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ANNALS

OF THE

LYCEUM OF NATURAL HISTORY.

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OF THE

NINTH VOLUME.

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ANNALS

OF THE

LYCEUM OF NATURAL HISTORY.

I.—*Notes on the Later Extinct Floras of North America, with Descriptions of some New Species of Fossil Plants from the Cretaceous and Tertiary Strata.*

By J. S. Newberry.

Read April 22d, 1867.

The Cretaceous Flora of North America.

It is only within the last ten years that we have obtained any information whatever in regard to the nature of the vegetation which clothed the land that represented North America during the Cretaceous period. Previous to that time large collections of fossils had been made from rocks of that age on the Atlantic and Gulf coasts, but the beds which furnished them were marine sediments, and the fossils they contained were principally mollusks and radiates, but included also fragments of skeletons of Cretaceous saurians, *Mosasaurus*, *Hadrosaurus*, &c., and teeth of *Ptychodus*, a Selachian fish. In these remains there was found a generic correspondence with those of the middle and upper Cretaceous beds of the Old World, and many species were recognized as the same found there. In 1855, Dr. F. V. Hayden made the second of his numerous journeys into the country bordering the upper Missouri, which have resulted in such important contributions to our knowledge of the geology of the interior of the continent. At this time he was connected as Geologist and Naturalist with an exploring party sent out by the War Department under command of Lieut. (now Gen.) G. K. Warren, Corps of Topographical Engineers, U. S. A.

In the great mass of interesting materials brought by Dr. Hayden, were a number of angiospermous leaves obtained from a red sandstone lying at the base of the Cretaceous formation at Blackbird Hill, in Nebraska. Outline sketches of some of those leaves were sent to the distinguished fossil Botanist, Prof. Oswald Heer, of Zurich, Switzerland. By him they were pronounced of Miocene age, and referred to the genera *Laurus*, *Populus*, *Liriodendron*, &c.; a narrow lanceolate leaf, being considered identical with *Laurus primigenia*, Ung.; a broad rounded one, with *Populus Leuce*, Ung., both found in the Miocene of Europe. At the same time the fossils themselves were submitted to me for examination, and, regarding the so-called *Populus Leuce* as generically identical with some large rounded leaves described by Zenker from the Cretaceous sandstone of Blankenburg, Germany, I considered this florula as of Cretaceous age—confirming the conclusions of Messrs. Meek and Hayden, who on other evidence had referred the deposit from which they came to that period. The plant called *Laurus primigenia* by Prof. Heer, I considered a *Salix*, and the other leaves, as representing the genera *Platanus*, *Populus*, *Fagus*, *Liriodendron*, *Sassafras*, *Magnolia*, &c. Unfortunately, Prof. Heer had only sketches, and those of but part of these leaves; and while I had the specimens all before me, I had no specimens of the Cretaceous flora of Europe, but only figures and descriptions of the comparatively few leaves up to that time found in this formation by Zenker, Dr. Debey, Steihler, and others. It was therefore quite impossible that we could then make an intelligent comparison of the two floras. The genera recognized among these plants by Prof. Heer and myself were, for the most part, living in our forests, and largely represented in the Miocene strata of Europe. It is not surprising, therefore, that Prof. Heer should have considered them of Tertiary age, and that this opinion should be shared by many others.

Soon after the discovery of these plants by Dr. Hayden, he went again to Nebraska and Kansas, accompanied by Mr. Meek, and collected from various exposures of Lower Cretaceous sandstone numerous additional specimens of the same and different species. Subsequently, I went myself to the region where these were collected, and spent some years in the study of the geology of the interior of the continent, exploring a large area occupied by Cretaceous rocks, in Kansas, Colorado, Arizona, New Mexico, and Utah. During these explorations I obtained from the Cretaceous strata, at a great number of localities, angiospermous leaves, consisting of some of the species obtained by Dr. Hayden, with many others, all of which are described in the report of the San Juan expedition, not yet published. In numerous instances, as Dr. Hayden had done, I obtained these leaves from the sandstones overlaid by calcareous beds containing *Gryphæa Pitcheri*, *Inoceramus problematicus*, and many other unmistakable Cretaceous fossils. These leaves I found to be characteristic of the strata in which they were first discovered, and was able to obtain them at nearly every exposure which I examined. In the end I had before me, collected by Dr. Hayden and myself, at least fifty distinct species of leaves of this character from this horizon, with fragments, scarcely sufficient for description, of perhaps as many more.

Though Mr. Meek, Dr. Hayden and myself had thus demonstrated the true position first taken by us in regard to the age of the beds which furnish these leaves, the flora they represented was so modern in its character that the European palæontologists were still unwilling to admit the possibility of its being older than Tertiary; and it was only when, in 1863, M. Marcou and Prof. Capellini made a special journey to Nebraska, and collected fossils from the same localities that had yielded them to Meek and Hayden, that the fact was admitted that this flora was really of Cretaceous age.

The plants collected by Messrs. Marcou and Capellini embraced sixteen species, which have been described by Prof. Heer in the "Memoires de la Société Helvetique des Sciences Naturelles, 1866;" viz.: *Populus litigiosa*, *P. Debeyana*, *Salix nervillosa*, *Betulites denticulata*, *Ficus primordialis*, *Platanus* (?) *Newberryana*, *Proteoides grevilliæformis*, *P. acuta*, *P. daphnogenoides*, *Aristolochites dentata*, *Andromeda Parlatorii*, *Diospyros primæva*, *Cissites insignis*, *Magnolia alternans*, *M. Capellinii* and *Liriodendron Meekii*.

