from top*, *for* is *read* in.

Page 59, *line* 7 *from top*, *for* left valve *read* right valve.

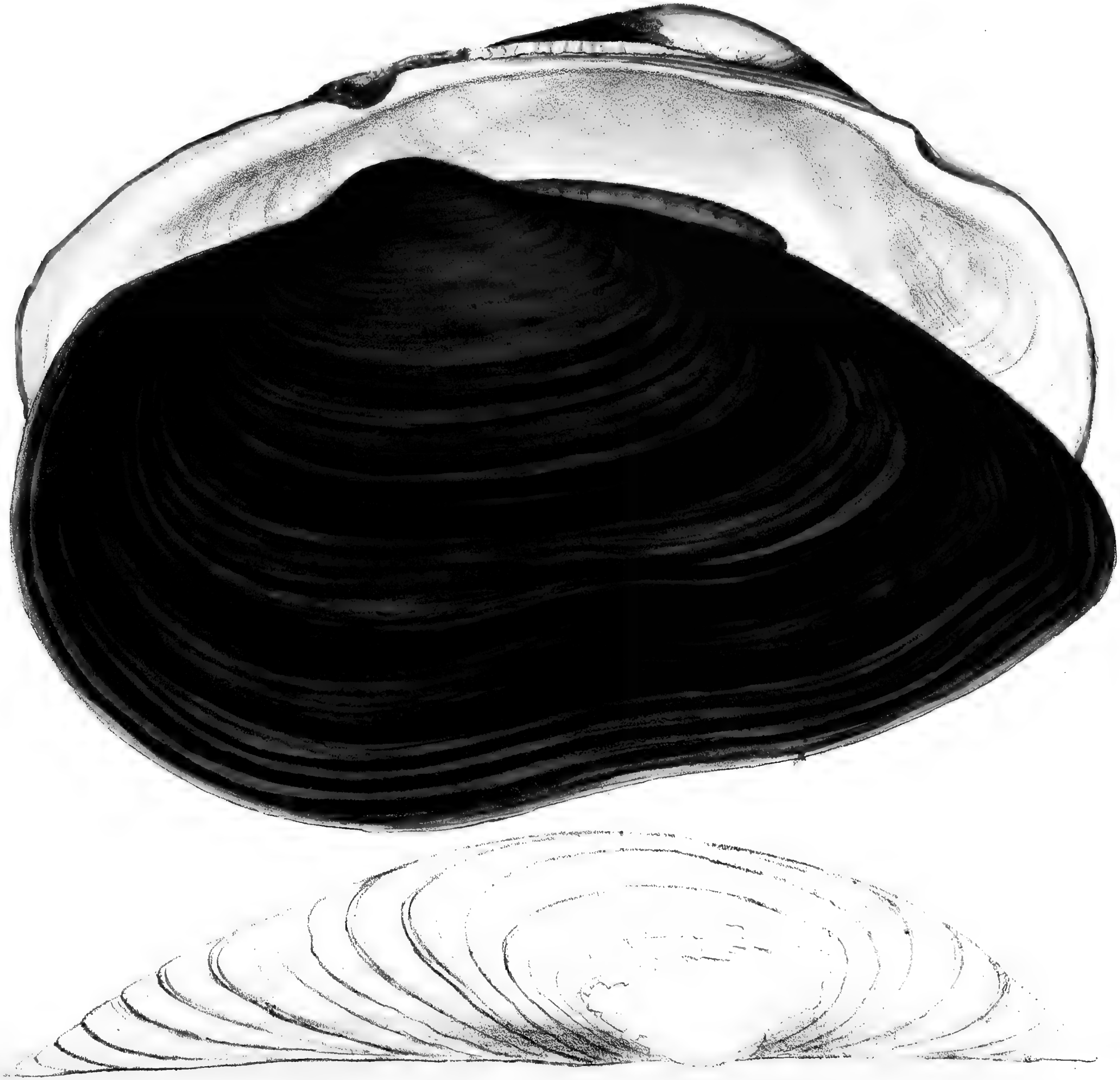
Page 59, *line* 17 *from bottom*, *for* forms *read* performs.

Page 96, *line* 8 *from top*, *for* Pepinianus *read* Pepiniana.

Page 131, *line* 9 *from top*, *for* membranacea *read* membranaceus.

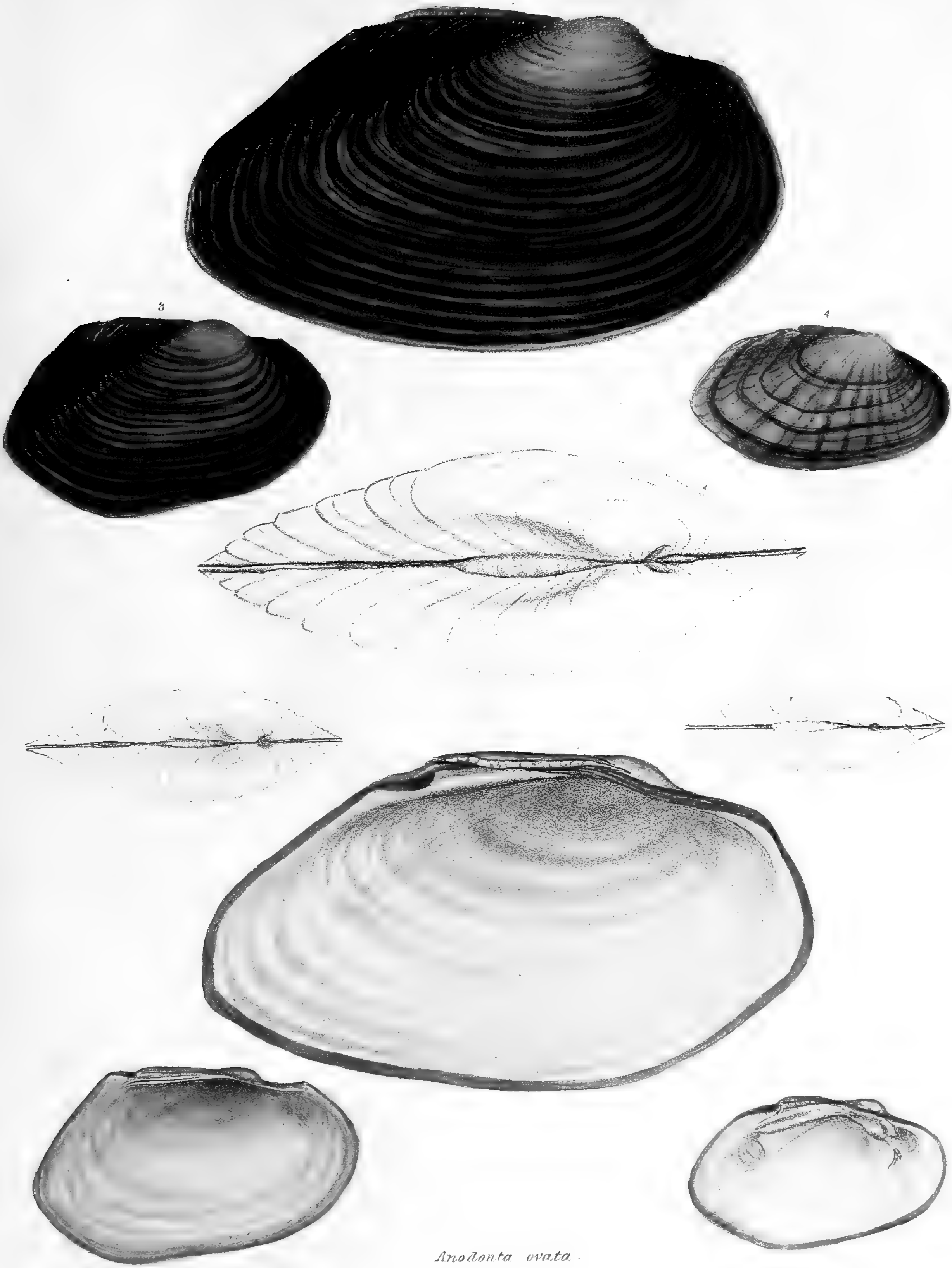
Page 140, *line* 7 *from bottom*, *dele* obovate, *and place* angulata *under* crassa

Page 422, *line* 3 *from bottom*, *for* Tessut *read* Tessier.



Anodonta gigantea.

Drawn by J. Drayton.

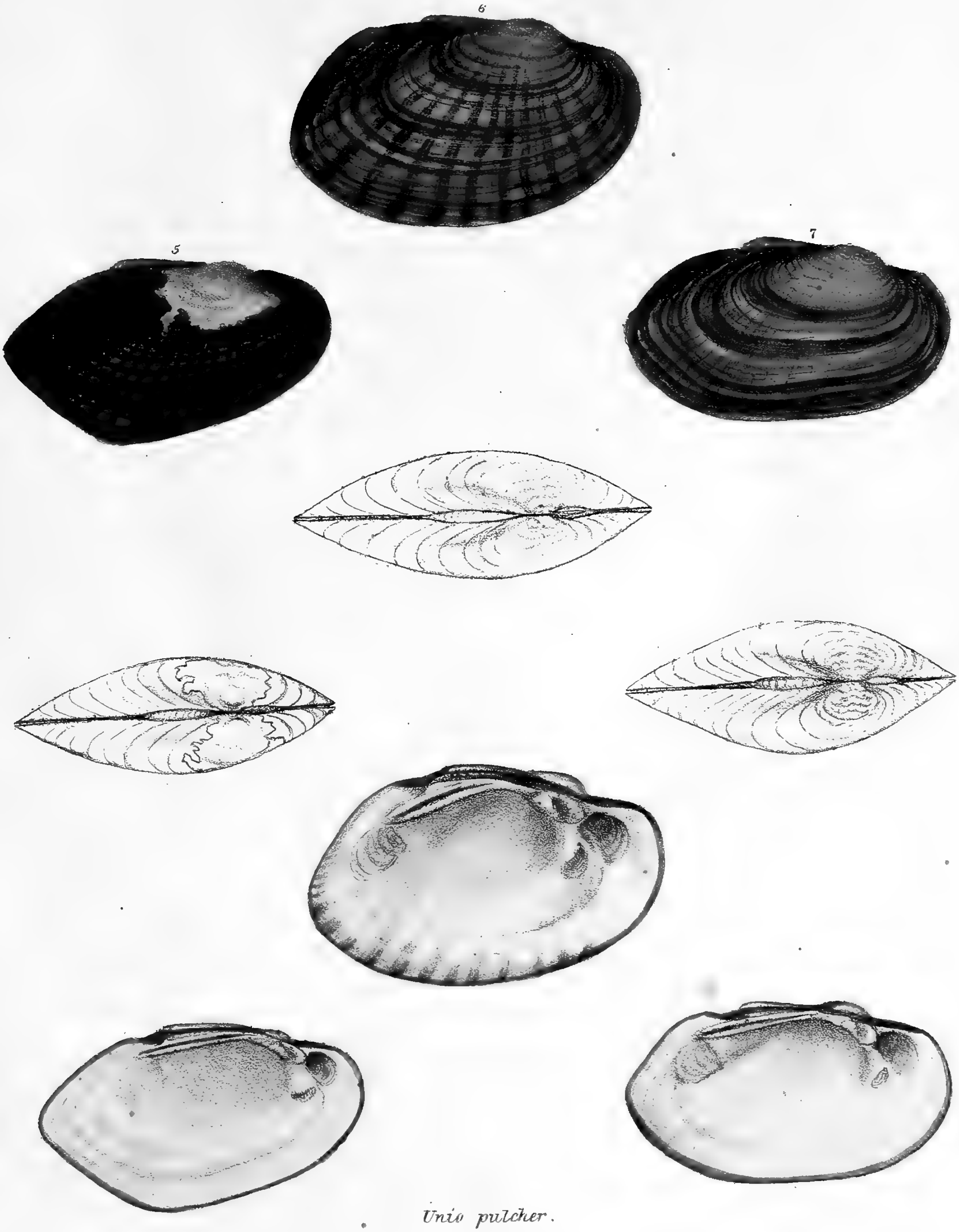


Anodonta ovata.

Unio Bengalensis.

Unio venustus.

