WHITE, C.A.

...On marine Eocene, fresh-water Miocene and other fossil Mollusca... 1885.

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[Bulletin No. 18.]

The publications of the United States Geological Survey are issued in accordance with the statute, approved March 3, 1879, which declares that—

"The publications of the Geological Survey shall consist of the annual report of operations, geological and economic maps illustrating the resources and classification of the lands, and reports upon general and economic geology and paleontology. The annual report of operations of the Geological Survey shall accompany the annual report of the Secretary of the Interior. All special memoirs and reports of said Survey shall be issued in uniform quarto series if deemed necessary by the Director, but otherwise in ordinary octavos. Three thousand copies of each shall be published for scientific exchanges and for sale at the price of publication; and all literary and cartographic materials received in exchange shall be the property of the United States and form a part of the library of the organization: And the money resulting from the sale of such publications shall be covered into the Treasury of the United States."

On July 7, 1882, the following joint resolution, referring to all Government publications, was passed by Congress:

"That whenever any document or report shall be ordered printed by Congress, there shall be printed in addition to the number in each case stated, the 'usual number' (1,900) of copies for binding and distribution among those entitled to receive them."

Under these general laws it will be seen that none of the Survey publications are furnished to it for gratuitous distribution. The 3,000 copies of the Annual Report are distributed through the document rooms of Congress. The 1,900 copies of each of the publications are distributed to the officers of the legislative and executive departments and to stated depositories throughout the United States.

Except, therefore, in those cases where an extra number of any publication is supplied to this office by special resolution of Congress, as has been done in the case of the Second, Third, Fourth, and Fifth Annual Reports, or where a number has been ordered for its use by the Secretary of the Interior, as in the case of Mineral Resources and Dictionary of Altitudes, the Survey has no copies of any of its publications for gratuitous distribution.

ANNUAL REPORTS.

Of the Annual Reports there have been already published:

I. First Annual Report to the Hon. Carl Schurz, by Clarence King. 1880. 8°. 79 pp. 1 map.—A preliminary report describing plan of organization and publications.

II. Report of the Director of the United States Geological Survey for 1880–'81, by J. W. Powell. 1882. 8°. lv, 588 pp. 61 pl. 1 map.

III. Third Annual Report of the United States Geological Survey, 1881–'82, by J. W. Powell. 1883 8°. xviii, 564 pp. 67 pl. and maps.

IV. Fourth Annual Report of the United States Geological Survey, 1882–'83, by J. W. Powell. 1884. 8°. xii, 473 pp. 85 pl. and maps.

The Fifth Annual Report is in press.

MONOGRAPHS.

Of the Monographs, Nos. II, III, IV, V, VI, VII, and VIII are now published, viz:

II. Tertiary History of the Grand Cañon District, with atlas, by Clarence E. Dutton, Capt., U. S. A. 1882. 4°. xiv, 264 pp. 42 pl. and atlas of 24 sheets folio. Price $10.12.

III. Geology of the Comstock Lode and the Washoe District, with atlas, by George F. Becker. 1882. 4°. xv, 422 pp. 7 pl. and atlas of 21 sheets folio. Price $11.

IV. Comstock Mining and Miners, by Eliot Lord. 1883. 4°. xiv, 451 pp. 3 pl. Price $1.50.

V. Copper-bearing Rocks of Lake Superior, by Roland D. Irving. 1883. 4°. xvi, 464 pp. 15 l. 29 pl. Price $1.85.

VI. Contributions to the Knowledge of the Older Mesozoic Flora of Virginia, by Wm. M. Fontaine. 1883. 4°. xi, 144 pp. 54 l. 54 pl. Price $1.05.

VII. Silver-lead Deposits of Eureka, Nevada, by Joseph S. Curtis. 1884. 4°. xiii, 200 pp. 16 pl. Price $1.20.

VIII. Paleontology of the Eureka District, by Charles D. Walcott. 1884. 4°. xiii, 298 pp. 24 l. 24 pl. Price $1.10.

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The following are in press, viz:

IX. Brachiopoda and Lamellibranchiata of the Raritan Clays and Greensand Marls of New Jersey, by Robert P. Whitfield. 1885. 4°. ix, 338 pp. 35 pl.

X. Dinocerata. A Monograph of an Extinct Order of Gigantic Mammals, by Othniel Charles Marsh. 1885. 4°. —, — pp. 56 pl.

XI. Geological History of Lake Lahontan, a Quaternary Lake of Northwestern Nevada, by Israel Cook Russell. 1885. 4°. —, — pp. 46 pl.

The following are in preparation, viz:

I. The Precious Metals, by Clarence King.

Geology and Mining Industry of Leadville, with atlas, by S. F. Emmons.

Geology of the Eureka Mining District, Nevada, with atlas, by Arnold Hague.

Lake Bonneville, by G. K. Gilbert.

Sauropoda, by Prof. O. C. Marsh.

Stegosauria, by Prof. O. C. Marsh.

BULLETINS.

The Bulletins of the Survey will contain such papers relating to the general purpose of its work as do not properly come under the heads of ANNUAL REPORTS or MONOGRAPHS.

Each of these Bulletins will contain but one paper and will be complete in itself. They will, however, be numbered in a continuous series, and will in time be united into volumes of convenient size. To facilitate this each Bulletin will have two paginations, one proper to itself and another which be longs to it as part of the volume.

Of this series of Bulletins Nos. 1 to 18 are already published, viz:

1. On Hypersthene-Andesite and on Triclinic Pyroxene in Augitic Rocks, by Whitman Cross, with a Geological Sketch of Buffalo Peaks, Colorado, by S. F. Emmons. 1883. 8°. 42 pp. 2 pl. Price 10 cents.

2. Gold and Silver Conversion Tables, giving the coining value of Troy ounces of fine metal, etc., by Albert Williams, jr. 1883. 8°. ii, 8 pp. Price 5 cents.