It is an interesting fact that of these sixteen species, but three are identical with those obtained before from the same quarries, or those collected by myself elsewhere at the same geological horizon—an illustration of the richness of the flora which they represent. My own observations prove this richness still more clearly, for, as I have said, in the outcrops of the Lower Cretaceous rocks at the West, I have detected at least a hundred species of conifers and angiospermous trees. Of these it rarely happened that, in the chance exposure of a cliff or water-washed surface, anything like a perfect specimen could be detached and brought away. As a consequence we have, in the figures and descriptions now published or prepared, but a very imperfect view of the flora of the Cretaceous period on this continent, even as it has been exhibited to my eyes; and there is every reason to believe that but a small proportion of its elements have as yet been observed at all.

On the western margin of the continent it is well known that the Cretaceous strata are quite largely developed; having been recognized in Sonora, California, Oregon, Washington Territory, and Vancouver's Island. From the latter locality quite a number of fossil plants have been collected, which have been described by Prof. Heer, Mr. Lesquereux, or myself. The first knowledge which we obtained of the Cretaceous beds of Vancouver's Island was derived from the descriptions by Mr. Meek (Transactions of the Albany Institute, vol. 4, p. 37) of some fossil mollusks collected by Dr. Turner. Subsequently, in 1858, the collections made by the United States Northwest Boundary Commission were placed in my hands for examination. These included fossil plants from the coal beds of Nanaimo, Vancouver's Island, which were associated with *Inoceramus*, *Pholadomya*, etc., before described by Mr. Meek, and which plainly indicated their Cretaceous age. These plants were described by the writer in 1863 (Boston Journal of Natural History, vol. 7, No. 4). Previous to that time the fossil plants collected by Dr. Evans, United States Geologist for the Territory of Oregon, were committed to Mr. L. Lesquereux, the well-known Botanist, who published descriptions of them in the American Journal of Science. Of these the following were from Nanaimo, viz.:

Populus rhomboidea,	Lesqx.
Quercus Benzoin,	"
Quercus multinervis,	"
Quercus platinervis,	"
Salix Islandicus,	"
Cinnamomum Heerii,	"
Ficus *sp.*	"

with which are enumerated, but not described in full, "a *Platanus* with the same nervation as *Quercus platinervis*," a *Chamaerops* agreeing with *Sabal Lamanonis*, Brgt., common in the European Miocene, a very fine *Salisburia*, very variable in the outline of its leaves, and named *Salisburia polymorpha*, also a small piece of a fern referable to the genus *Lastrea*, and a *Sequoia* probably identical with *S. sempervirens*."

The Bellingham Bay plants described by Mr. Lesquereux consisted of species of *Smilax*, *Quercus*, *Planera*, *Cinnamomum*, *Persoonia*, *Diospyros*, and *Acer*. By Mr. Lesquereux the plant-bearing strata of Bellingham Bay and Vancouver's Island were regarded as of the same age, and from the resemblance of the species they contain to those found in the Miocene of Europe, he pronounced them to be of that date (Op. Cit. vol. xxvii., p. 362). In a subsequent number of the American

Journal of Science (vol. xxviii., p. 85), is published a letter from Prof. Heer upon these plants, of which sketches had been sent him by Mr. Lesquereux. In these notes the extinct flora of Vancouver's Island and Bellingham Bay are considered of the same age, and brought still nearer the Miocene of Europe; quite a number of species being regarded as identical with those found at Oeningen, &c.

Since that time a collection of fossil plants made by Dr. C. B. Wood, at Nanaimo, V. I., and at Buzzard's Inlet, British Columbia, was sent by Dr. Hooker to Prof. Heer for examination. From the coal mine at Nanaimo but a single species of this collection was obtained; a conifer, considered by Prof. Heer as identical with *Sequoia Langsdorfii*, Br. sp., a species common in the Miocene of Europe. From these facts it will be seen that the modern aspect of the fossil flora of Vancouver's Island has produced the same misapprehensions as the Cretaceous flora of Nebraska. This, however, is not to be wondered at, and conveys no reproach to the eminent scientific men who have been misled by it. The identification of species by few and fragmentary specimens, or still worse by sketches, is a difficult and hazardous task for any one to perform; and in regard to the generic relations of the plants described, it can only be said that previous to the discovery of such modern genera as *Liriodendron*, *Magnolia*, *Sassafras*, &c., in the Cretaceous rocks, they were naturally regarded as belonging to the present or Tertiary flora. It is also true that the flora of the Cretaceous period in the Old World has until recently been considered, from the number of Cycads it includes, as a continuation of the Jurassic flora; and it contains East Indian forms, none of which have as yet been discovered on this continent. There is no more doubt, however, that the plant-bearing strata of Vancouver's Island are Cretaceous, than in regard to those of Nebraska. A very large number of Cretaceous mollusks have been collected, both in the overlying beds and those containing the plants, as was stated by the writer in

1863, in the report on the fossils collected by the Boundary Commission.