Drawn on stone by J. Drayton

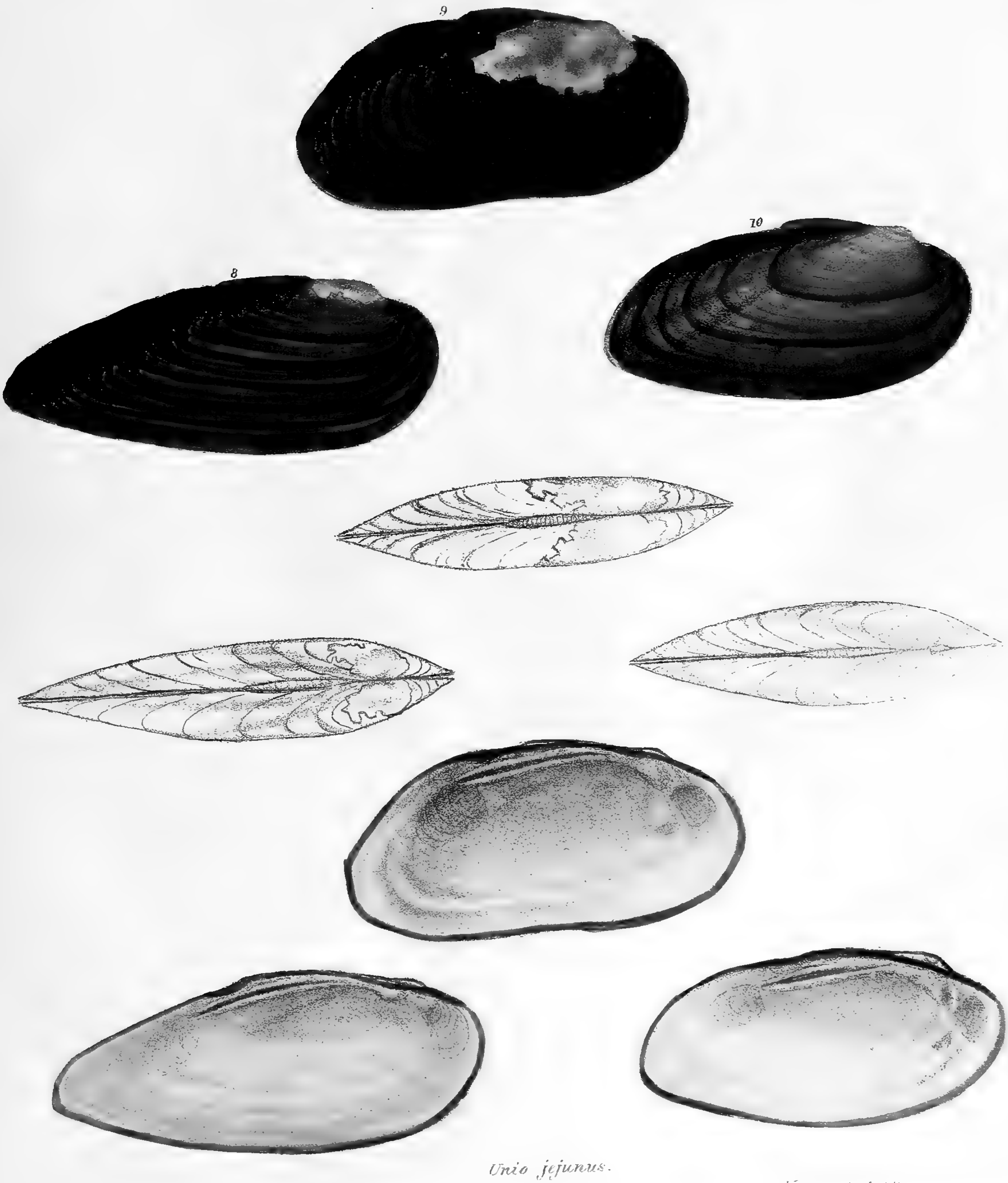


Unio Vaughanianus.

Unio pulcher.

Unio obscurus.

Drawn on stone by J. Drayton.

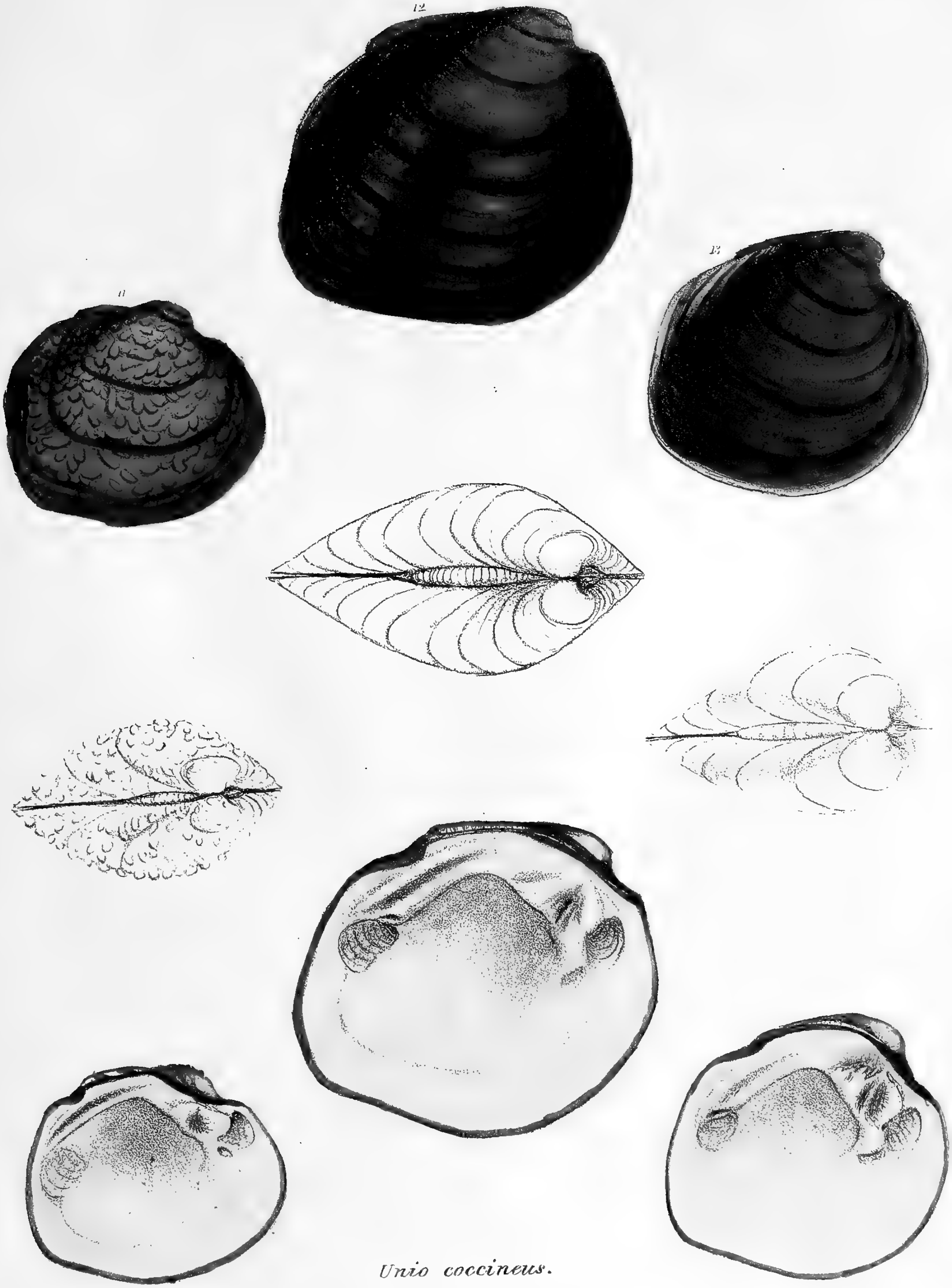


Unio jejunus.

Unio [illegible]

Unio Fisherianus.

Drawn on Ston [illegible]



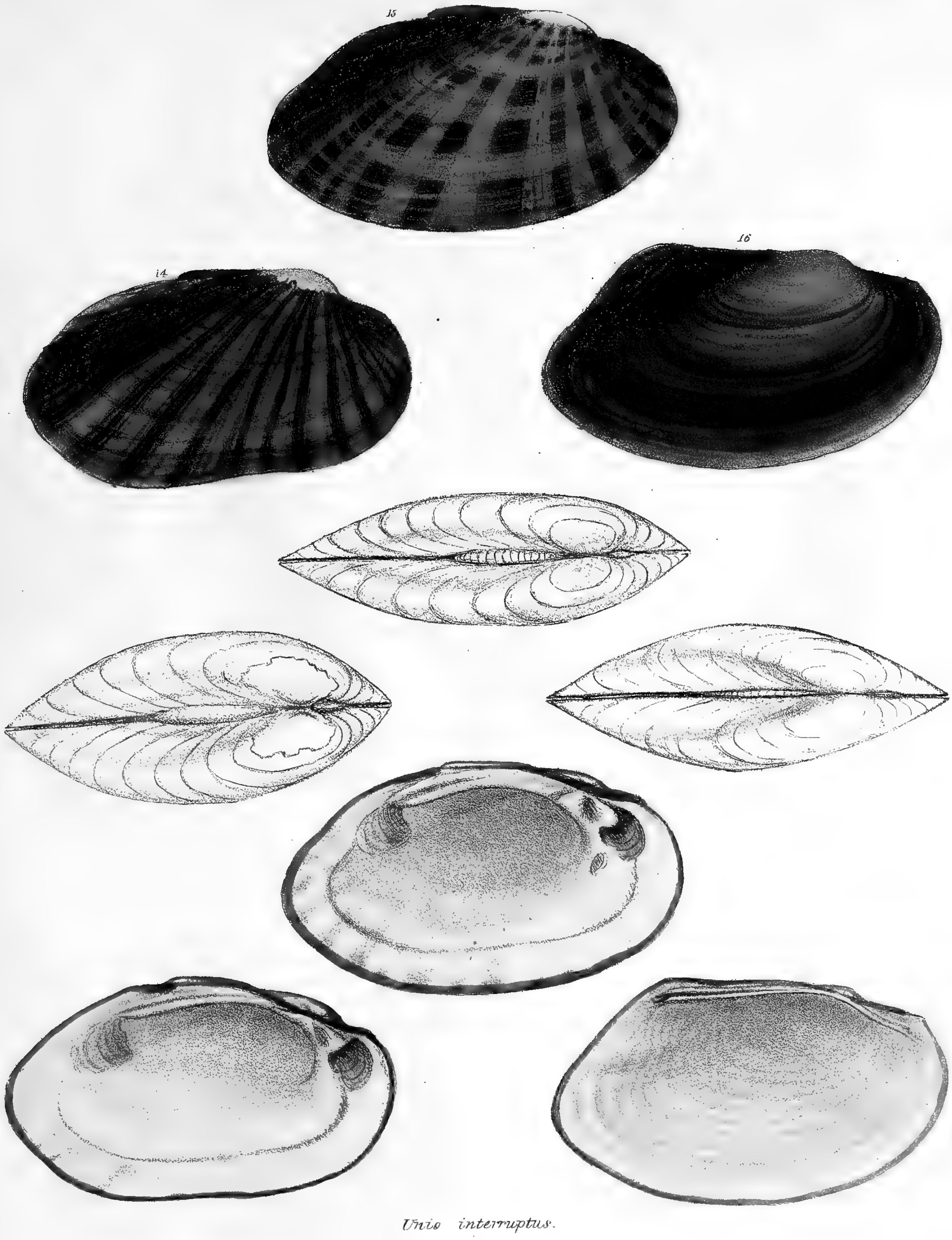
Unio coccineus.

Unio turgidus.

Unio solidus.

Drawn by J. Drayton

PL. VI Vol. 6.