3. On the Fossil Faunas of the Upper Devonian, along the meridian of 76° 30′, from Tompkins County, New York, to Bradford County, Pennsylvania, by Henry S. Williams. 1884. 8°. 36 pp. Price 5 cents

4. On Mesozoic Fossils, by Charles A. White. 1884. 8°. 36 pp. 9 pl. Price 5 cents.

5. A Dictionary of Altitudes in the United States, compiled by Henry Gannett. 1884. 8°. 325 pp. Price 20 cents.

6. Elevations in the Dominion of Canada, by J. W. Spencer. 1884. 8°. 43 pp. Price 5 cents.

7. Mapoteca Geologica Americana. A catalogue of geological maps of America (North and South), 1752–1881, by Jules Marcou and John Belknap Marcou. 1884. 8°. 184 pp. Price 10 cents.

8. On Secondary Enlargements of Mineral Fragments in Certain Rocks, by R. D. Irving and C. R. Vanhise. 1884. 8°. 56 pp. 6 pl. Price 10 cents.

9. A Report of work done in the Washington Laboratory during the fiscal year 1883–'84. F. W. Clarke, chief chemist; T. M. Chatard, assistant. 1884. 8°. 40 pp. Price 5 cents.

10. On the Cambrian Faunas of North America. Preliminary studies by Charles Doolittle Walcott. 1884. 8°. 74 pp. 10 pl. Price 5 cents.

11. On the Quaternary and Recent Mollusca of the Great Basin; with Descriptions of New Forms, by R. Ellsworth Call; introduced by a sketch of the Quaternary Lakes of the Great Basin, by G. K. Gilbert. 1884. 8°. 66 pp. 6 pl. Price 5 cents.

12. A Crystallographic Study of the Thinolite of Lake Lahontan, by Edward S. Dana. 1884. 8°. 34 pp. 3 pl. Price 5 cents.

13. Boundaries of the United States and of the several States and Territories, by Henry Gannett. 1885. 8°. 135 pp. Price 10 cents.

14. The Electrical and Magnetic Properties of the Iron-Carburets, by Carl Barus and Vincent Strouhal. 1885. 8°. 238 pp. Price 15 cents.

15. On the Mesozoic and Cenozoic Paleontology of California, by Dr. C. A. White. 1885. 8°. 33 pp. Price 5 cents.

16. On the higher Devonian Faunas of Ontario County, New York, by J. M. Clarke. 1885. 8°. 86 pp. 3 pl. Price 5 cents.

17. On the Development of Crystallization, etc., by Arnold Hague and J. P. Iddings. 1885. 8°. 44 pp. Price 5 cents.

18. On Marine Eocene, Fresh-water Miocene, and other Fossil Mollusca of Western North America, by Dr. C. A. White. 1885. 8°. 26 pp. 3 pl. Price 5 cents.

Numbers 1 to 6 of the Bulletins form Volume I, and numbers 7 to 14 Volume II. Volume III is not yet complete.

The following are in press, viz:

19. Notes on the Stratigraphy of California, by George F. Becker. 1885. 8°. 28 pp. Price 5 cents.

20. Contributions to the Mineralogy of the Rocky Mountains, by Whitman Cross and W. F. Hillebrand. 1885. 8°. — pp. 1 pl. Price — cents.

21. The Lignites of the Great Sioux Reservation, by Bailey Willis. 1885. 8°. — pp. 5 pl. Price — cents.

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STATISTICAL PAPERS.

A fourth series of publications having special reference to the mineral resources of the United States is contemplated.

Of that series the first has been published, viz:

Mineral Resources of the United States, by Albert Williams, jr. 1883. 8°. xvii, 813 pp. Price 50 cents.

The second volume of this series, Mineral Resources 1883 and 1884, is in preparation and will soon be put to press.

Correspondence relating to the publications of the Survey, and all remittances, which must be by POSTAL NOTE or MONEY ORDER, should be addressed

TO THE DIRECTOR OF THE
UNITED STATES GEOLOGICAL SURVEY,
Washington, D. C.

WASHINGTON, D. C., *May* 20, 1885.

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UNITED STATES GEOLOGICAL SURVEY

J. W. POWELL DIRECTOR

ON

MARINE EOCENE FRESH WATER MIOCENE

AND OTHER FOSSIL MOLLUSCA

OF

WESTERN NORTH AMERICA

BY

CHARLES A. WHITE M. D.

WASHINGTON

GOVERNMENT PRINTING OFFICE

1885

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ON FOSSIL MOLLUSCA OF WESTERN NORTH AMERICA.

By CHARLES A. WHITE

THE OCCURRENCE OF CARDITA PLANICOSTA LAMARCK IN WESTERN OREGON.

There is probably no species among all the known fossil mollusca concerning the geological age of which paleontologists are more in accord than *Cardita planicosta* Lamarck. It is a well-known form in the European Eocene, and it is quite as characteristic of the Eocene of our Atlantic and Gulf borders as of the Eocene of Europe. The European and the American specimens differ so little from each other that no one now pretends to question their specific identity. Both the European and the American strata furnish specimens of this species in abundance and great perfection, so that all the characteristics of the shell are well known. Its range of variation is not great, being mainly apparent in the extent of the obliquity of the axis and in the varying distinctness of definition of the ribs and their interspaces. In some cases the ribs upon the anterior part of the shell are broadly convex and the interspaces there are narrow and not sharply defined from the ribs at their sides. In the case of a few examples these characteristics are found to extend to other parts of the shell, but usually the ribs are more flattened and the interspaces are in the form of more or less sharply defined grooves between the ribs. In some cases the ribs and separating grooves are distinctly defined all the way from the beaks to the free borders of the valves; but in others the ribs and grooves, while they are well defined upon the umbonal and median portions of the valves, become obsolete before reaching their free borders. The character of the variation to which the surface markings of this species are thus seen to be subject is such that if it becomes excessive in any group of examples it is suggestive of a specific difference. The hinge is massive and constant in its characteristics.