As regards the strata containing the plants and coal of Bellingham Bay, further observations and collections must be made there before the question can be said to be definitely settled. Mr. Gabb, palæontologist to the California geological survey, who has recently visited Bellingham Bay, has been led by the molluscous fossils obtained there to consider all the coal-bearing series of that district as Cretaceous. If this be so there has been some error in the labelling of specimens which have come into my hands professedly from "Bellingham Bay." Some of them are unquestionably Miocene, for they include *Glyptostrobus Europæus*, *Taxodium occidentale*, and other plants found in the Miocene strata of Dacotah and Montana. The truth probably is that both formations are represented at or near Bellingham Bay. The coal of Coose Bay and the fossiliferous strata at Astoria are known to be Miocene, as are also the plant-bearing beds at Birch Bay and Buzzard's Inlet, and I have lately received a beautiful collection of Miocene plants from a locality not far distant in the interior.

From Orcas Island, which occupies an intermediate position between Bellingham Bay and Vancouver's Island, a collection of plants was made by Mr. George Gibbs of the Boundary Commission, in which the species are, with perhaps one exception, different from those obtained from the other two localities mentioned. These include ferns, palms and broad-leaved plants described in the report to which I have alluded, where they are referred to the Cretaceous period.

Combining the contributions thus made to our knowledge of the Cretaceous flora, and referring to this formation all that we now know to belong there, we have the following list of genera and species:

N. A. Cretaceous Plants now or hitherto described.

Populus rhomboidea,	Lesqx.	Nanaimo.

Salix Islandica,	Lesqx.	Nanaimo.
Quercus Benzoin,	"	"
Quercus multinervis,	"	"
Quercus platinervis,	"	"
Cinnamomum Heerii,	"	"
Salisburia polymorpha,	"	"
Aspidium Kennerlii,	Newb.	"
Sabal sp.	"	"
Taxodium cuneatum,	"	"
Ficus (?) cuneatus,	"	Orcas Is.
Tæniopteris Gibbsii,	"	"
Sphenopteris (Asplenium) elongata,	"	"
Populus Debeyana,	Heer	Nebraska.
P. litigiosa,	"	"
Salix nervillosa,	"	"
Platanus Newberryana,	"	"
Andromeda Parlatorii,	"	"
Diospyros primæva,	"	"
Phyllites Vannonæ,	"	"
Aristolochites dentata,	"	"
Cissites insignis,	"	"
Ficus primordialis,	"	"
Magnolia alternans,	"	"
M. Capellinii,	"	"
Liriodendron Meekii,	"	"
Betulites denticulata,	"	"
Proteoides daphnogenoides,	"	"
P. acuta,	"	"
P. grevilliaeformis,	"	"
Leguminosites Marcouanus,	"	"
Sapotacites Haydenii,	"	"
Populus cyclophylla,	"	"
Phyllites obcordatus,	"	"
Sassafras cretaceum,	Newb.	"
Liriodendron primævum,	"	"

Araucaria spatulata,	Newb.	Nebraska.
Quercus salicifolia,	"	"
Magnolia rotundifolia,	"	"
Platanus latiloba,	"	"
Fagus cretacea,	"	"
Sphenopteris corrugata,	"	"
Pyrus (?) cretacea,	"	"
Populus elliptica,	"	"
P. microphylla,	"	"
P. cordifolia,	"	"
Acerites pristinus,	"	"
Alnites grandifolia,	"	"
Salix flexuosa,	"	"
S. cuneata,	"	"
S. membranacea,	"	"
Quercus antiqua,	"	S. Utah.
Quercus sinuata,	"	"
Cupressites Cookii,	"	New Jersey.

From this list it will be seen that the Cretaceous strata of the west coast include some forms not yet discovered in the Kansas and Nebraska beds. Among these, *Salisburia*, *Sabal*, *Cinnamomum*, &c., are indicative of a warmer climate. Possibly these genera may hereafter be detected in the plant beds of Kansas, Nebraska, and New Mexico, but as yet we have no intimation of their existence, and there is nothing now known in the Cretaceous flora of that region which gives it a tropical or even sub-tropical character.

It will be remembered that this vegetation grew upon a broad continental surface, of which the central portion was considerably elevated. This would give us physical conditions not unlike those of the continent at the present day; and it would seem to be inevitable that the isothermal lines should be curved over the surface somewhat as at present. It may very well happen, therefore, that we shall find the palms and cinnamons restricted to the Western margin of the Cretaceous continent. It will be seen by the notes now given of the Tertiary flora of our continent, that, at a later date, palms grew in the same region where these Cretaceous plants are found; but cinnamons and other tropical plants seem to be entirely wanting in the Tertiary flora of the central part of the continent, while on the west coast both palms and cinnamons lived during the Tertiary period as far north as the British line. We have therefore negative evidence from the facts, though it may be reversed at an early day by further observations, that the climate of the interior of our continent during the Tertiary age was somewhat warmer than at the beginning of the Cretaceous period, and that during both the same relative differences of climate prevailed between the central and western portions that exist at the present day.

DESCRIPTIONS OF SPECIES.

Sphenopteris corrugata. (n. sp.)

Form of frond unknown; pinnules ovate or cuneiform, narrowed at the base, obtuse, lobed, often plicated longitudinally; nerves distinct, dichotomously branching from the base.

The specimens of this fossil collected by Dr. Hayden are fragmentary and imperfect, but quite sufficient to show it to be different from any described species.

Formation and Locality. Lower Cretaceous strata, Blackbird Hill, Nebraska. (Dr. Hayden.)