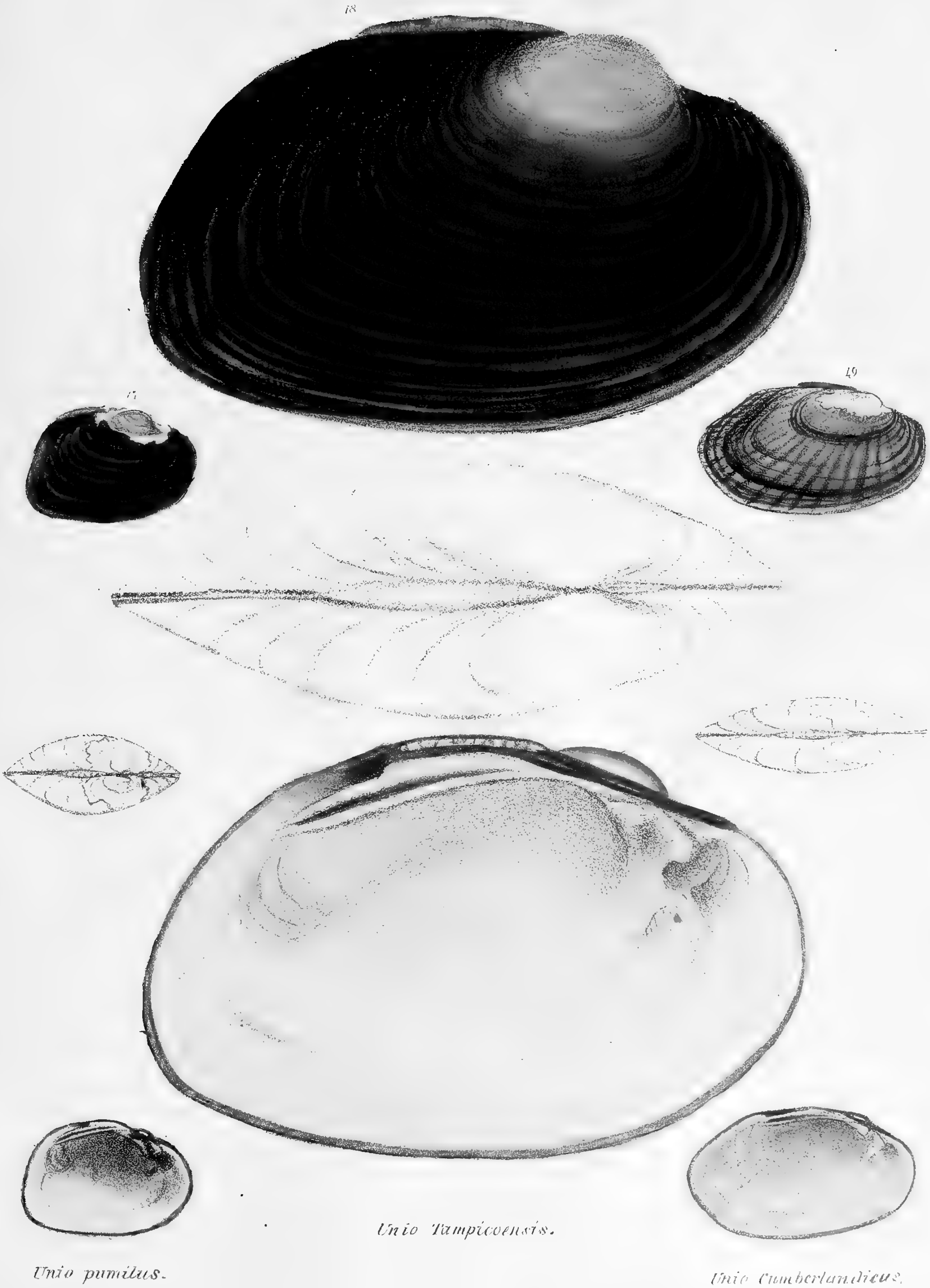
Unio interruptus.

Unio Hydianus.

Unio lamellatus.

Drawn on stone by J. Drayton.

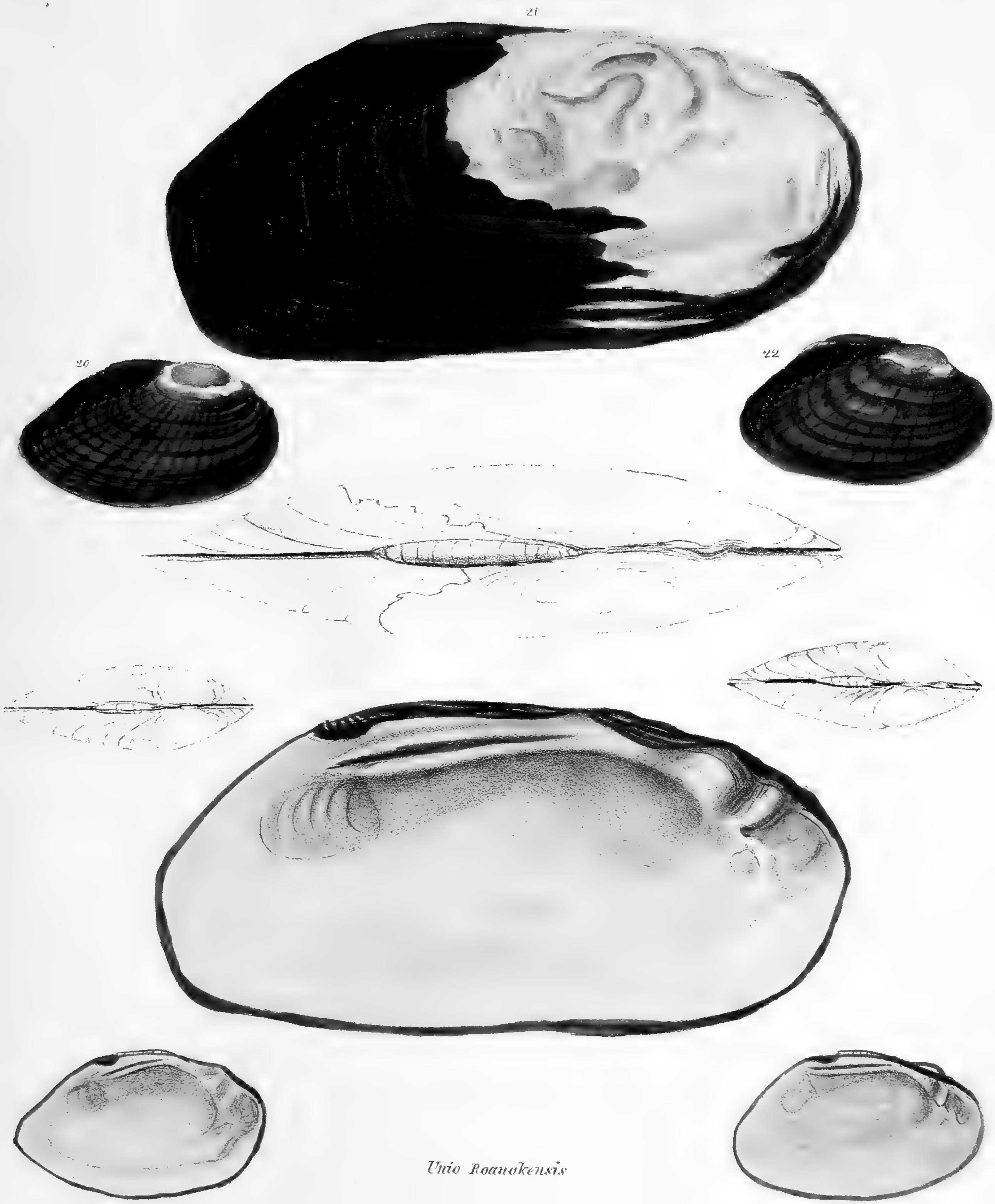
Pl. VII Vol. 6.



Unio Tampicoensis.

Unio pumilus.

Unio Cumberlandicus.



Unio Roanokensis

Unio simus.

Unio notatus.

J. Drayton Del

Unio Hopetonensis

Unio Jayensis

Unio lugubris

Drawn by J.Drayton

Pl. X Vol. 6.

Unio Barnesiana

Unio Creperus

Unio gibber

Unio Zeiglerianus

Unio glaber

J Drayton Del.

PL. XI. Vol 6

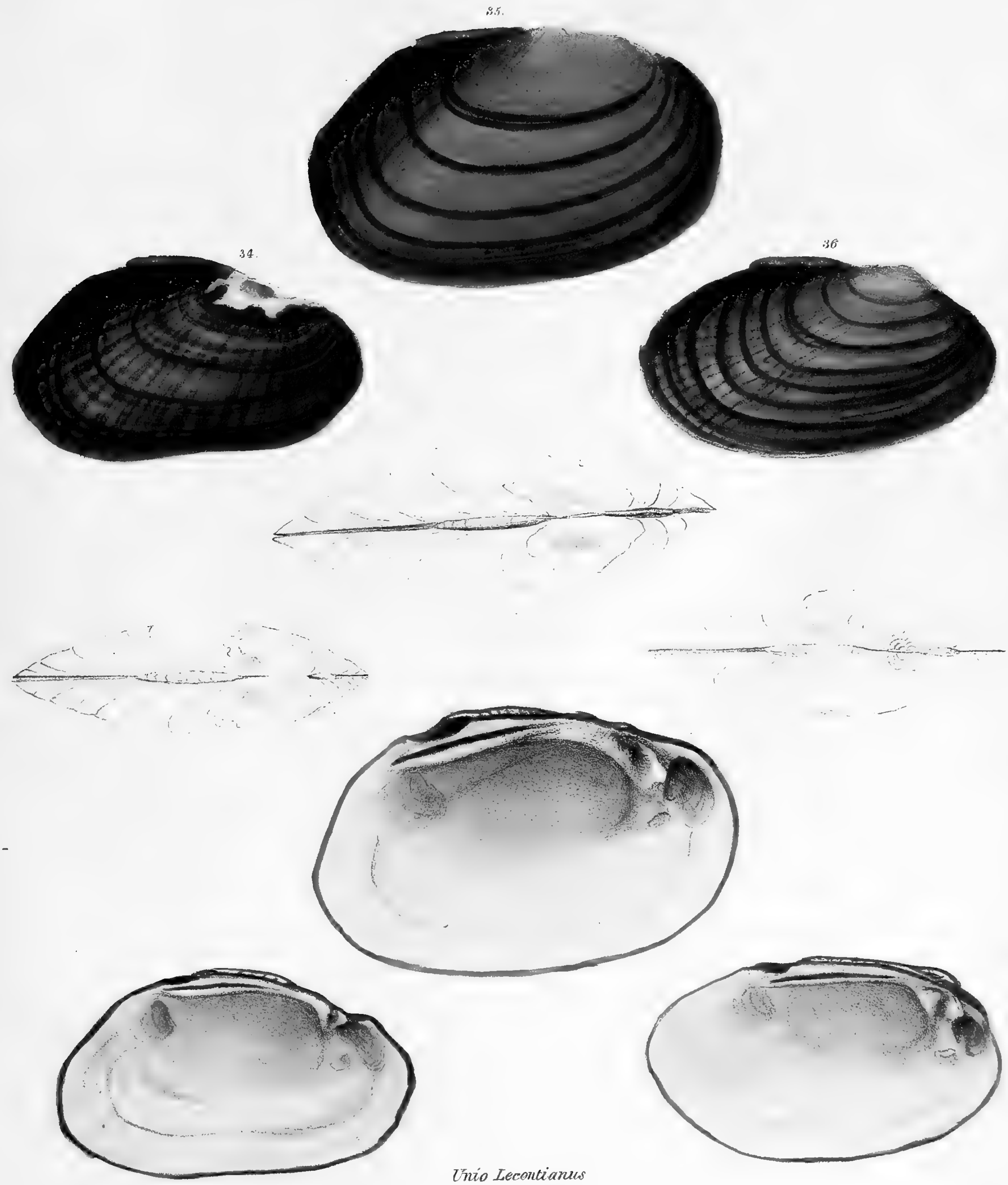
Unio carbonarius

Unio Vanuxemensis

Unio folliculatus

J Drayton del

PL. XII Vol. 6.

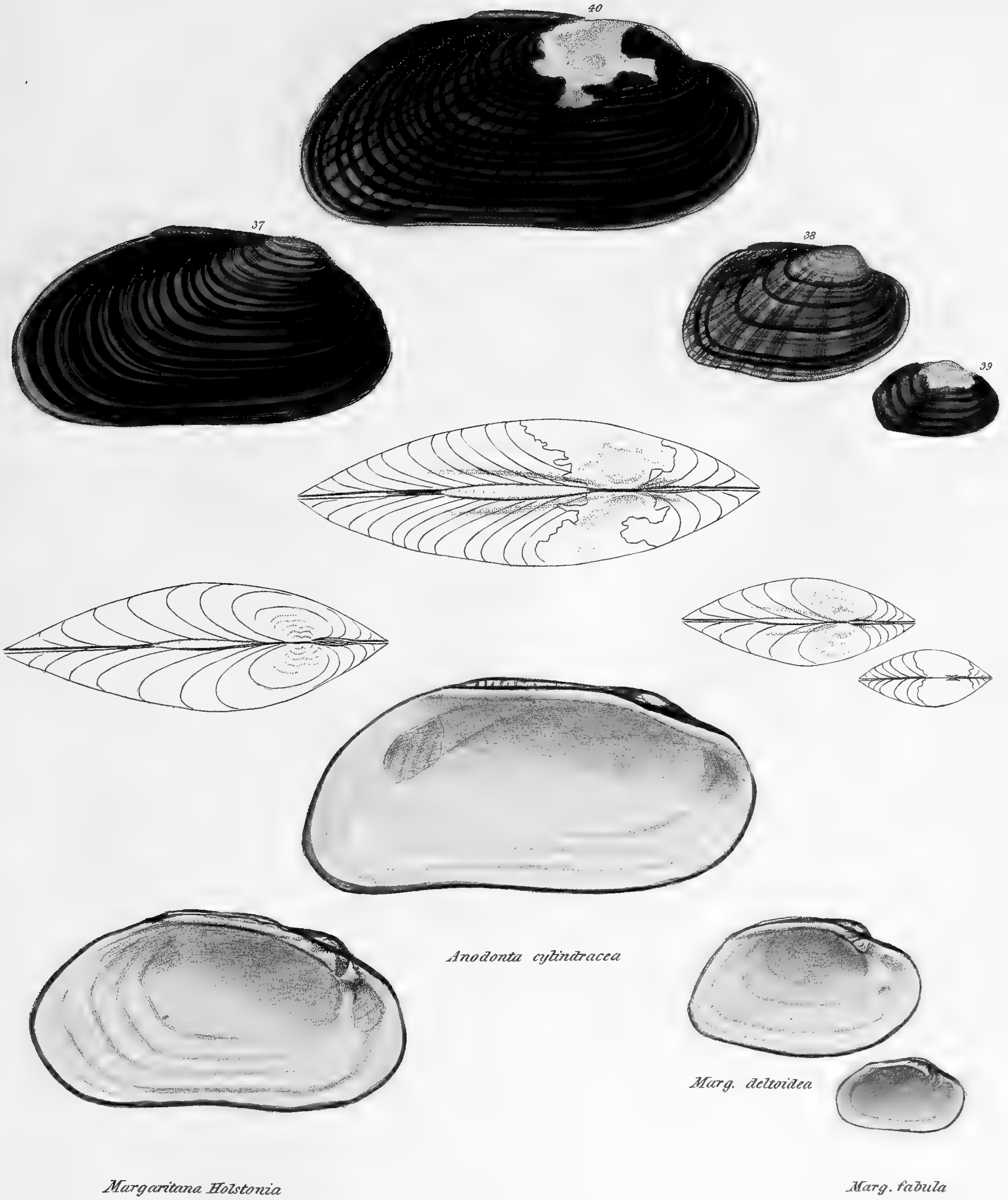


Unio Lecontianus

Unio Medellinus

Unio Muhlfeldianus

Drawn by J. Drayton



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PL. XIV Vol.6.