Mr. Conrad recognized this species among the collections which were obtained some thirty years ago, by parties connected with the Pacific Railroad surveys,[1] from strata in California which have since received

[1] See Pacific Railroad Reports, Vol. V, pp. 317–329.

the name of the Téjon group. This group was referred to the Cretaceous period by the geologists of the State Geological Survey of California, but I have elsewhere given my reasons for regarding it as of Eocene age,[2] as Conrad, Marcou,[3] Heilprin,[4] and others have also done. The California *Cardita* just referred to, Mr. Gabb regarded as specifically distinct from *C. planicosta*, and he gave it the name of *C. hornii*.[5] I have seen only fragments of the California form, but judging from these and Mr. Gabb's description and figures I am inclined to regard it as a variety of *Cardita planicosta*, differing from the typical form only in the unusual broad convexity of all, instead of a part, of its ribs. The difference between the California specimens and the typical form of *C. planicosta*, as was shown by Mr. Gabb, consists mainly or wholly in this character of the ribs and their interspaces, and this I believe to be a case of extreme variation of *Cardita planicosta* which is not incompatible with specific identity.

Some specimens of *Cardita* which I am unable to distinguish specifically from *C. planicosta* have been lately received at the office of the Survey which were obtained from strata that are perhaps equivalent with those which bear *C. hornii*, and which appear to me to be intermediate between typical examples of that species and *C. hornii*. These specimens were collected by Prof. Thomas Condon, at the town of Albany, in the Willamette Valley, Oregon. They are numbered 13405 in the Catalogue of the U. S. National Museum. The stratum which contains these shells is an indurated dark colored shale, which was found a few feet beneath the surface of the ground in digging a cistern at Albany.

Unfortunately neither this stratum nor any known equivalent of it has been recognized elsewhere, and as the stratum was not exposed at the surface where the discovery was made, and the digging was not continued through it, nothing is definitely known of its stratigraphical relations. Strata which bear characteristic Miocene fossils are found in the valley of the Willamette only a few miles away, but so far as I am aware no strata have hitherto been found in any part of Oregon which bear *Cardita planicosta*, nor any nearly related form. Unfortunately, also, although a dozen or more of the shells of the *Cardita* were obtained, only a few fragments of other shells were found associated with them. Some of these apparently represent a species of *Crassatella*, but further than this they have yielded no definite information.

Three of the valves found at Albany are represented on Plate I. These specimens have been chiseled out of the matrix in which they were embedded, and their natural surface has therefore been somewhat injured, but enough remains in its natural condition to give a fair illus-

[2] See Bull. U. S. Geol. Survey, No. 15.

[3] See Bull. de la Société Géologique de France (3), T. XI, 1883, pp. 407–435.

[4] Proc. Acad. Nat. Sci. Phila. for 1882, pp. 195–214; also Cont. Ter. Geol. and Paleont. U. S., pp. 102–116.

[5] Paleontology of California, I, p. 174, Pl. 24, Fig. 157; also II, p. 187, Pl. 30, Fig. 83.

tration of the surface characters of the shell. The vertical diameter of two of these illustrated specimens is proportionally less as compared with the transverse diameter, than is usual with typical examples of *C. planicosta*, but that of one of them is not, and several of the other associated specimens have also the usual dimensions. None of the Oregon specimens show the hinge in a sufficiently perfect condition to afford a good figure of it, but some of them exhibit the hinge characters so plainly as to make it evident that this far western shell does not differ in respect to the hinge from the typical examples of *Cardita planicosta*. I do not therefore hesitate to refer it to that species.

The discovery of these shells in Western Oregon possesses more than ordinary interest for several reasons. First, it adds materially to our knowledge of the already known wide geographical range of *Cardita planicosta*. Second, it is (if we except the *Cardita hornii* of Gabb) the first recognition of that species in the Pacific coast region that has been made. Third, *Cardita planicosta* being regarded by all paleontologists as of Eocene age, its discovery in Oregon indicates the existence there of the Eocene formation, of which no other indication is now known. It is not improbable that the stratum from which these fossils were taken represents a portion of the Téjon group of California. No evidence of it, however, is at present known other than that which is suggested in the preceding paragraphs and by the probability that the Oregon specimens and the *C. hornii* of Gabb are only varieties of *Cardita planicosta*.

FOSSIL MOLLUSCA FROM THE JOHN DAY GROUP IN EASTERN OREGON.

Some two years ago Prof. E. D. Cope placed in my hands a small collection of fossil mollusks, which were obtained by Mr. Jacob L. Wortman, of the Army Medical Museum, from a lacustrine deposit in Eastern Oregon which has come to be known as the John Day group. Professors Leidy,[6] Marsh,[7] and Cope[8] have described vertebrate fossils from that deposit, which has been referred by those authors to the Miocene; and by Professors Leidy and Cope it has been regarded as equivalent with the White River group of Dakota. Mr. King regarded it as equivalent with his Truckee group,[9] which occurs in the valley of Snake River, in Southeastern Oregon, and also in Northern Nevada.

Last summer, also, Prof. Thomas Condon, of the University of Oregon, presented to the Survey a small collection of shells which he obtained from the John Day group at or near the same locality as that from which Professor Cope obtained his specimens. Professor Condon found those shells associated with the vertebrate fossils which were described by Professor Leidy (*loc. cit.*), and Mr. Wortman also found the mollusks associated in the same layers with the vertebrate remains. Upon Prof. Condon's label accompanying these shells he designates the locality as "the North Fork of John Day River, Oregon, at the angle of the big bend, longitude 119° 40′, latitude 44° 50′. Professor Condon's collection embraces the same species which Professor Cope's contained, but no others.

These collections contain one, and perhaps two, species of *Unio* and four or five species of pulmonate gasteropods, which latter I refer to the Helicidæ; but no other invertebrate forms were found associated with them. The John Day deposit being of lacustrine origin one could not expect to find it containing the remains of an extensive molluscan fauna, as compared with the faunas of marine deposits; but these small collections do not embrace so wide a variety of forms as lacustrine faunas usually present. No gill-bearing, nor palustral pulmonate gasteropods are found among them, and all bivalve mollusks, except the Uniones which have just been mentioned, are also absent. It is therefore quite apparent, from a zoological point of view, that these collections represent only a part, and probably only a small part, of the

[6] See Vol. I, U. S. Geol. and Geog. Survey of the Terr., 1873.