Araucaria spatulata. (n. sp.)

The only specimen of this beautiful species contained in the collections of Dr. Hayden, is a fragment of a branch nearly half an inch in diameter. On this the leaves are thickly set, their bases slightly decurrent, being scarcely separated from each other. From these bases, the leaves radiate in all directions, and are slightly recurved. They are half an inch in length, broadly spathulate, obtuse, and narrowed at the base. Along the medial line passes a distinct carina, which vanishes towards the apex.

From all living or fossil species, this seems very clearly distinguished by the form of the leaves. Two species of *Arau-*

carites have been described from the Cretaceous formation, of which descriptions are before me: *A. acutifolius* Endl. and *A. crassifolius* Endl. (Synops. Conif. p. 301); neither of which has spathulate leaves.

There is little doubt that this was a true *Araucaria*, and not very unlike, in its general aspects, some species now living.

It is also probable that these trees formed extensive forests on the land during the Chalk period, as I have found the Cretaceous strata in some localities in the West literally filled with large trunks of coniferous trees, many of which have rather the structure of *Araucaria* than of *Pinus*, *Abies* or *Juniperus*, although all these genera were represented at that epoch.

Formation and Locality. Upper Cretaceous strata, Sage Creek, Nebraska. (Dr. Hayden.)

Nyssa vetusta. (n. sp.)

Leaves large, obovate, entire, thick and smooth, pointed and slightly decurrent on the petiole; nervation strong; midrib straight and extending to the summit; lateral nerves pinnate, set at somewhat unequal distances, straight and parallel below, forked and inosculating above, forming a festoon parallel with the margin; tertiary nerves forming an irregular network of polygonal and relatively large areoles.

Of this species there are numerous specimens in the collections made by Dr. Hayden in as good preservation as the material in which they are fossilized will permit. The nervation is strongly marked, and all its more prominent characters as appreciable in the fossil as they were in the fresh leaves. In nervation, consistence, and outline these leaves are almost undistinguishable from those of the "Pepperidge" (*Nyssa multiflora*). The primary and secondary nervation of some species of *Magnolia* also exhibit a strong resemblance to that of these fossils, but a less complete correspondence than *Nyssa* presents. Without the fruit, or at least leaves preserved in a fine argillaceous sediment in which the finer details of nervation are given, the affinity suggested must be considered to some extent conjectural.

Formation and Locality. Red ferruginous sandstone of Lower Cretaceous formation, Blackbird Hill, Nebraska. (Dr. Hayden.)

Pyrus cretacea. (n. sp.)

Leaves petioled, small, roundish-oval or elliptical, often slightly emarginate, entire or finely serrate; medial nerve strong below, rapidly diminishing toward the summit; lateral nerves four or five pairs with intermediate smaller ones, diverging from the midrib at unequal angles, curved toward the summits, where they anastomose in a series of arches parallel with the margin; tertiary nerves forming a network of which the areolæ are somewhat elongated.

There are a number of leaves in the collection, of which the characters, as far as they are discernible, agree more closely with those of the species of *Pyrus* than with any other with which I have compared them. All the traces of their original structure which remain, however, are quite insufficient to permit their generic limitation to be determined with any degree of certainty. The leaves of many of the allied genera of the *Rosaceæ* have so much in common, that even with the leaves of the living plants it would be difficult, if not impossible, to separate them. The fossils before us are, however, very characteristic of the formation which contains them, and for that reason require notice, and as far as practicable description.

There are several other leaves in the collection which seem to me to have belonged to Rosaceous trees, and there is perhaps no *a priori* improbability that *Pyrus* began its existence on this continent with its congeners and companions in our forests of the present day.

Formation and Locality. Lower Cretaceous sandstone, Smoky Hill, Kansas. (Dr. Hayden.)

Liriodendron primævum. (n. sp.)

Leaves three-lobed, upper lobe emarginate, all the lobes rounded; nervation delicate, principal nerve straight or slightly curved, terminating in the sinus of the superior lobe; secondary nerves gently arching upward, simple or forked near the extremities, a few more delicate ones alternating with the stronger.

This leaf is considerably larger than that of *L. Meekii* Heer, less deeply lobed, and the lobes more broadly rounded. In its general aspect this species approaches much nearer the living tulip-tree, and the Tertiary species of Europe (*L. Procaccinii* Ung.), than that described by Professor Heer from the collections of Dr. Hayden (*L. Meekii*). The leaves of the former species are, however, generally more deeply lobed, and the lobes are acute, but I have collected leaves of *L. Tulipifera* of small size with all the lobes rounded, and in all respects remarkably like that under consideration. On the whole, this is so like the leaf of our tulip-tree that there can be little doubt that it represents a species of the same genus which grew on our continent at the commencement of the Cretaceous epoch. This is one of the most important facts deduced from the collections of Dr. Hayden, for the genus *Liriodendron* is now represented but by a single species, which is confined to North America. During the Miocene Tertiary epoch, however, it formed part of the flora of Europe, as well preserved leaves of a species very closely allied to, if not identical with the living one, grew in Italy, Switzerland, and Iceland.

Thus this comes into the interesting category of *Magnolia*, *Liquidambar*, *Sassafras*, &c.: genera which flourished both in Europe and America during the Miocene epoch, but which have long since ceased to exist on the European continent.