Anodonta salmonia

Anodonta Wardiana

Anodonta Buchanensis

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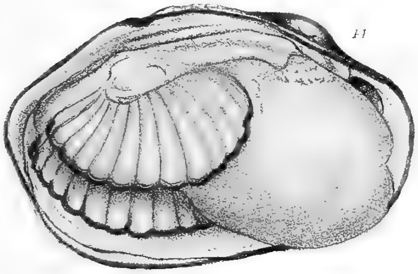
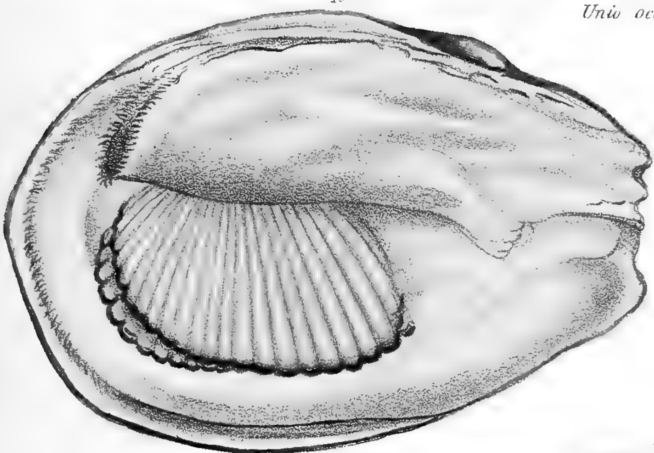
PL. XV Vol. 6.