[7] See American Journal of Science, Vol. IX (3), p. 52.

[8] See Vol. III, U. S. Geol. Survey of the Terr., 1884.

[9] See U. S. Geol. Expl. 40th Parallel, Vol. I, p. 423.

land and fresh water molluscan fauna which existed in and about the lake in which the John Day strata were deposited.

The Uniones of these collections are of the plain oval, unornamented type, such as is common to the fresh-water deposits of all the epochs from the Cretaceous period to the present time. The land snails, which are represented on Plate III, are not only of modern types, but at least three of the species are, in my opinion and that of Dr. R. E. C. Stearns, too near like living forms to warrant one in giving them new specific names.

It is so apparent, from the evidence furnished, that these fossil forms represent the living species ancestrally that one may reasonably make the same use of them, with reference to their genetic history, as if the continuity of that history were known by actual observation. These forms, whose genetic history and specific identity have so evidently been continued in unbroken lines from the John Day epoch to the present time, have endured remarkable vicissitudes of physical conditions as well as considerable geographical dispersion since Miocene time. Some of the changes which have taken place in that region since then are very remarkable. One of the greatest volcanic outflows which the earth has known, covering thousands of square miles with melted rock and forming the great mountains of the Cascade range, occurred in and near that region since those mollusks lived upon the borders of the John Day lake. The Glacial epoch has come and gone since then, and an immense subaerial erosion has taken place over the whole region, the extent of which one cannot comprehend without witnessing its results. Not a mammalian species or genus now exists indigenously upon the North American continent that existed then, and all other vertebrate forms of continental life have materially changed; but living descendants of those land snails are thriving to-day in the same region and under the same specific forms that their remote ancestors bore.

The Truckee group, which King referred to the Miocene, and which has already been mentioned, also contains a small molluscan fauna all the members of which belong to other families than those which are represented by the mollusca of the John Day deposit which are at present known.[10] It may be that none of the species which are known to exist in one of these groups will ever be found in the other; but that representatives of the families which are missing from each may yet be found in the other is to be expected, because those missing families are such as are usually represented in lacustrine waters. The probabilities that the land mollusca of the John Day deposit may yet be found in the Truckee and other Miocene deposits of Western North America are, in my opinion, greater than that any of the gill-bearing mollusca of one should be found in the other if, as is supposed, those deposits were

[10] See Proc. U. S. Nat. Museum, V, pp. 99-102, Pl. V; also Third Annual Report of the U. S. Geological Survey, Pl. XXXII.

formed in separate hydrographic basins; because the distance between those supposed basins was not so great as to prevent the free dispersion of land mollusks across the intervening space.

It is true that the fauna of the Truckee group contains types of gill-bearing mollusca which are now extinct upon this continent; but this does not necessarily prove that it is older than the John Day fauna, because a considerable part of the living fresh-water types of North American mollusks are known to extend back to much earlier epochs.[11] I have elsewhere shown the probability that the latter had direct and continuous fluvatile habitat from those early times to the present, while the Truckee fauna probably lived in a lake whose waters were not continued in fluvatile streams to the present time, as other lacustrine waters were, after they had ceased to exist as a lake by the deepening of its outlet. The Truckee hydrographic basin, with its gill-bearing molluscan fauna, was probably destroyed as a result of the changes which attended the great volcanic outflows which have just been referred to, while contemporaneous, and even older, lacustrine waters, further eastward, were perpetuated in a fluvatile condition to the present time.

Whether the John Day, Truckee, and other lacustrine deposits which have been referred to the Miocene epoch were all really synchronous or not, must be shown by other evidence than that which the remains of mollusca, and especially land mollusca, have yet furnished, or that they are ever likely to furnish. The facts to which I have alluded show that during a part, and probably all, of the epochs which have passed since the closing portion of the Cretaceous period, quite dissimilar gill-bearing molluscan faunas existed contemporaneously upon the North American continent, a part of which faunas were closely related to living faunas and a part were not. Therefore such dissimilarity does not necessarily prove a difference of age. Again, a considerable proportion of the fresh-water and land mollusca now living in North America belong to tpyes which have been found fossil in the later Cretaceous, earliest Tertiary, and in subsequent strata; and some of the forms which have lived in these different epochs are so nearly like living species that they cannot be satisfactorily separated from them. Therefore such forms alone cannot be relied upon to prove the synchronous origin of the formations which respectively contain them.

It is evident that ever since land mollusca existed they have been very slow to change, even as regards their specific forms, and in all those continental areas whose fluvatile systems have been preserved through a series of epochs, the fresh-water gill-bearing mollusca also have been almost as slow to change as the land mollusca have been. Although the value of the fossil remains of land and fresh-water mollusca is thus seen to be much less than that of the fossil remains of ma-

[11] See Third Annual Report U. S. Geological Survey, pp. 481–486.

rine mollusca, as indices of the geological age of the strata containing them, they are still of much value in local geology, and they are of great importance in biological investigations.

Few as they are, the representatives of the John Day molluscan fauna, which are illustrated on Plates II and III, possess a good degree of interest in several respects. They not only all belong to types which are now living in or near the same region where the fossil forms are found, but a part of the latter are so nearly like living species that, as before said, I have not thought it advisable to separate them. The species are all different from any that have hitherto been know in a fossil condition. The extraordinary physical changes which have taken place in that region since Miocene time seem not to have interrupted the continuous existence there of the large and varied land molluscan fauna which existed in the John Day epoch. Nearly related as are these fossil forms to living land mollusca, they are found associated with mammalian remains which belong to extinct species, genera, and families, and it is therefore by means of the latter that their antiquity is shown.