These specimens also teach us the still more interesting truth, that *Liriodendron*, *Sassafras*, *Magnolia*, *Quercus*, *Salix*, *Platanus*, *Populus*, and many others of our living genera, date back on this continent to a period long anterior to the dawn of the Tertiary age, and, having survived all the changes of the incalculable interval, now form the most conspicuous elements in our existing forests.

Formation and Locality. Lower Cretaceous sandstone, Blackbird Hill, Nebraska. (Dr. Hayden.)

Sassafras cretaceum. (n. sp.)

Leaves petiolate, decurrent at base, very smooth above, strongly nerved below; three-lobed; lobes entire and acute. The nervation is all strongly defined; the central nerve straight or nearly so; the lateral primary nerves springing from it at an angle of 30°; secondary nerves regularly arched till they approach the margin of the lobes, when they are abruptly curved and run together. From these the tertiary nerves are given off at a right angle, and from these the quaternary nerves spring at a similar angle, together forming a network of which the areoles are sub-quadrate.

It is perhaps not certain that the relationship between this beautiful fossil and the living *Sassafras* is as intimate as I have suggested, for Dr. Hayden obtained no fruits with the leaves, though, from the abundance of the latter, it is to be hoped that they may yet be found in the same locality. Until the fructification shall be procured, the suggestion that a species of our modern genus *Sassafras* flourished as far back as the epoch of the deposition of the Lower Cretaceous strata, may be accepted with a certain degree of mental reservation. It is true, however, that there is a most marked correspondence, both in external form and nervation, between the living and the fossil plants; the differences being no greater than we might expect to find between species of the same genus. The nervation of the fossils is stronger and more regular, and the whole aspect of the leaf rather neater and more symmetrical.

With the material already before us, we may at least infer that there was living in the American forests of the Chalk period a Lauraceous tree, bearing trilobate leaves, having the general aspect and nervation of those of our *Sassafras*.

Formation and Locality. Lower Cretaceous sandstone, Blackbird Hill, Smoky Hill Fork, Nebraska and Kansas. (Dr. Hayden.)

Magnolia obovata. (n. sp.)

Leaves large, obovate, entire, thick and smooth; pointed and slightly decurrent on the petiole; nervation strong; midrib straight and extending to the summits; lateral nerves pinnate, set at somewhat unequal distances, straight and parallel below, forked and inosculating above, forming a festoon parallel with the margin; tertiary nerves forming an irregular network of polygonal and relatively large areoles.

Of this species there are numerous specimens in the collections made by Dr. Hayden, in as good preservation as the material in which they are fossilized will permit. The nervation is strongly marked, and all its more prominent characters as appreciable in the fossil as they were in the fresh leaves.

In nervation, consistence, and outline, these leaves must have been strikingly like those of some of the Chinese magnolias, as *M. purpurea*, &c., which have obovate leaves, and I have provisionally grouped them together. Without the fruit, or at least leaves preserved in an argillaceous sediment in which the finer details of nervation are given, the affinity suggested must, however, be considered to some extent doubtful.

Formation and Locality. Red ferruginous sandstone of Lower Cretaceous formation, Blackbird Hill, Nebraska. (Dr. Hayden.)

Acerites pristinus. (n. sp.)

Leaves petiolate, cordate at the base, five-lobed, lobes entire, acute (?); five strong and nearly equal veins radiate from the base into the lobes. The small nerves are distributed over the surface in a fine network of which the meshes are sub-rectangular.

The specimens which I have of this plant do not give the entire outline of the leaf. In general form they would seem to have resembled those of *Acer saccharinum*, and still more those of *A. pseudoplatanus* of Europe, but are apparently more simple than those of either of these species. With the species of *Acer* described from the Tertiary strata it is not likely to be confounded, though bearing some resemblance to *A. integerrimus* (Viv. Mem. Soc. Geol. France, 1833, vol. 1, p. 133, tab. xl. fig. 6). In that species, however, the lobes are narrower and more elongated. Four species of *Acerites* have been described from the Cretaceous strata of Europe. Of these I have only the descriptions of two, *A. repandus* and *A. styracifolius* Ung., both of which are quite different from this.

Formation and Locality. Lower Cretaceous sandstone, Blackbird Hill, Nebraska. (Dr. Hayden.)

Populus elliptica. (n. sp.)

Leaves long—petioled, sub-orbicular or transversely elliptical, slightly cuneate at the base, and apiculate at summit; lower half of leaf entire; superior half, or more, very regularly and rather finely obtusely serrate, or crenate, the points of the teeth inclining upward; primary nerves usually 5, sometimes 3, radiating from the base at equal angles; from these the secondary nerves spring at acute angles.

This is an exceedingly neat and well-defined species, very fully represented in Dr. Hayden's collections. It is symmetrical in form, broader than high, forming a transverse ellipse, from the opposite sides of which rise the corresponding and equal projections of the apiculate summit, and slightly decurrent base. The crenation of the upper portion of the leaf is very regular and neat, the teeth of small size, and turned upward. The general aspect of the leaf is not very different from that of some specimens of *P. tremuloides*, but the entire margins at the lower half of the leaf, the more elliptical outline, shorter point, and larger and more regular teeth, mark its specific differences with sufficient distinctness, while the correspondence which the leaves of the two species present, in the general characters of form, nervation and crenation, affords satisfactory evidence of generic identity, and apparently bears unquestionable testimony to the existence, at the dawn of the

Cretaceous epoch in America, of trees, like, in all the generalities of their appearance and economy, those most common in our present forests.