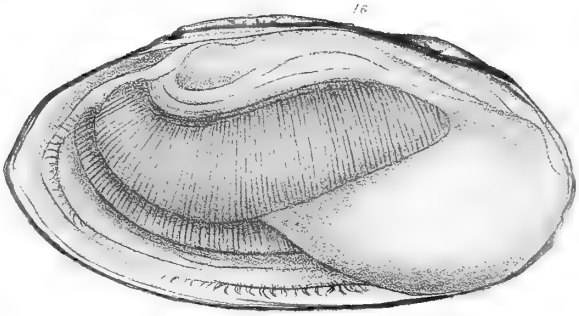
14

Unio ochraceus



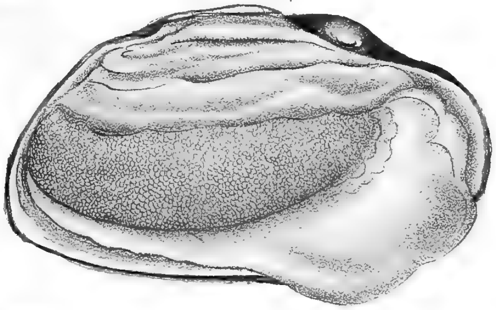
15

Unio cariosus



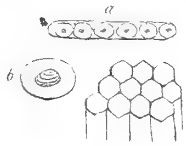
16

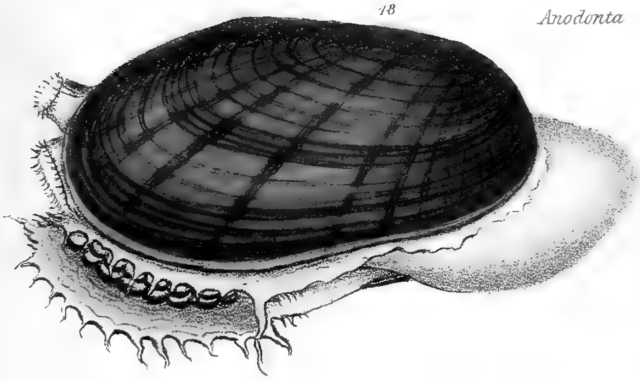
Anodonta fluviatilis



17

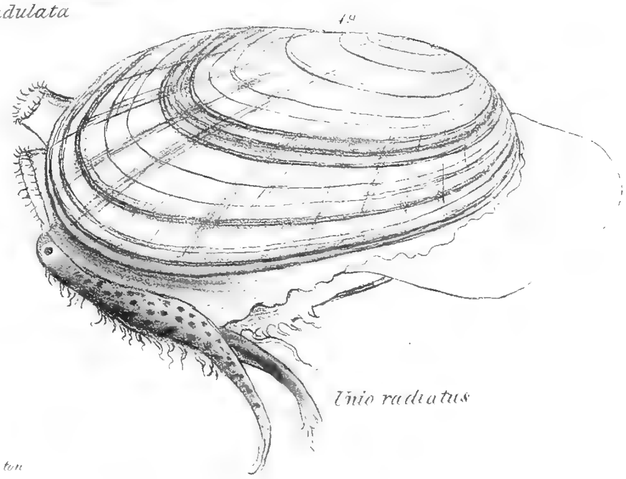
Anodonta undulata





18

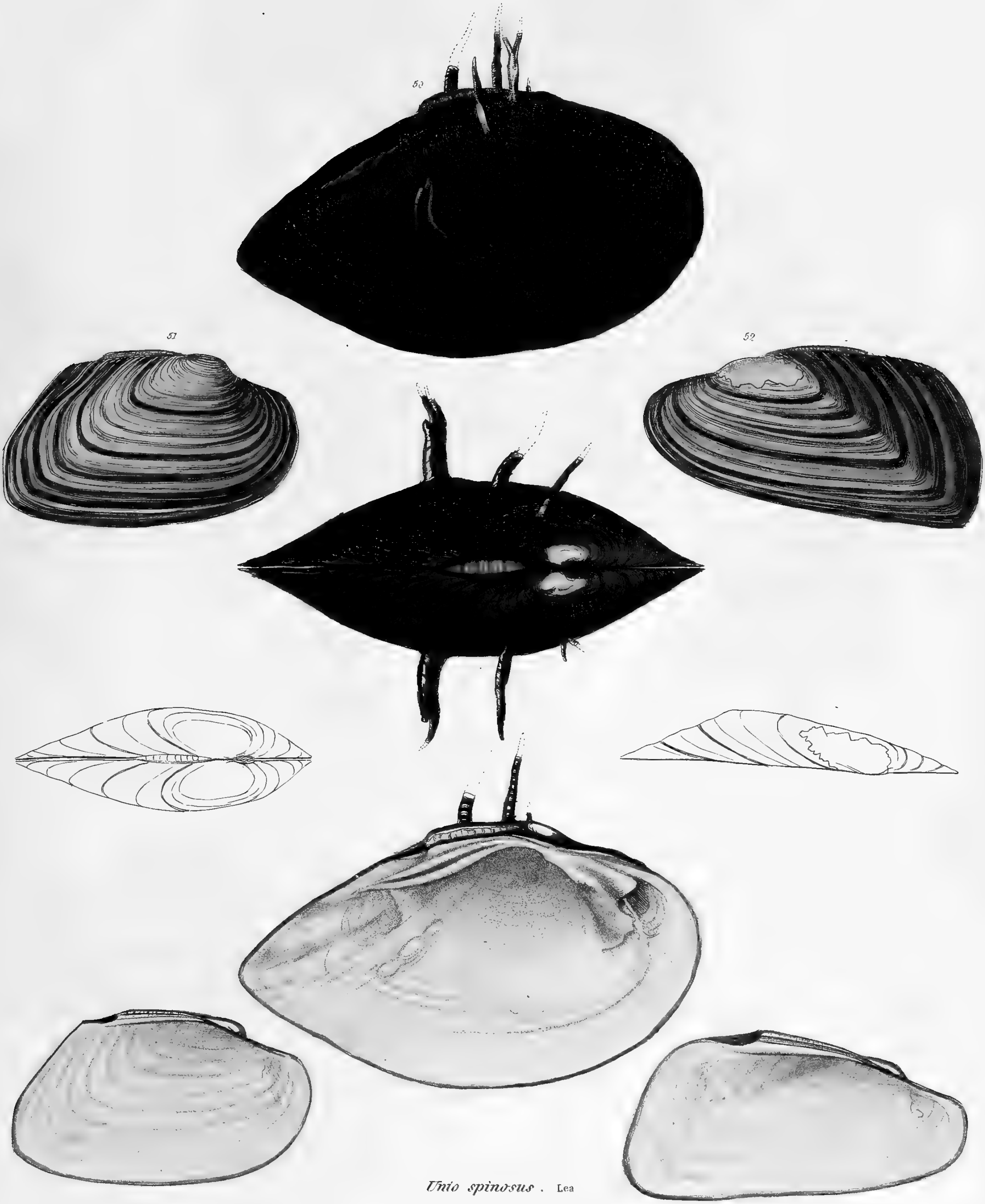
Unio radiatus



19

Unio radiatus

Drawn & on stone by J Driston

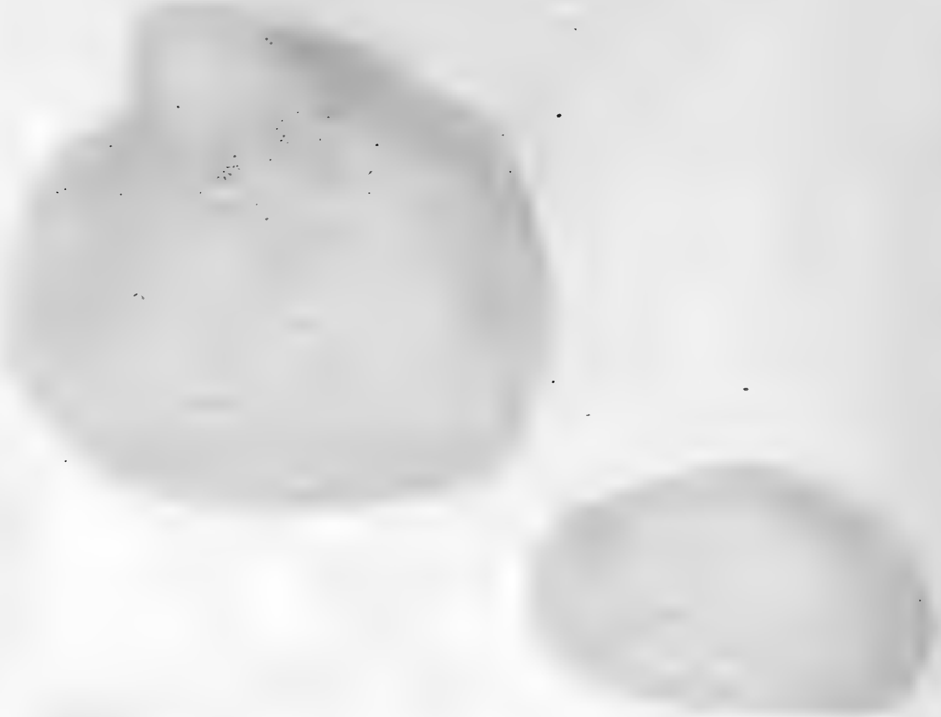


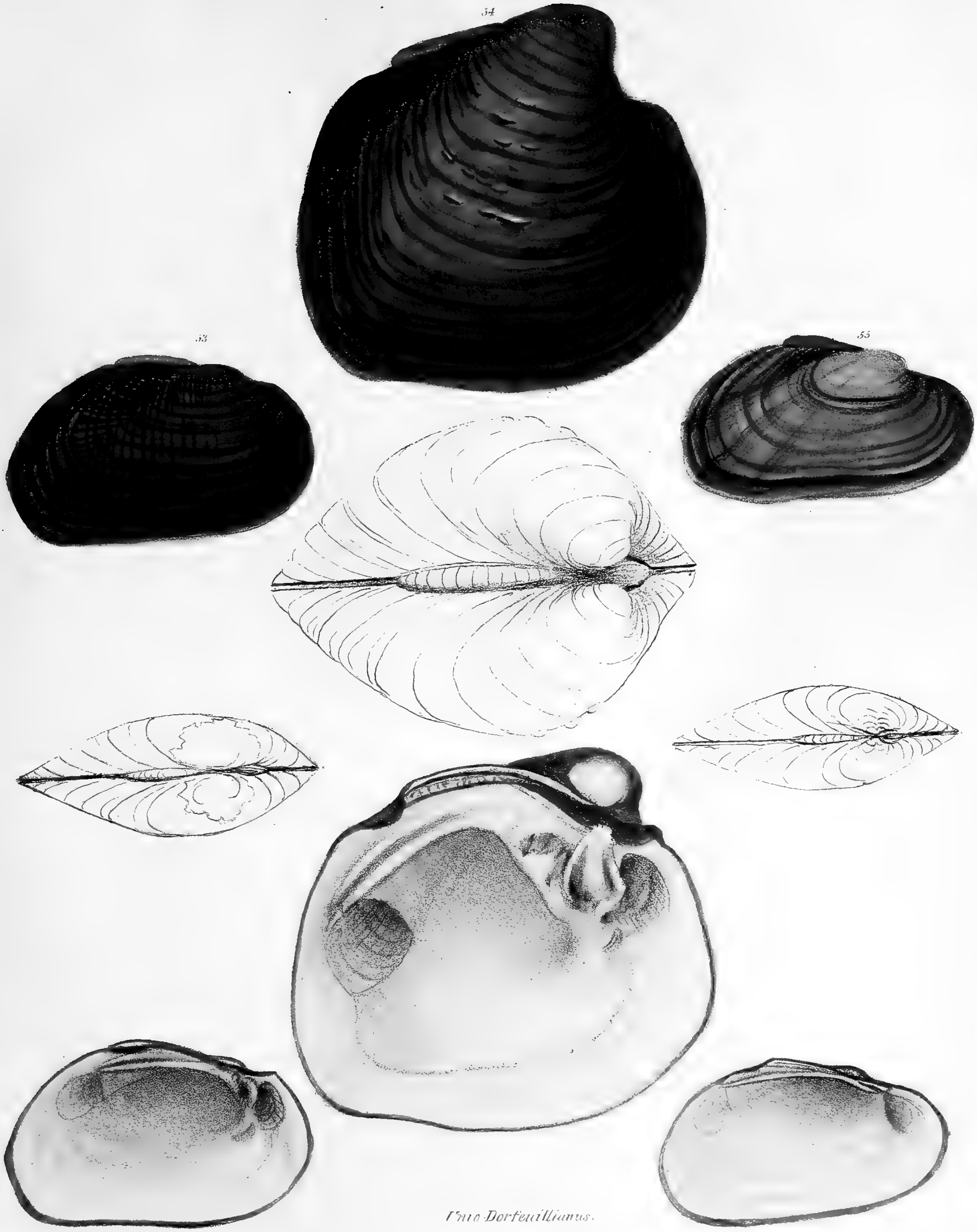
Unio spinosus. Lea

Anodonta Pepinianus.

Anodonta angulata

Drawn & Engr'd by J. Drayton.



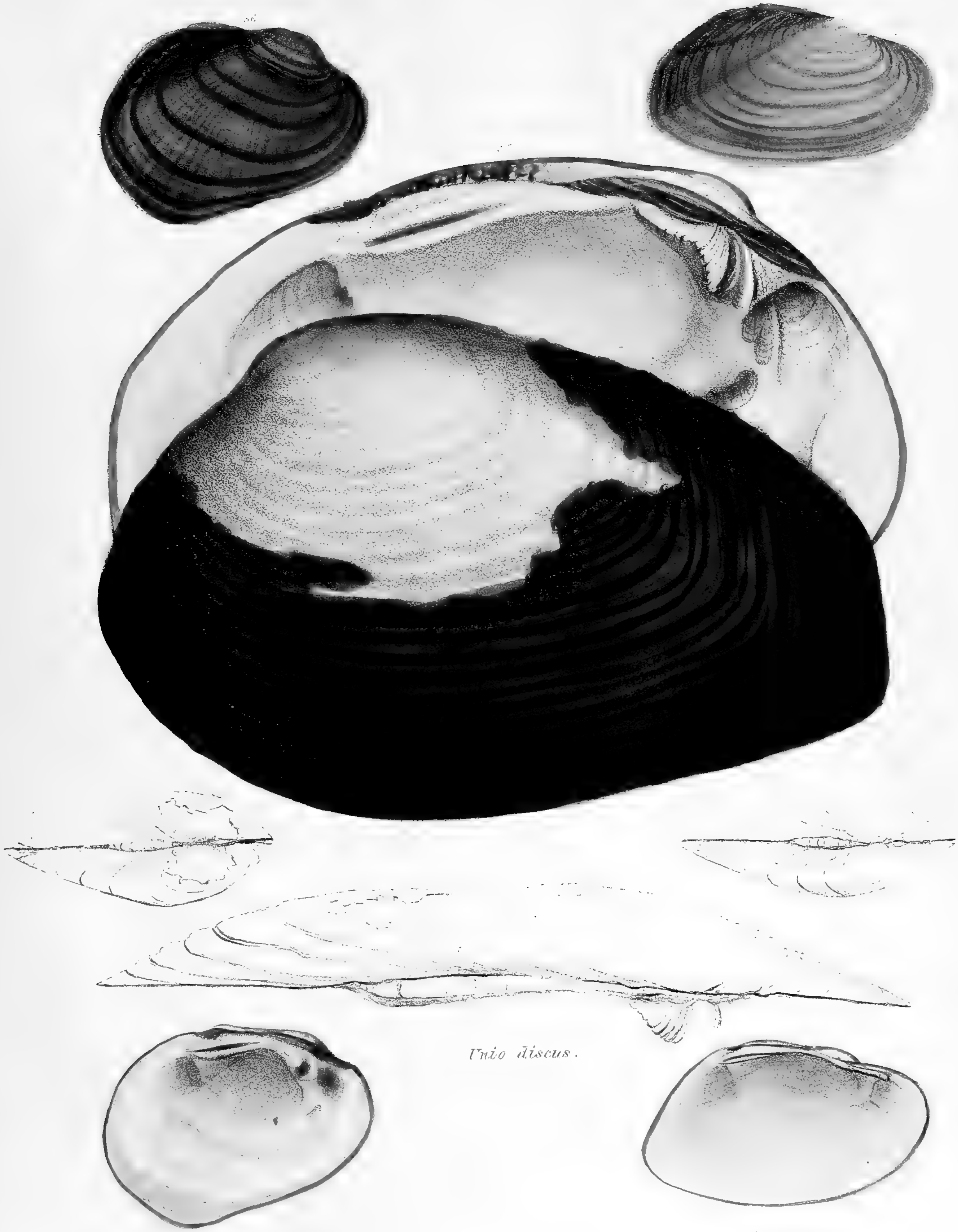


Unio Dorfeuillianus.

Unio pliciferus.

Unio Lapham[illegible].

Drawn by J. Prat[illegible]

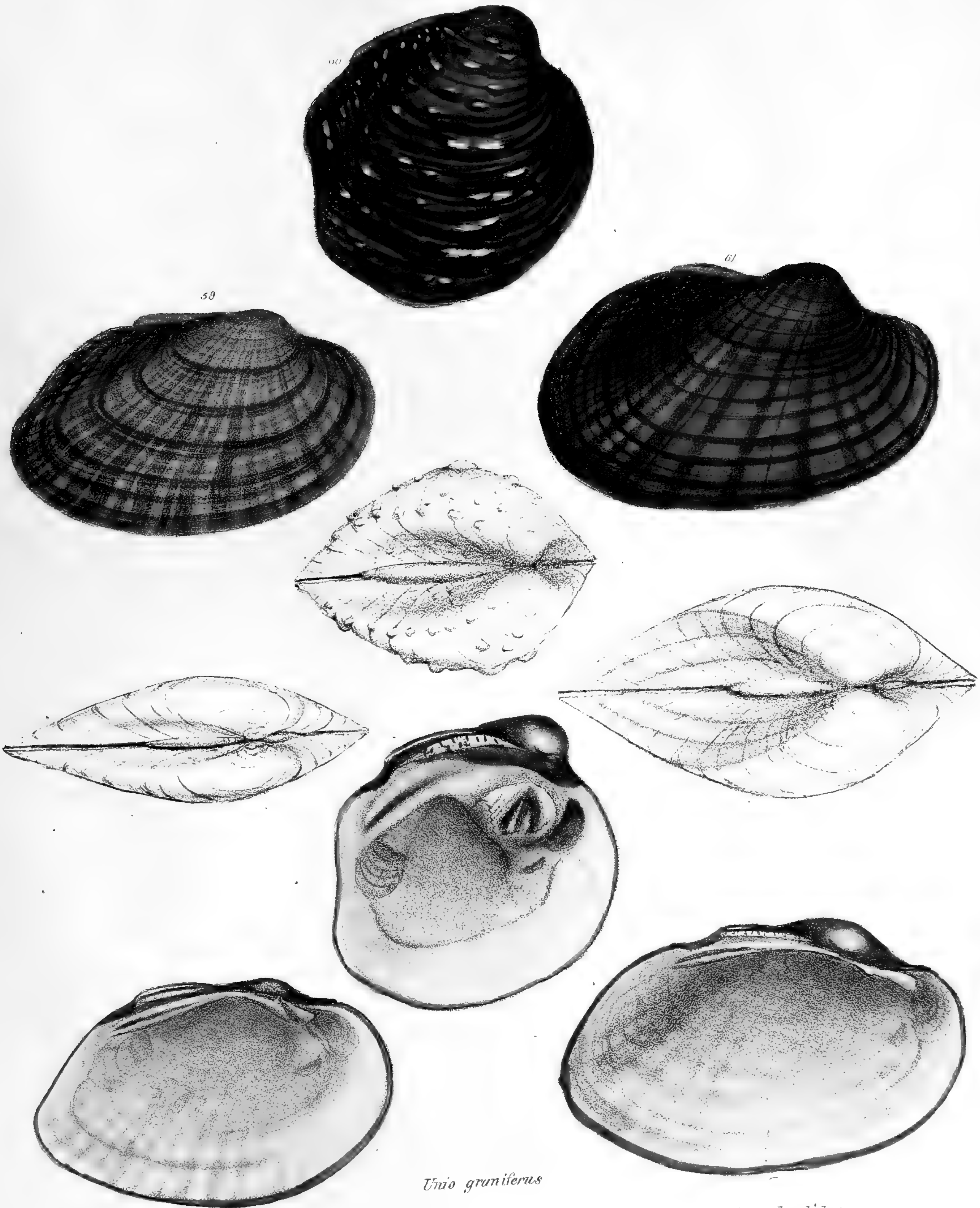


Unio discus.

Un. Rangianus

Unio contradens.

PL. XIX Vol. 6.