UNIONIDÆ.

Genus UNIO RETZIUS.

Unio condoni, sp. nov.

(Plate II, Figs. 1, 2, and 3.)

Shell transversely subelliptical in marginal outline, short in front of the beaks, elongate, and narrowing behind them to the posterior end; valves moderately, but somewhat irregularly convex; basal margin nearly straight, but having a slight emargination a little behind the mid-length; front margin regularly rounded; dorsal margin broadly convex; posterior margin sloping backward and downward above, and narrowly rounded below; beaks broad, depressed, and situated near the front of the valves, often much eroded; umbonal region broad and prominent. Surface plain except that upon the antero-basal portion of each valve a number of crenulated radiating lines appear. (Museum No. 13404.)

Length, 90 millimeters; greatest height, 53 millimeters.

The specimens are all in a damaged condition, so that all the specific characters have not been clearly ascertained. The relative length and height of the shell appears to be subject to considerable variation, which is probably due in part to sex and in part to difference in age, the young, in all cases, having been proportionally shorter than the adult shells. A conspicuous feature of this species is its broad, prominent umbones, rising above the depressed beaks. The extensive erosion which the beaks of most of the specimens have suffered, and which evidently occurred while the animal was living, is also worthy of note.

The amount of the erosion is no greater than often occurs upon the shells of living fluvatile unios, but among the fossil species of North America eroded beaks have seldom been observed.

The specific name is given in honor of Prof. Thomas Condon, who discovered the specimens which are figured on Plate II.

HELICIDÆ.

The Helicidæ of the John Day fauna, which are mentioned in the foregoing and following paragraphs, and figured on Plate III, I submitted to Dr. R. E. C. Stearns, whose familiarity with that family, and especially as it is developed in Western North America, is well known. His comments upon the same will be found under the head of the respective species on the following pages.

Helix (Aglaia) fidelis Gray.

(Plate III, Figs. 1, 2, and 3.)

The following are Dr. Stearns's remarks upon this form:

"This fossil form at once suggests the well known and widely distributed living species *Helix* (*Aglaia*) *fidelis* Gray, of Western North America. A careful comparison of it with the very large geographical suite of that species, which includes a great number of localities within its known area of distribution, verifies the suggestion. The only objection that I can anticipate as likely to be made is that the umbilicus, in the most perfect of the fossil examples, is closed; but in the specimen referred to there is some evidence of mechanical flattening, as if by external pressure. Aside from this, a critical examination of the large suites in the United States National Museum (the Stearns collection) shows a great range of variation in that character. While in some specimens the umbilicus is widely open, in others it is so nearly covered that a slightly increased deposit of callus in the umbilical region would so completely seal it as to make it imperforate. My conclusion is that these fossil specimens may be safely attributed to *Helix* (*Aglaia*) *fidelis*." (Museum No. 13400.)

Helix (Patula) perspectiva Say.

(Plate III, Fig. 7.)

The collections contain only one example of this form, which is somewhat damaged. Dr. Stearns observes that this specimen, "in the number and closeness of its whorls and general aspect, although somewhat distorted by compression, points directly to the living species *Helix* (*Patula*) *perspectiva* Say." (Museum No. 13402.)

Helix (Monodon?) dallii Stearns (MS.).

(Plate III, Figs. 4, 5, and 6.)

Dr. Stearns regards this form as an undescribed one, and he has accordingly furnished me with the following description of it, together

with some remarks upon its nearest allies, as indicated by his large collections:

"Shell elevated, subconical, base flattened-convex, imperforate; umbilical region depressed. Lip moderately thickened and reflected. Surface traversed by fine incremental lines, and also marked by minute pits (cicatrices?) as seen under a magnifier, indicating that it had a hirsute epidermis. Whorls six to six and a half, rounded and gradually increasing. Suture quite distinct. Aperture rounded, lunate.

"Of the three specimens submitted to me for examination the foregoing description is made from the most perfect. A comparison of the three exhibits the following differences:

" Maximum height, 0.63, 0.52, 0.60 inches; maximum diameter, 0.85, 0.79, 0.85 inches. Apical angle about 95.

" Mr. Tryon, to whom I submitted this form, regards it as allied to the West Polynesian groups *Chlorea* and *Geotrochus*, and still more closely allied to the group *Artemon* of *Streptaxis*. After a careful comparison of this fossil form with the living Helices of the west coast of North America, I find that while the former is larger than any specimens of *Helix* (*Mesodon*) *columbianus* that I have seen, and differs from that species in the matter of the umbilicus, and in having a less reflected lip, in other respects it presents many of the characters of the latter, especially in the following particulars: In general aspect (size and umbilicus excepted), apical angle, when compared with elevated individuals; number of whorls and convexity of the same; sutural definition; ratio of increase in the size of the whorls; basal convexity; and finally in the shape of the aperture.

"*Helix* (*Mesodon?*) *dallii* suggests an ancestral form from which have proceeded such living representatives as are known by the names of *Helix columbianus*, *H. devia*, and varieties *H. germana*, etc. Of these well-known forms the first, *H. columbianus*, dominates through the greater portion of its geographical domain. Its distribution is northerly to Lituya Bay, Alaska (Dall), where it is found on the forest-clad benches which extend from the base of the Mt. St. Elias Alps westerly to the Pacific Ocean, in latitude 59°. Southerly it extends to the region around Monterey Bay, California, (Hemphill), latitude 36°; and if *H. devia* variety, from Salmon Springs, Idaho (Hemphill), may be regarded as so nearly related to *H. columbianus* as to warrant its being placed as a variety of the latter, then the range of the species is eastward to the meridian of 116°. Individuals which unquestionably belong to *H. columbianus* have been collected at or near the Dalles of the Columbia River, near the 121st meridian. There is reason to believe that the southern boundary of its range may be placed still further south, even to the region bordering upon the Santa Barbara Channel, south of latitude 34°. (Museum No. 13401.)