In the Miocene plants collected by Dr. Hayden on the Upper Missouri a species of *Populus* occurs (*P. rotundifolia*), which exhibits a striking resemblance in general form to that now under consideration. In that species, however, the crenation of the superior margin is uniformly coarser and less acute, and the nervation is more delicate.

Formation and Locality. Lower Cretaceous sandstone, Blackbird Hill, Nebraska. (Dr. Hayden.)

Populus microphylla. (n. sp.)

Leaves very small, scarcely an inch in length, roundish in outline, somewhat wedge-shaped at base, where they are entire; the upper part of the leaf rounded and deeply toothed, teeth conical, acute or slightly rounded at the summits; nerves radiating from the base, branching above, the branches terminating in the dentations of the margin.

This very neat species might be supposed to be only a form of *P. elliptica*, with which it is associated, but a number of specimens of each show no shading into each other, and it is scarcely possible that so wide a variation of marginal dentation should exist in the same species. Although the leaves of *P. elliptica* are two or three times as large as those of the species under consideration, the teeth of the margins are less than half the size, and are of a different type, being inclined upward, the sides of each tooth of unequal length; while the dentations of *P. microphylla* are conical in outline with nearly equal sides.

Formation and Locality. Lower Cretaceous sandstone, Blackbird Hill, Nebraska. (Dr. Hayden.)

Populus? Debeyana. (Heer.)

A number of leaves in the collection before me are clearly identical with that referred with doubt by Prof. Heer to

Populus, from the generalities of its nervation, and impressions of what would seem to have been glands at the base on either side of the point of insertion of the petiole. In our specimens, however, there are no glandular impressions, and the departure from the normal type of nervation in *Populus*, noticed by Prof. Heer, is still more conspicuous.

The strong pair of basilar nerves, so characteristic of the poplars, is entirely wanting; the inferior lateral nerves being small, and the stronger ones, which succeed them above, are not opposite. In view of the marked departure which these leaves exhibit from the nervation and form of the typical poplars, Prof. Heer suggests that they may represent an extinct genus of the order *Salicineæ*, but it seems to me their affinities are closer with the *Magnoliaceæ*, and that it is even probable that they represent a species of the genus *Magnolia*.

Formation and Locality. Lower Cretaceous sandstone, Blackbird Hill, Nebraska. (Dr. Hayden.)

Populus(?) Cordifolia. (n. sp.)

Leaves heart-shaped, slightly decurrent on the petiole; margins entire; nerves fine but distinctly defined; medial nerve straight or slightly curved, running to the margin; lateral nerves 6 on each side, given off at an angle of about 50°, nearly parallel among themselves, straight near the base of the leaf, slightly curved toward the summit; lower lateral nerves giving off on the lower side about 4 simple or once forked, slightly curved branches which terminate in the basilar margin; second pair of lateral nerves giving off about three similar branches on the lower side, which run to the lateral margins; third pair supporting about two, and fourth pair one branch on the lower side near the summit; tertiary nerves springing from the secondary nearly at right angles, slightly arched and running across nearly parallel to connect the adjacent secondary nerves.

In its general aspect this species closely resembles the preceding, but several specimens which I have before me agree in being less rounded and more heart-shaped, and the lateral nerves are more numerous and given off at a larger angle.

In these leaves the basilar nerves reach the lateral margins below the middle and with their second branches, as a consequence, have more the aspect of some of the leaves of the *Cupuliferæ*, such as *Corylus*. The lattice-like arrangement of the tertiary veins in this as in the other species of this group, is very characteristic of the *Cupuliferæ*, though not strictly limited to them. If we could imagine a *Corylus* with rounded or broadly cordate leaves, of which the margins were entire, we should have a very near approach to these plants.

Formation and Locality. Lower Cretaceous strata, Blackbird Hill, Nebraska. (Dr. Hayden.)

Salix membranacea. (n. sp.)

Leaves petioled, large, smooth and thin, lanceolate, long pointed, rounded or abruptly narrowed at the base, near which they are broadest ; margins entire, medial nerve slender, often curved, secondary nerves remote, very regularly and uniformly arched from their bases, terminating in, or produced along the margins till they anastomose ; tertiary nerves given off nearly at right angles, forming a very uniform network of which the areoles are polygonal and often quadrate.

This is a strongly marked species, of which I have specimens fossilized in fine clay, and exhibiting with great distinctness all the details of nervation. It was evidently thin and membranous in texture, though attaining a large size. Like most of the willows, it is frequently unsymmetrical, one side being most developed and the midrib curved.

The leaf is broadest near the base, and is thence narrowed into a long and acute point.

Formation and Locality. Lower Cretaceous strata, Raritan River, New Jersey. (Prof. Cook.)

Salix Meekii. (n. sp.)

Leaves petioled, thin and delicate, lanceolate, acute at both ends, nervation delicate, midrib slender, secondary nerves fine, springing from the medial nerve at an angle of [illegible], gently arched and [illegible] tomosing near the margins; net-work of tertiary veins somewhat lax, but composed of nervules of such tenuity as to be rarely visible.