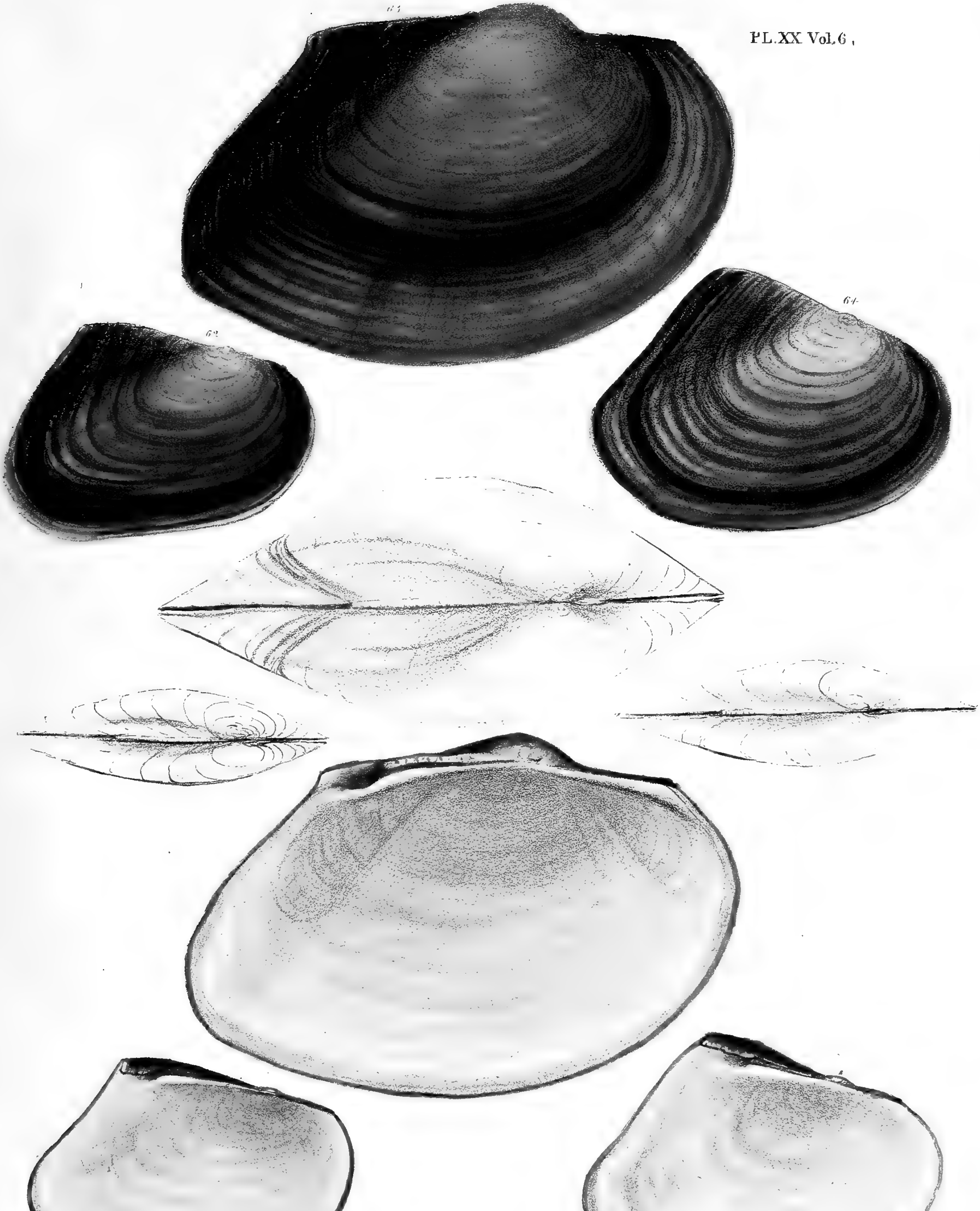
Unio Menkianus

Unio granilerus

Unio splendidus

Drawn &c by J. Drayton

PL. XX Vol. 6.

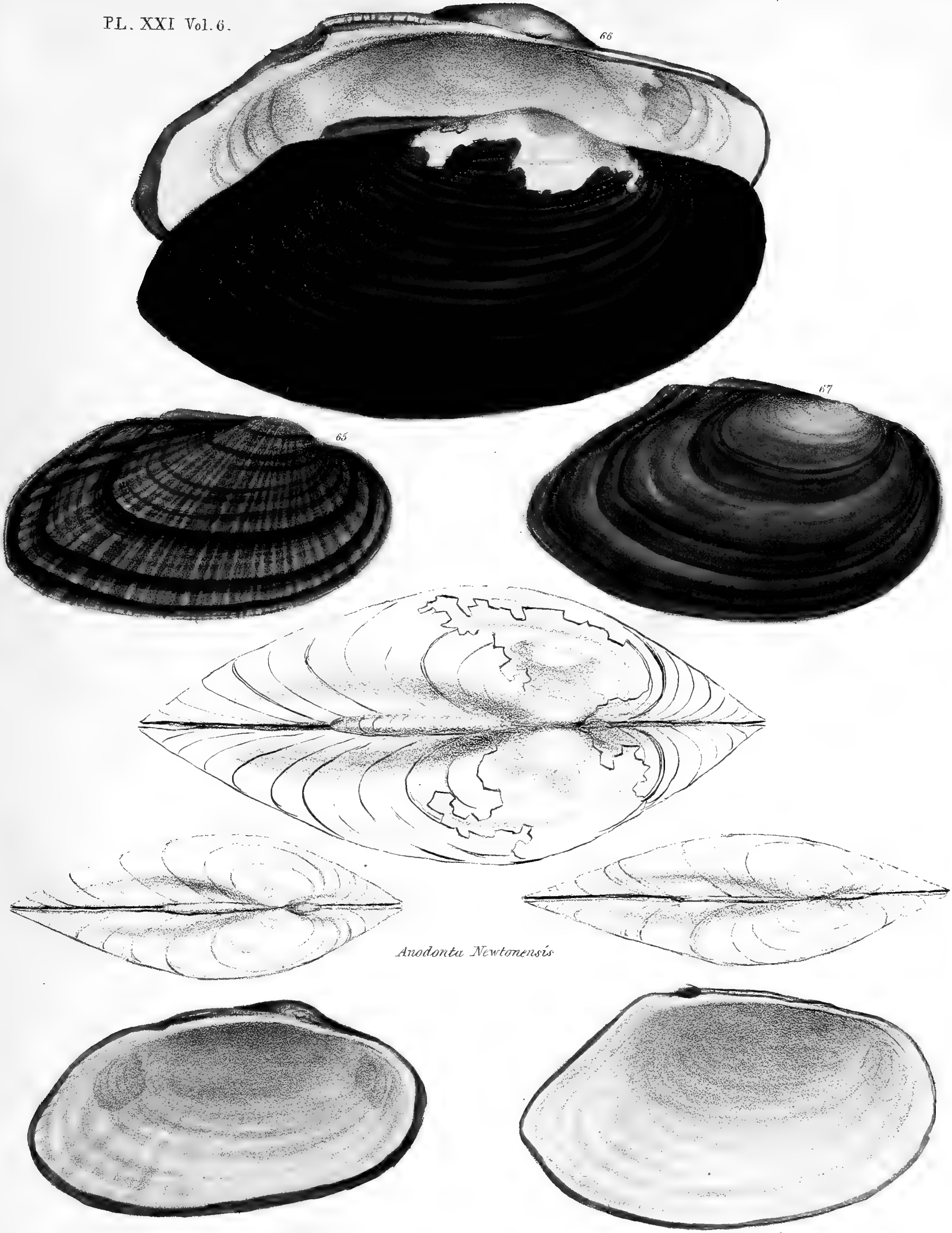


Anodonta decora

Anodonta Nuttalliana

Anodonta Wahlamatensis

PL. XXI Vol. 6.