"I have proposed for the specific name of this interesting form that of the eminent conchologist, Mr. W. H. Dall."

Genus GONOSTOMA Held = AMMONITELLA Cooper.

Gonostoma yatesii Cooper.

(Plate III, Figs. 8, 9, 10, 11 and 12.)

The collections contain four specimens of this form, all of them imperfect, but together they show quite satisfactorily its specific and generic characters. Dr. Stearns remarks of these specimens as follows: "They belong to the *Gonostoma* group of the Helicidæ. I have compared them with a suite of the species described by Dr. Cooper, *G. yatesii*, and although the fossil examples are considerably larger than any of these recent ones, I am unable to detect any other difference. This generic form, which was originally published under the name of *Ammonitella* by Dr. Cooper, was discovered in a cave near Cave City, Calaveras County, California, by Dr. L. G. Yates. It has not been found living elsewhere. Comparatively few examples have ever been found, and it is rare in the best collections." (Museum No. 13403.)

SUPPLEMENTARY NOTES ON THE NON-MARINE FOSSIL MOLLUSCA OF NORTH AMERICA.

In the work entitled "A Review of the Non-Marine Fossil Mollusca of North America," which was published in the Third Annual Report of the United States Geological Survey, and also separately, it was my intention to make mention of and to figure all the fossil species of those mollusks which were then known, and to present some remarks upon their respective geological and zoological relations. The object of that work was not to revise the species which had been published, but to give a concise synopsis of all the brackish and fresh-water and land mollusca which had been found in a fossil condition, excepting only those which are found in the Post-Tertiary deposits, all the known forms of which are regarded as identical with living species, and also to present some general discussions concerning them. Since the publication of that work it has appeared that some things were omitted which it ought to have contained, and also a few erroneous statements were inadvertently made therein. Some additions to our knowledge of the forms which the scope of that work embraced have been made and published since then. The object of this article is to supply those omissions and to correct the errors of statement just referred to and also to present figures of the species which have been published since that work appeared, with remarks upon them.

ADDITIONS.

The scope of the "Review," as it was originally planned, did not include any living species, although such might have been found in a fossil as well as in a living condition; but some living species of land and fresh-water mollusks are known to extend back into the Tertiary period, and these, at least, ought not to be excluded. Three of the species which are described and figured in the preceding article, although they were discovered among vertebrate remains of Miocene age, are regarded as identical with living forms. They ought, therefore, to be added to the list of North American non-marine mollusca, together with the two species therein described as new.

Besides the five species which are described and figured in the preceding article of this bulletin, three non-marine species have been published by Mr. C. D. Walcott, of the United States Geological Survey. They were obtained by him from the base of the Carboniferous series

in the Eureka mining district, Nevada; and he has given to them the following names: *Ampullaria? powelli*, *Physa prisca*, and *Zaptychius carbonaria*.[12] These three species were published with figures in Science, Vol. II, p. 808 (1883), and also in Monograph VIII of the United States Geological Survey, pp. 261–263 (1885).

These shells are especially interesting on account of their great geological age and the evidence which they present of the great antiquity of two of the common fresh-water genera among living mollusks. Pulmonate gasteropods belonging to the Geophila have long been known in Carboniferous strata, but these are the first fresh-water gasteropods that have yet been found in North American strata of that age.

There seems to be no room for doubt that the shell which Mr. Walcott refers to *Physa* is a typical species of that genus, nor that the animal which formed it was in all essential respects like its living congeners. The form which he refers with doubt to *Ampullaria* apparently belongs to that genus; and its association with *Physa* favors this view of its generic character. *Zaptychius* is a new genus proposed by Mr. Walcott, which appears to belong to the Auriculidæ. It is therefore suggestive of a more or less brackish condition of the water in, or near which it lived.

Under the head of "Spurious and Doubtful Species," as treated in the "Review," mention should have been made of an Alaskan shell which Eichwald referred to the *Unio martini* of d'Orbigny. The shell in question was one of the collection which was made in Alaska by Peter Doroschin, and which was published by Dr. E. von Eichwald in a work entitled "Bemerkungen ueber der Halbinsel Mangischlak und die Aleutischen Inseln," page 168, Plate XVI, Figures 28 and 29. The specimen which he figures and describes, and which appears to have been the only one of the kind found by Doroschin, is less than a centimeter long, and is only a natural cast of the interior of the shell. Its generic identity could not therefore have been determined with certainty; and even if it had been found associated with a fresh-water fauna, it would have been impossible for any one to say with certainty that it belongs to the genus *Unio*, much less to say to what species it belongs. Having been found associated with *Ammonites* it is without doubt a marine shell and therefore not a *Unio*, and mention is made of it here only because it was referred by Eichwald to that fresh water genus.

CORRECTIONS.

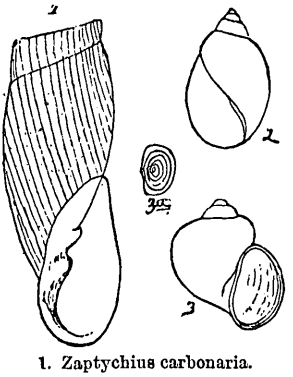
On page 459 (53) of the "Review," I have said: "Although *Cerithidea* is a well known living genus of the Old World, this species at present stands alone, or without near known allies, either living or fossil, among North American mollusca, if its generic relations are correctly under-

[12] See figures on next page.

stood, as stated above." That the shell referred to (*Cerithidea nebrascensis* Meek & Hayden) does thus stand alone as a distinct type, I still think is true; but the implied statement that there are no living species of *Cerithidea* in North America is an error. Several typical species of that genus are known to exist on both coasts of the southern part of North America. None of those species, however, nor any other North American forms known to me, either fossil or living, are of the type of the fossil form referred to. Meek & Hayden placed it with doubt in the subgenus *Pirenella*, but it seems to be more like a true *Cerithium*.