This is the plant of which an outline sketch was sent Prof. Heer by Mr. Meek. In that sketch the general form was alone given, the details of nervation as well as the texture of the leaf not being deducible from it. Prof. Heer considered it a *Laurus*, and as probably identical with *Laurus primigenia* Ung., a common species in the Tertiary of Europe. Aside from the *a priori* improbability of this plant found in the Lower-Cretaceous rocks being identical with one which in the old world dates back no further than the Miocene, there are characters in the fossil itself which seem to separate it from even the genus of *L. primigenia*. The nervation has a different aspect from that of any of the *Lauraceæ* with which I am acquainted, being both more lax and delicate, the secondary nerves less accurately arched, and their summits more wavy; the patterns found by their anastomosis less regular and determinate. In these respects, as well as in its comparatively thin and delicate texture, it resembles much more the Willows than the Laurels.

It seems hardly worth while to compare the plant before us with any of the living Willows, for everything indicates that all the species of the Chalk, both vegetable and animal, long since perished. Among the great number of fossil species found in the Tertiary strata there are several which have a general resemblance to it, and from which it might be unwise to regard it as distinct if they were from the same formation. *Salix elongata* Web. (Tertiarflora der Niederrheinischen Braunkohlenformation, Taf. xix. fig. 10,) has nearly the same form, but the secondary nerves are given off at a larger angle, and are much more arched.

From its associate species in the Cretaceous strata it seems not difficult to distinguish it. *Salicites Hartigi* Dunker (Paleontographica 4. Band. 6, Lief. 81, Taf. xxxiv. fig. 2) is apparently much more strongly nerved. The general form was perhaps similar, although Dunker's specimen wants both point and base.

Formation and Locality. Lower Cretaceous strata, Blackbird Hill, Nebraska. (Dr. Hayden.)

Salix flexuosa. (n. sp.)

Leaves narrow, linear, pointed at each end, sessile or very short-petioled; medial nerve strong, generally somewhat flexuous; secondary nerves pinnate, leaving the principal nerve at an angle of about 40°, somewhat branched and flexuous, but arching so as to inosculate near the margins.

This is perhaps only a variety of the preceding species (*S. Meekii*), which it resembles in its nervation as far as can be observed in specimens fossilized in sandstone, but, although much narrower in its general form, it is less acuminate at either extremity, and is apparently sessile. As in some of our living narrow-leaved willows, these leaves are generally somewhat flexuous, and as they are seen lying in their natural curves on the surfaces of the rock, they have as familiar and perfectly willow-like a look as leaves of *Salix angustifolia* would, if artificially fossilized in the manner followed by Goeppert.

Since the above description was written, I have collected this species from a number of widely separated localities, and found it to hold its characters with great constancy.

Formation and Locality. Big Sioux, Blackbird Hill, Cedar Spring, &c., Nebraska, Colorado, and New Mexico.

Salix cuneata. (n. sp.)

Leaves of medium size, sessile or short-petioled, entire, elongate, narrow, acute at both ends, broadest toward the apex, gradually narrowed below to the base; medial nerve distinct; secondary nerves delicate, springing from the midrib at an angle of about 20° near the middle of the leaf, 15°—20° below, straight and parallel near the bases, gently arched above and inosculating near the margins.

This species presents some marked characters by which it may be distinguished from those before described. It is true that the variations of form among the leaves of our recent species of willow are almost infinite, and even in the same species, and from the same tree, leaves may be obtained of such different aspect that taken separately they might readily be mistaken for those of different species. Since the difficulty in the determination of recent willows is so great that it has become proverbial, specific distinctions derived from the leaves only, especially in those obtained from the same locality, may justly be looked upon with suspicion. Here as elsewhere, however, it is probable that recent botany will derive some aid from the careful study of fossil plants, and the nervation will probably be found to afford constant characters where the outlines of the leaves can hardly be relied on.

It will be seen by reference to the foregoing descriptions of *Salices* that a number of characters combine to distinguish what, for geological convenience, I have chosen to regard as distinct species. *Salix Meekii* is lanceolate, tapering nearly equally to both ends, which are alike acute; this leaf is petioled and the nervation regular and delicate.

S. flexuosa is sessile, linear and rather abruptly narrowed to point and base; nervation obscure, apparently very delicate and uniform.

S. cuneata is comparatively thick and leathery, the form symmetrical, lanceolate, pointed but scarcely acute at both ends; the midrib strong, prolonged into a short robust petiole; secondary nerves unequal, given off at a large angle, thick at base, slender, tortuous and irregularly confluent near the margins.

In *S. membranacea*, the leaves are large and thin, broadest near the base, which is rounded, summit long pointed and acute; nervation distinct and regular, but delicate.

Formation and Locality. Cretaceous sandstone, mouth of Big Sioux River, Nebraska. (Dr. Hayden.)

Platanus latiloba. (n. sp.)

Leaves petiolate, three-lobed, decurrent at the base, lobes broad, obtuse, or abruptly acuminate; principal nerves three, secondary nerves issuing from these at an acute angle, tertiary nerves leaving the secondary at a right angle, forming a network over the surface of the leaf, of which the areolæ are subquadrate.