Anodonta Newtonensis

Anodonta pavonia

Anodonta Oregonensis

Drawn by J Drayton

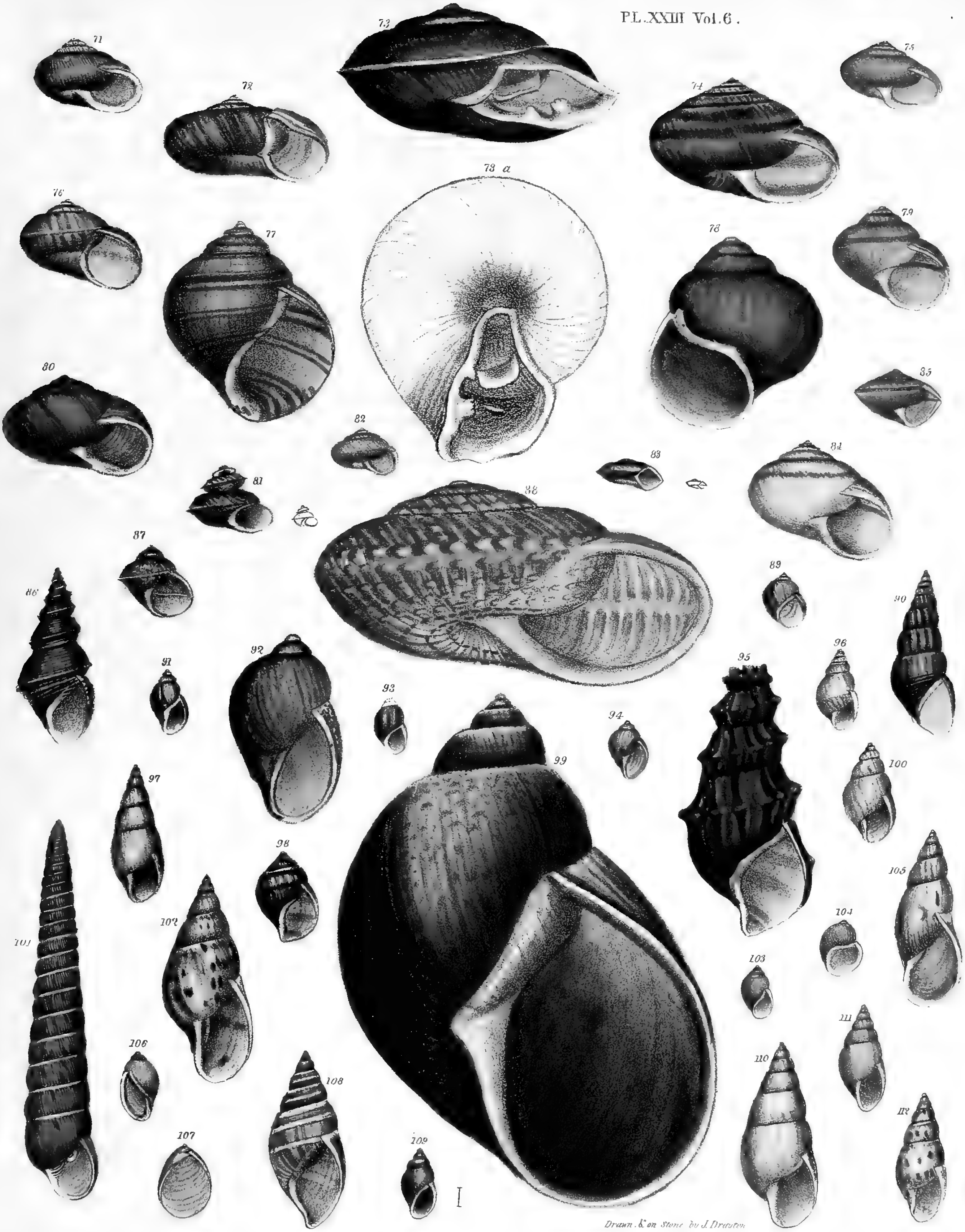
PL. XXII Vol. 6

Margaritana arcula

Anodonta exilis

Iridina cœlestis

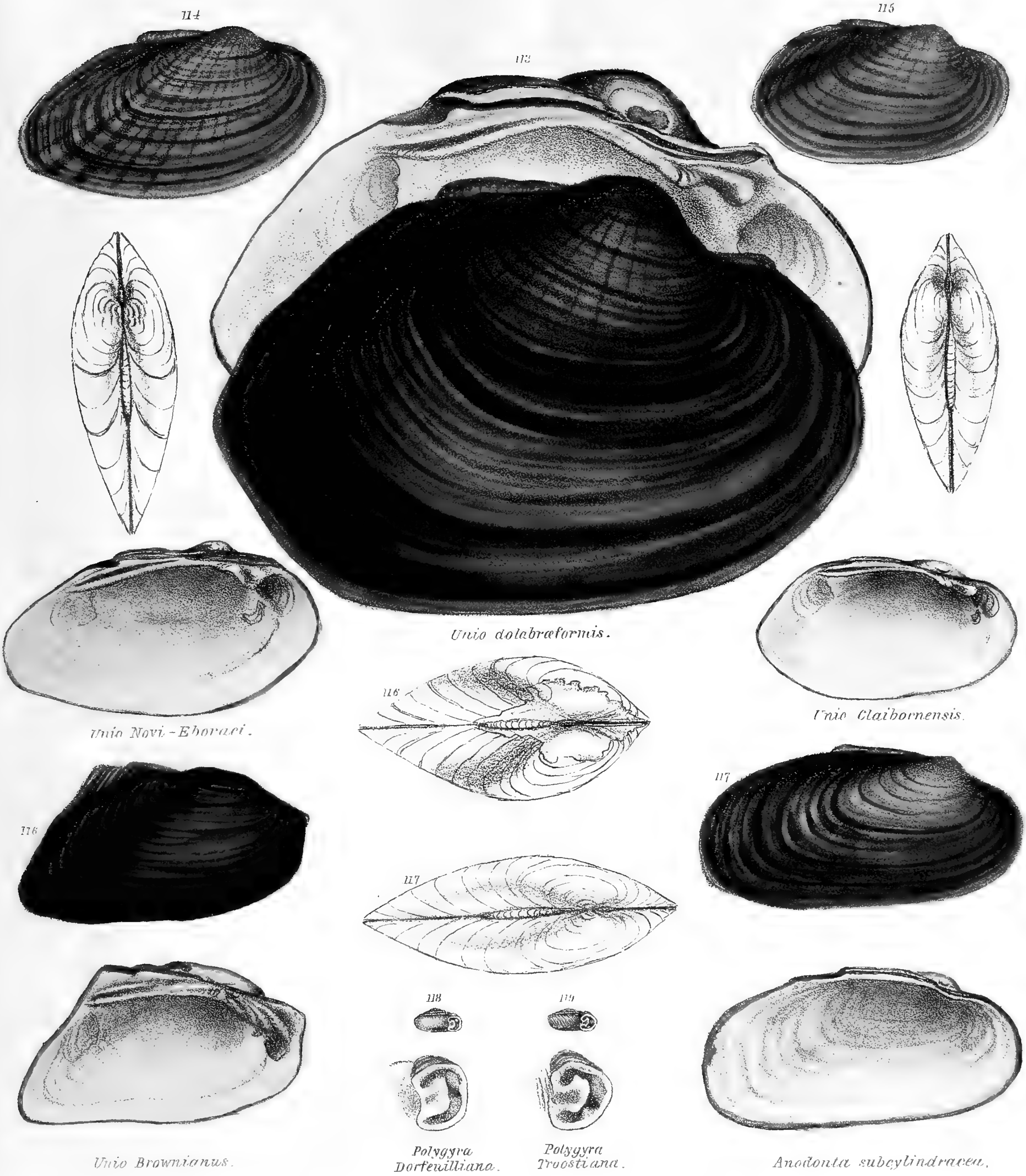
Drawn by J. Drayton



Drawn & on Stone by J. Drayton

71	Helix	Mitchelliana
72	„	Vancouverensis
73	Carocolla	Hydiana
74	Helix	Nuttalliana
75	„	Columbiana
76	Cyclostoma	Popayana
77	Ampullaria	Pealiana
78	Paludina	sinistrosa
79	Helix	Californensis
80	„	Townsendiana
81	Paludina	hyalina
82	Helix	Wardiana
83	Planorbis	lens
84	Helix	Nickliniana
85	„	Oregonensis
86	Melania	Troostiana
87	Cyclostoma	maculata
88	Helix	magnifica
89	Paludina	Nuttalliana
90	Melania	plicifera
91	Lymnæa	solida
92	Bulimus	glandiformis
93	Paludina	virens
94	Lymnæa	apacina
95	Melania	plicata
96	Bulimus	parvus
97	„	virgo
98	Melania	inflata
99	Bulimus	Gibbonius
100	„	lacteus
101	Megaspira	Ruschenbergiana
102	Bulimus	gracilis
103	Paludina	nuclea
104	Paludina	pallida
105	Bulimus	Pealianus
106	Physa	aurea
107	Succinea	aperta
108	Bulimus	decoratus
109	Paludina	Nickliniana
110	Bulimus	Columbianus
111	„	corneus
112	„	maculatus

PL. XXIV Vol. 6.



Unio dolabræformis.

Unio Novi-Eboraci.

Unio Claibornensis.

Unio Brownianus.

Polygyra Dorfeuilliana.

Polygyra Troostiana.

Anodonta subcylindracea.

Drawn by J. Drayton

Plate XXVI.

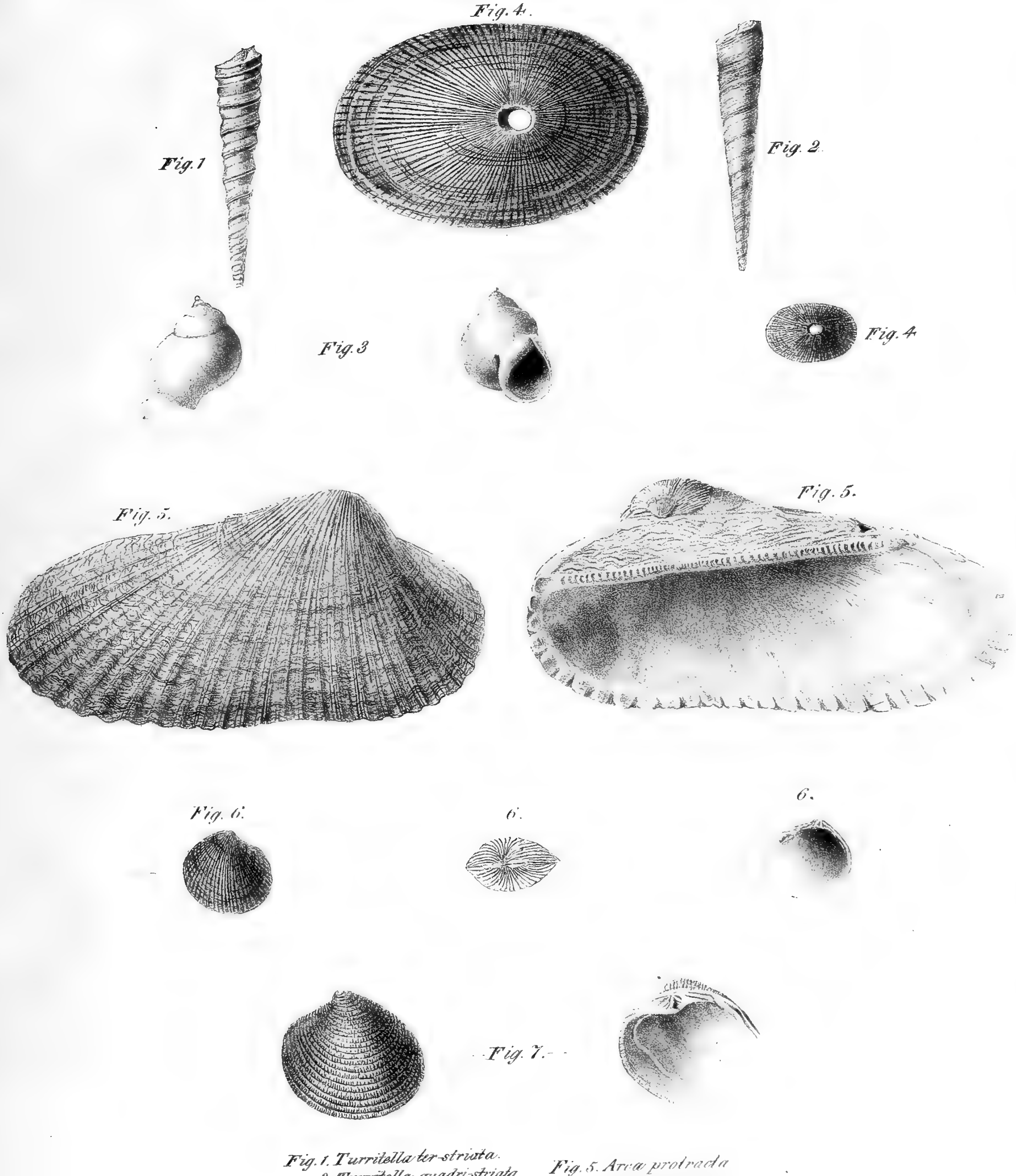


Fig. 1. *Turritella ter-striata.*
" 2. *Turritella quadri-striata*
" 3. *Natica perspectiva*
" 4. *Fissurella catilliformis*

Fig. 5. *Arca protracta*
6. *Lucina speciosa*
7. *Venus cortinaria.*

On Stone by A. Newsam.

Plate XXVII.

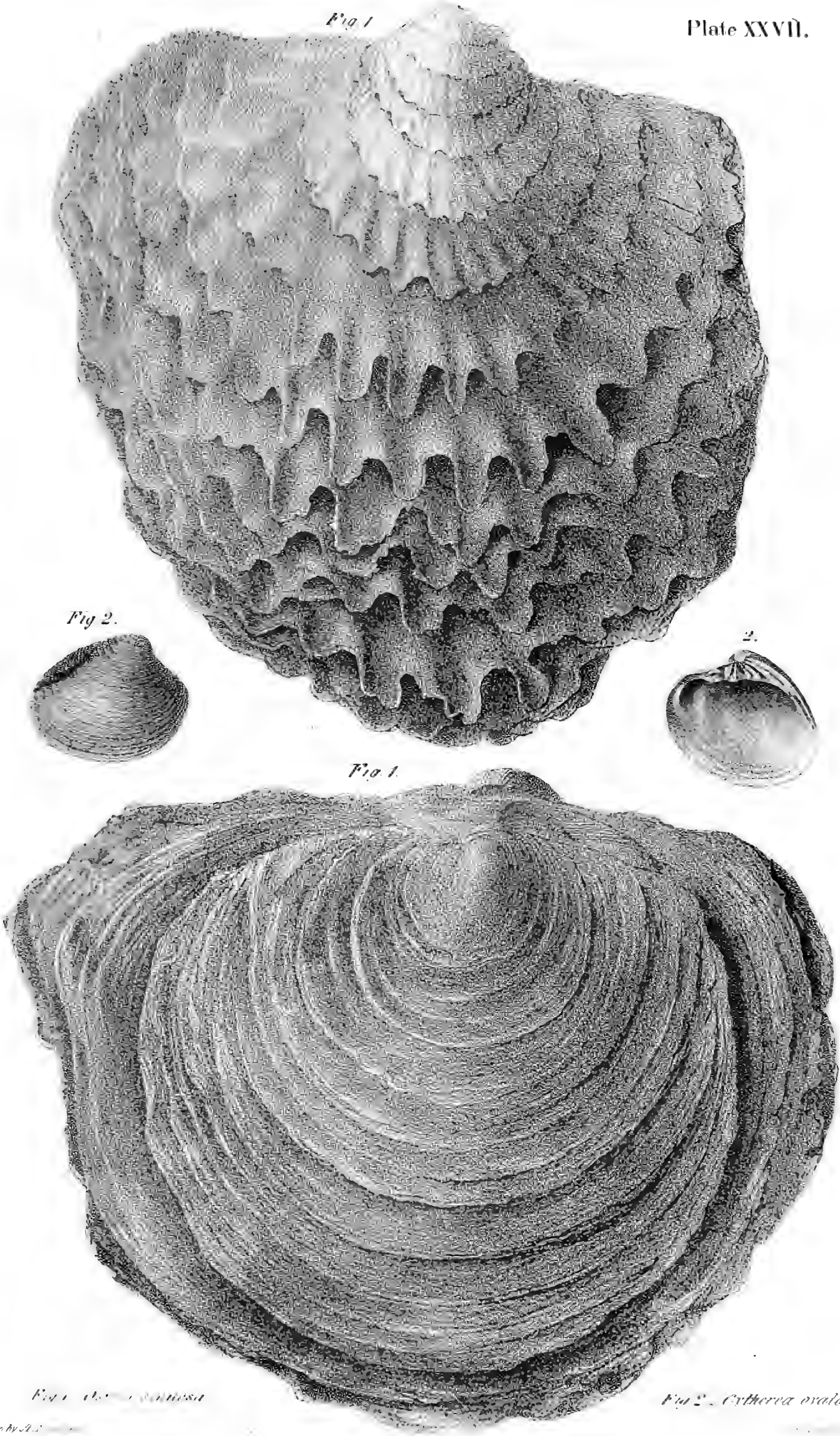
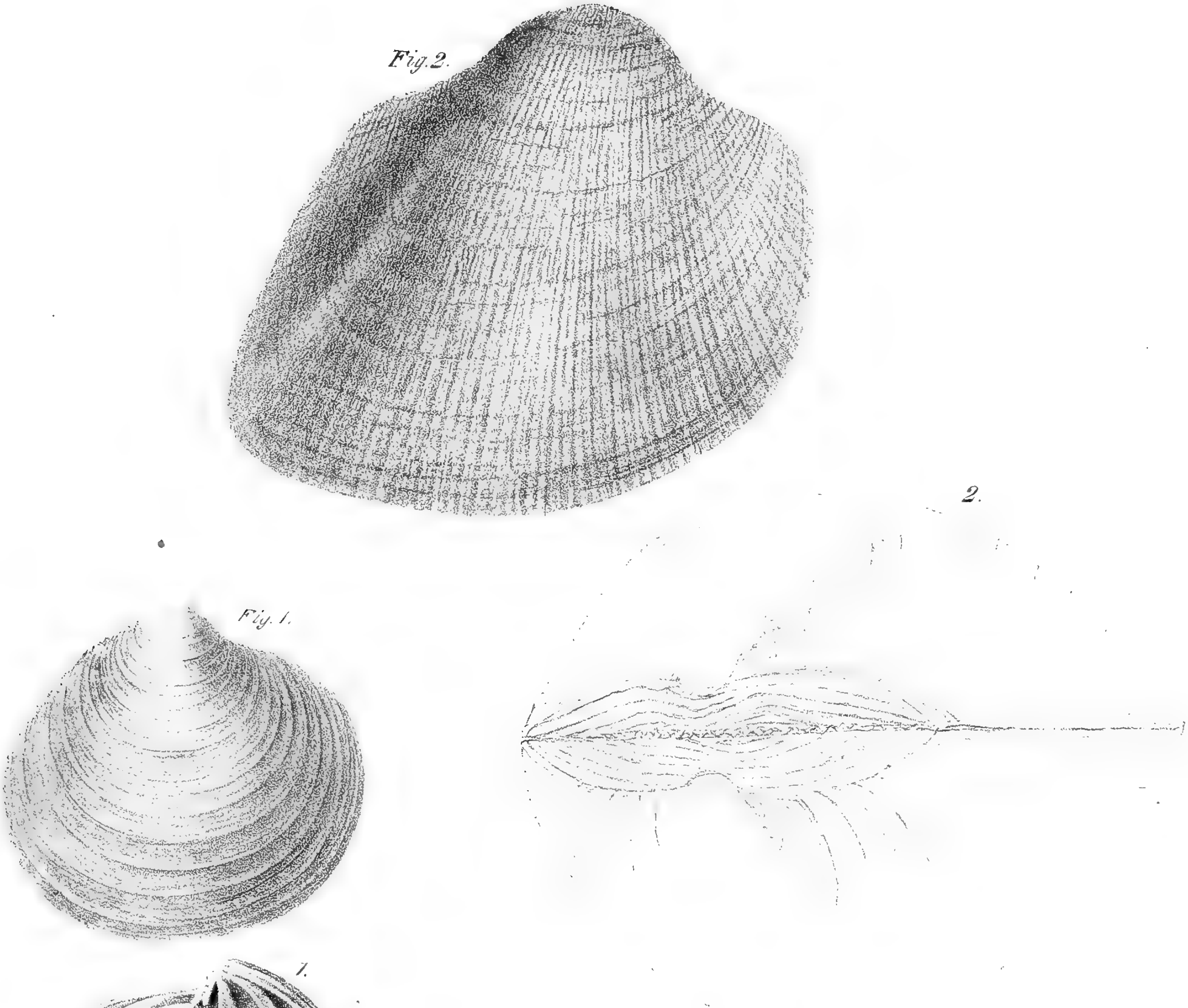