Again, on page 423 (17) of the "Review" I have said that the genus *Dreissena* van Beneden "is not known to be represented in North America by a single species, either living or fossil." At that time I regarded the *D. leucopheata* of Conrad, which is found along our Atlantic coast, together with a similar if not identical form found in Florida, as belonging to the genus *Modiola*. The animal of these forms has not yet been studied, but conchologists now generally accept them as species of *Dreissena*.

On page 469 (63, of the "Review," eighteenth line from the top, for "*Campeloma multistriata*" read *Campeloma multilineata*.



1. Zaptychius carbonaria.
2. Physa prisca.
3. Ampullaria? powelli.
3*a*. Operculum of the same.

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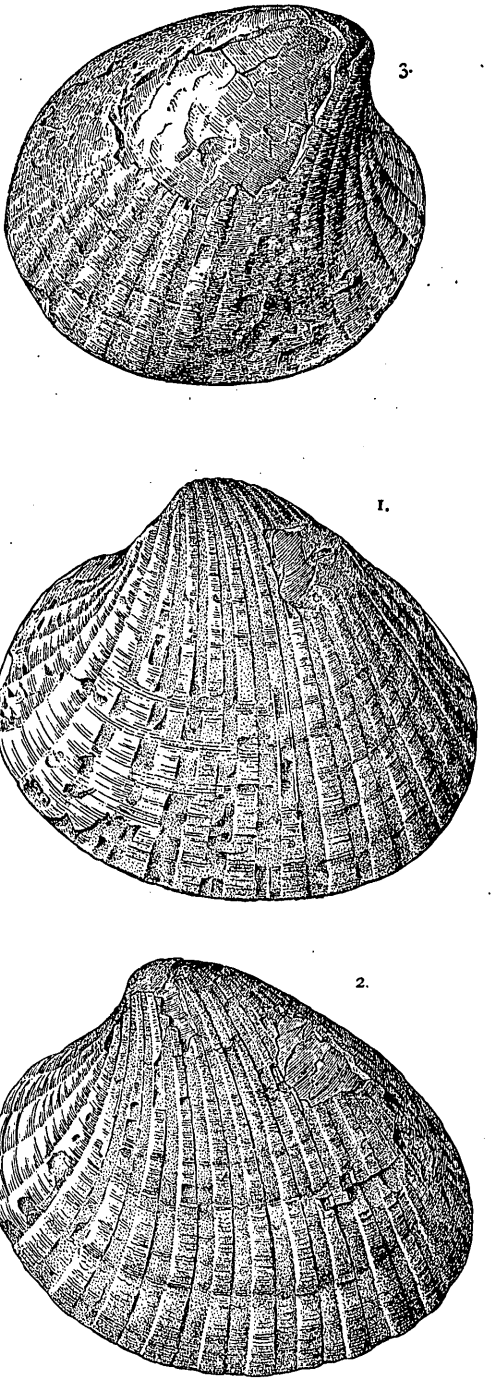
EXPLANATION OF PLATES.

PLATE I.

CARDITA PLANICOSTA.

Fig. 1. Lateral view of a left valve.
Fig. 2. Similar view of another left valve.
Fig. 3. Similar view of a right valve.

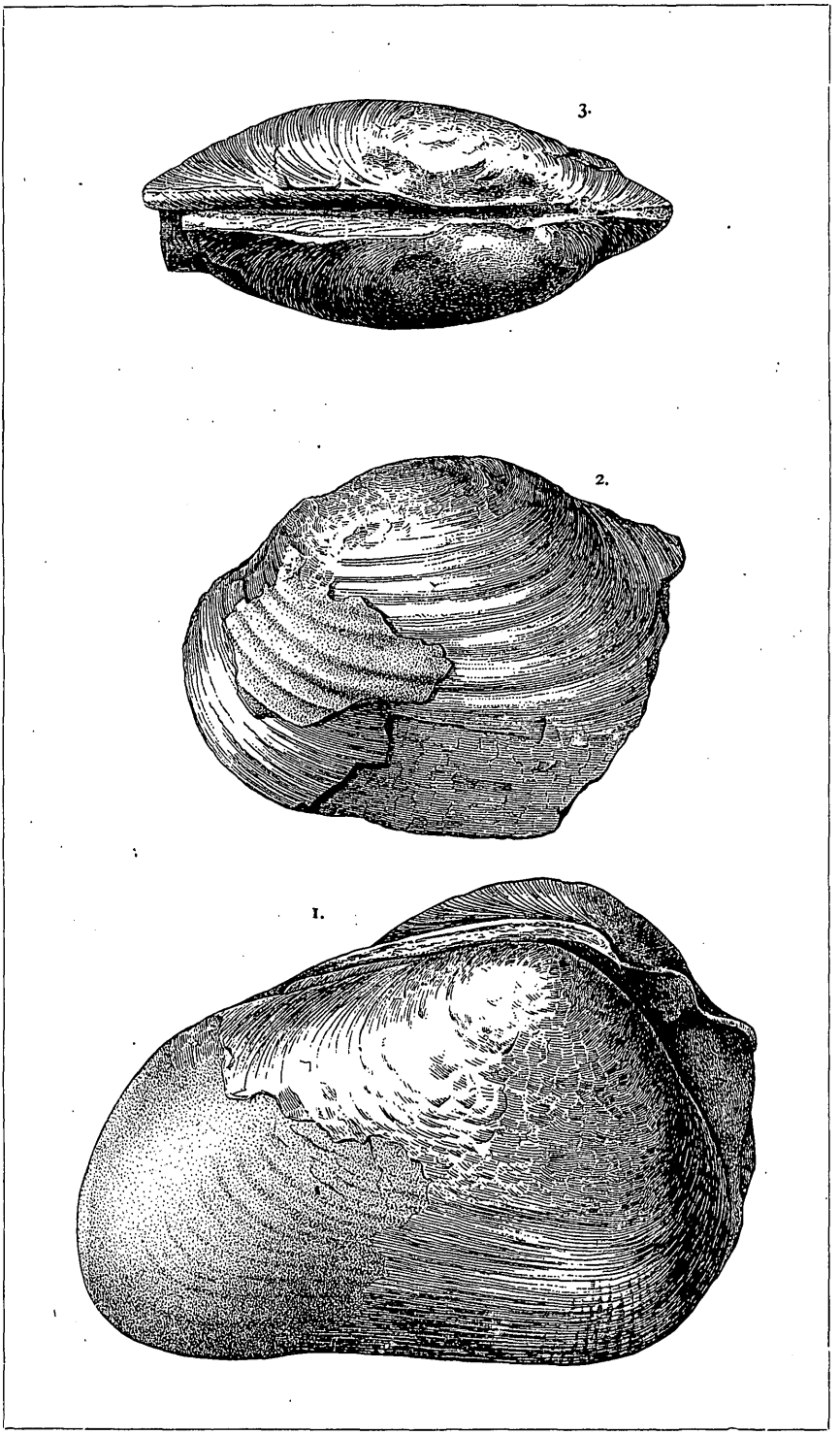


CARDITA PLANICOSTA.

PLATE II.

UNIO CONDONI.

Fig. 1. Lateral view of a right valve and part of a left valve.
Fig. 2. Right side view of an imperfect example, showing eroded beak.
Fig. 3. Vertical view of Fig. 2. All of natural size.



UNIO CONDONI.

PLATE III.

HELIX (AGLAIA) FIDELIS.

Figs. 1, 2, and 3. Lateral, vertical, and basal views of the same individual.

HELIX (MESODON?) DALLII.

Figs. 4, 5, and 6. Lateral, vertical, and basal view of the same individual.

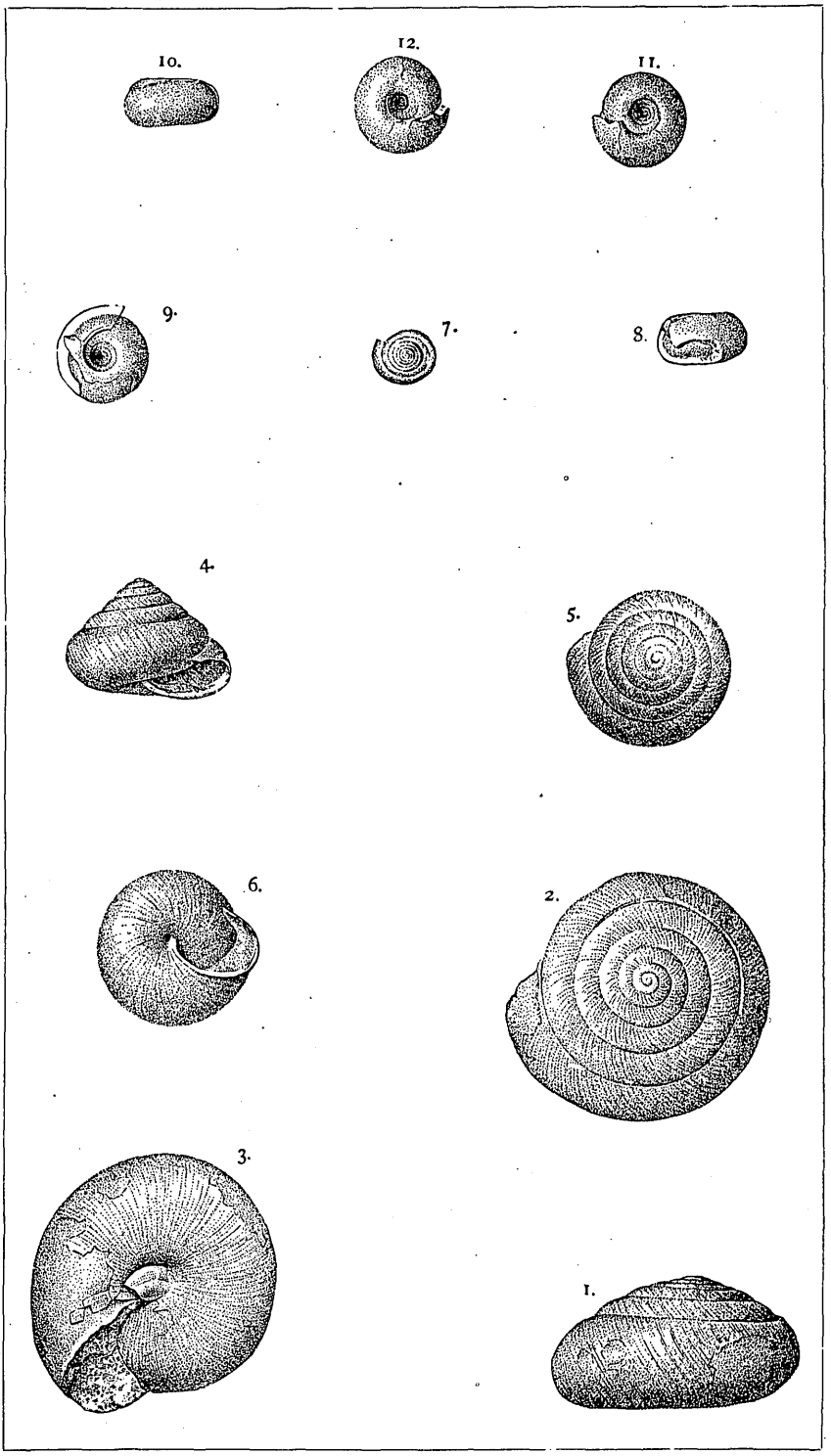
HELIX (PATULA) PERSPECTIVE.

Fig. 7. Vertical view of an imperfect example.

GONOSTOMA YATESII.

Figs. 8 and 9. Lateral and vertical views of an imperfect example.

Figs. 10, 11, and 12. Lateral, vertical, and basal views of another imperfect example.



HELICIDÆ.

NOTICE.

The bulletins of the United States Geological Survey will be numbered in a continuous series and will be bound in volumes of convenient size.

This bulletin will be included in Volume III.