Fig 1. [illegible]

Fig 2. Cytherea ovata.

On Stone by A. [illegible]

Plate XXVIII



On Stone by J. Newsam.

Fig. 1 Cytherea lenticularis.
„ 2. Cucullea onochela.

P.S. Duval Lith. Phila.

Plate XXIX.

Fig. 1.

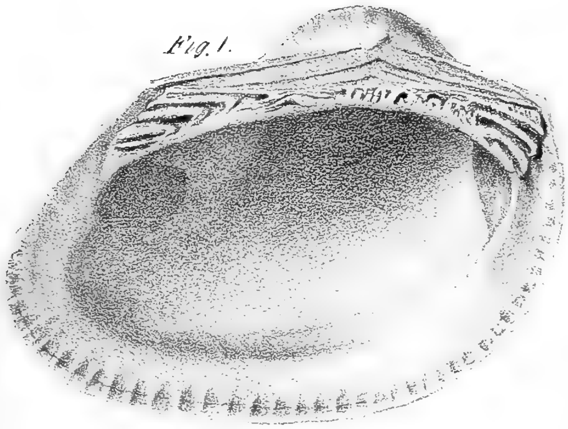
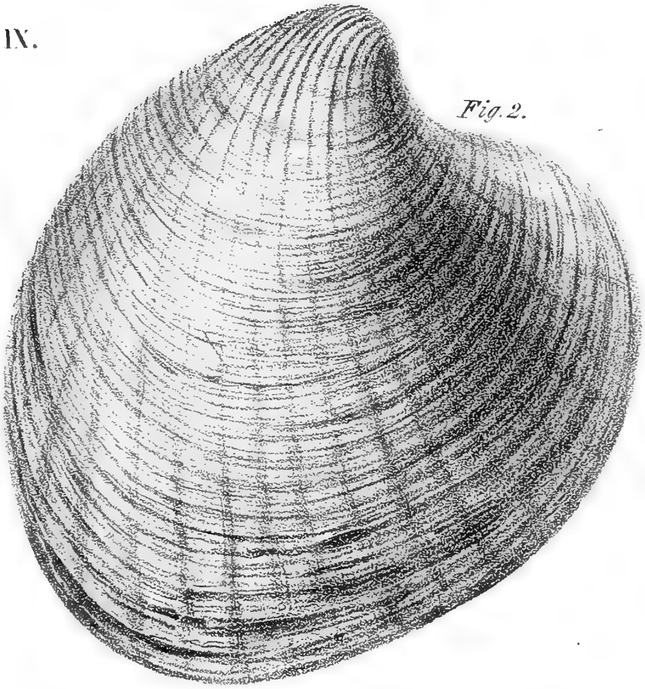
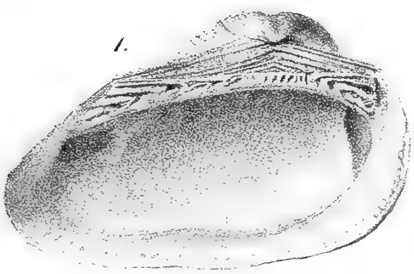


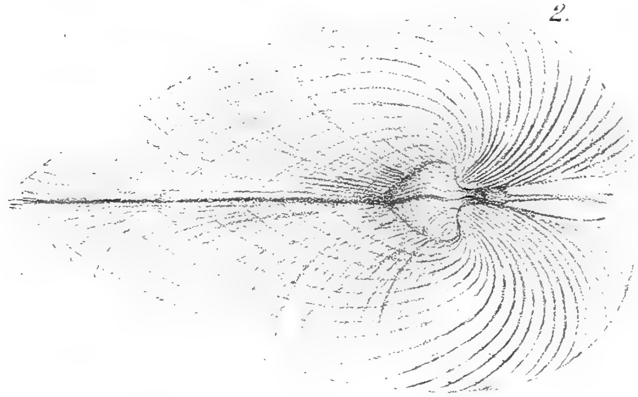
Fig. 2.



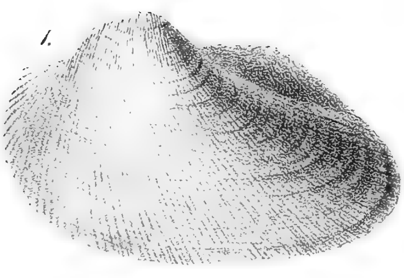
1.



2.



1.



2.

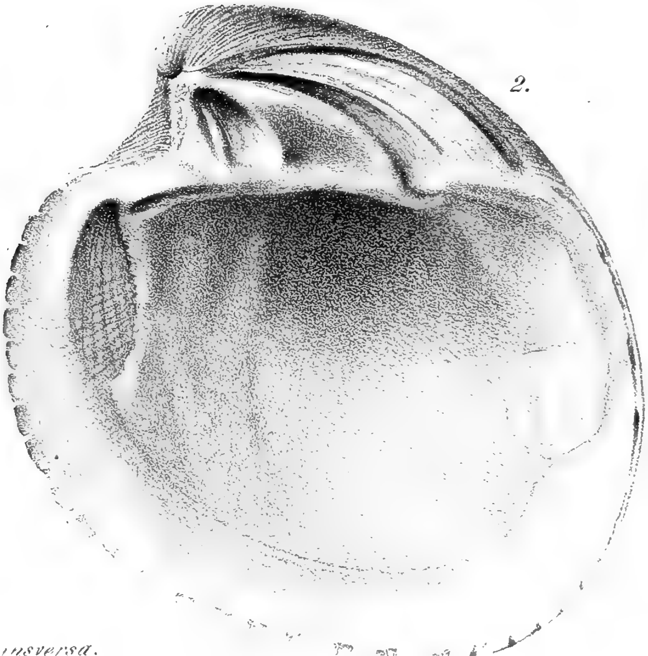


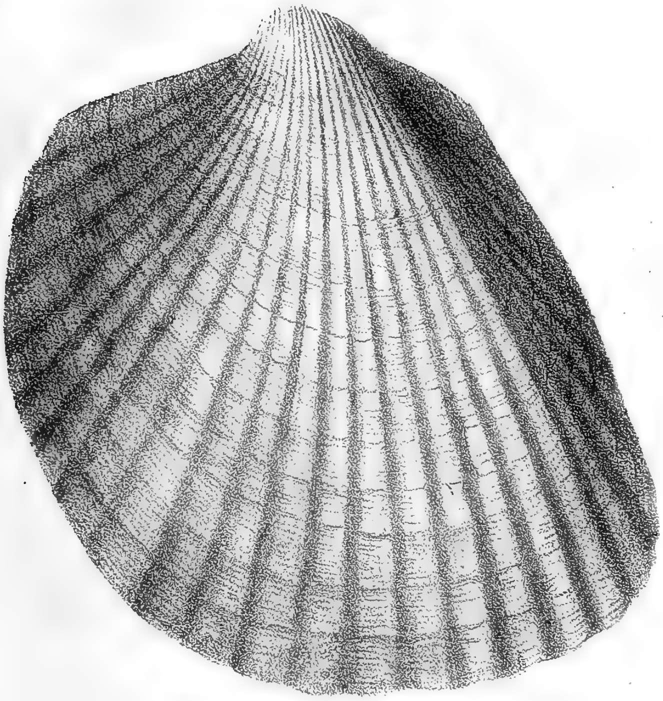
Fig. 1. Cucullæa transversa.
" 2 Venericardia ascia.

On Stone by A. Newsam

P. S. Duval Lith. Phil.a

Plate XXX.

Fig. 1.



1.

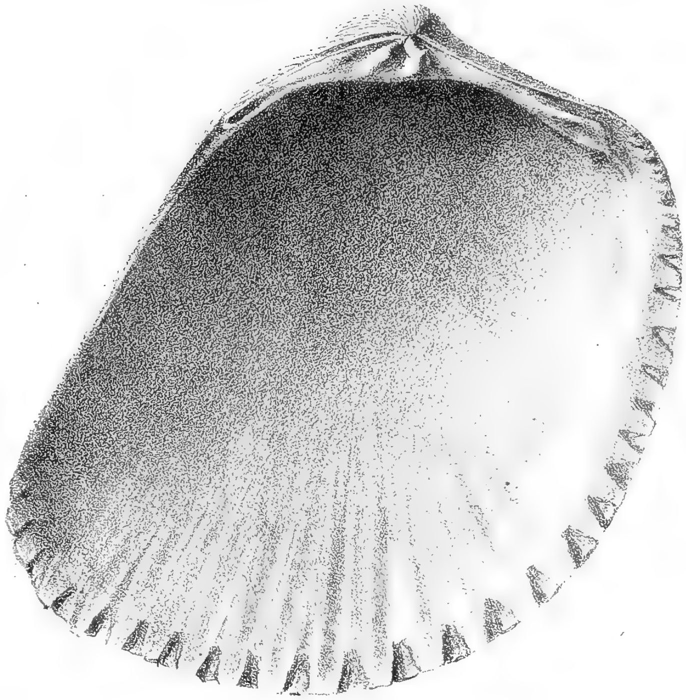
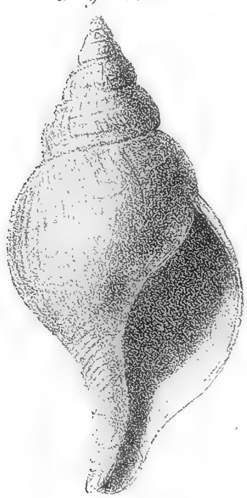
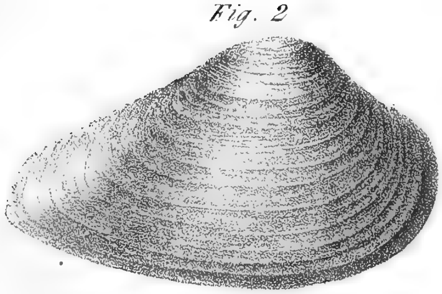


Fig. 3.



3.

Fig. 2



2

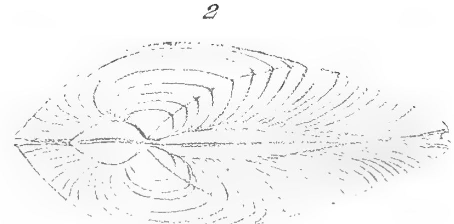


Fig. 1. Cardium quadrans.
" 2. Crassatella capri-cranium.
" 3. Fasciolaria rhomboidea.

On Stone by A. Newsam.

P. S. Duval, Lith. Phila.