Judging from the imperfect specimens which we have of this species, it is quite distinct from any described. Having the general form and nervation of the leaves of *P. occidentalis*, the margins are much less deeply sinuate, the lobes less acuminate, and the entire outline of the leaf more simple. The same is true of its relations with *P. orientalis* of the old world. The fossil species, of which several have been described by Unger and Goeppert, are quite distinct from this. The species described by Unger (*P. Sirii* and *P. grandifolia*) are much more deeply lobed, while that figured by Heer, Goeppert and Ettingshausen (*P. aceroides*) is less deeply lobed but more strongly toothed. All fossil species heretofore known are from the Tertiary strata, this being the first instance where the genus has been found in rocks of the Cretaceous epoch.

During the last summer (1858) I obtained specimens of still another species from the same geological formation in New Mexico. This has a larger and more lobate leaf, more like the Tertiary species *P. grandifolia*.

Formation and Locality. Lower Cretaceous sandstone, Blackbird Hill, Nebraska. (Dr. Hayden.)

Fagus cretacea. (n. sp.)

This pretty species is represented in the collection but by a single specimen. This is, however, remarkably well preserved, giving the general form and the details of nervation with great distinctness. From the character of the nervation, I have but little hesitation in referring it to the genus *Fagus*. Some of the *Rhamnaceæ*, particularly species of *Rhamnus* and *Frangula*, have leaves which would be very like the one before us if fossilized, but in the fossil plant the lateral nerves are sharply defined, numerous, almost perfectly parallel among themselves and run quite to the margins, which are seen to be slightly waved, the termini of the nerves being most prominent and the intervals between them forming shallow sinuses. In *Rhamnus*, however, even in *R. frangula*, of which the leaves so much resemble this, the margins are not waved, and the lateral nerves do not terminate as distinctly in them as they do in *Fagus*, and in our fossil.

A striking similarity will be noticed between some of the leaves of the living *Fagus sylvatica* and this, though there is no probability of that species having begun its life so early in the history of the globe as the first part of the Cretaceous period. The resemblance is noted only as giving good grounds for the reference of the fossil to the genus *Fagus*. It will be necessary however to find the fruit before the fact can be accepted as fully proven of the existence of beeches during the age of the Chalk.

A large number of fossil species of *Fagus* have been described from the Tertiaries of Europe, by Unger, Dunker, Heer, &c., but the genus has never before been obtained from the Cretaceous formation.

Formation and Locality. Lower Cretaceous sandstones, Smoky Hill, Kansas. (Dr. Hayden.)

Quercus salicifolia. (n. sp.)

Leaves petiolate, smooth, thick, entire, lanceolate, abruptly pointed at both ends; medial nerve strong, straight, or more or less curved; secondary nerves of unequal size, strong near their points of origin, becoming fine, flexuous and branching as they approach the margins of the leaf, where some of them inosculate by irregular curves, while others terminate in the margins.

This species differs considerably in its general aspect from the willow-like leaves with which it is associated, and must have been much thicker and smoother. The midrib is very strong, terminating below in a thick but short petiole. The lateral nerves are much less uniform and regular than those of the leaves to which I have referred. They are at first strong, but soon diminish, and many of them extend but half way to the margin; the others being unequally curved and branching irregularly, or anastomosing with each other. The finer details of nervation are not given in the specimens before me, and perhaps more ample material will show that our fossil should not be regarded as a *Quercus*, but as far as its characters are given, they agree best with those of that genus. The texture of the leaf was evidently thick, and its surface glossy, more so than in any *Salix* now living; the nervation, too, is more that of the oaks than willows; the alternation of larger with smaller secondary nerves, all diminishing rapidly and irregularly branched and flexuous above, are characters common to the leaves of all the willow-oaks. Some leaves of the living *Q. imbricaria* would closely resemble these if fossilized in the same manner. In the *Lauraceæ* with lanceolate leaves the nervation is generally much more exact and regular than in the specimen before us, the side nerves being generally curved gracefully and more or less uniformly upward, their extremities anastomosing, or, more rarely, reaching the margin. If the fine reticulation of the tertiary nerves was distinctly visible, there would perhaps be little difficulty in determining with a good degree of certainty the generic relations of this fossil. In the oaks this reticulation is very fine, the areolæ of pretty uniform size and quadrangular or polygonal, about as broad as long. In the willows the meshes are larger, more irregular and more or less elongated.

Formation and Locality. Lower Cretaceous sandstones. Blackbird Hill, Nebraska. (Dr. Hayden.)

Quercus cuneata. (n. sp.)

Leaves short petioled, lanceolate, pointed at both ends, acute, entire or slightly wave-margined; midrib strong; secondary nerves remote, nearly straight, with shorter intermediate ones; surface smooth, texture originally thick and leathery.

The leaves of this species must have been similar in form and consistence to those of the living *Q. imbricaria.* They were somewhat longer-pointed, and slightly more cuneate at the base; but leaves might be selected from the living tree which, if fossilized in the same manner, would be scarcely distinguishable from those before us. The nervation is strong, the primary and secondary nerves being very distinctly marked, the latter remote, straight the greater part of their length, gently curved toward their extremities.

Oaks would seem to have been numerous in the oldest forests of dicotyledonous trees of which we have any knowledge. Several species are enumerated by Stiehler as occurring in the Cretaceous sandstones of Blankenburg, but they are as yet not described; and in the tertiary flora of Europe, perhaps no genus is more largely represented.

On our own continent oaks were apparently common as early as the epoch of the deposition of the Lower Cretaceous strata, as leaves, which I have considered referable to *Quercus*, are included in most of the collections which I have made from these strata from widely separated localities, viz: Bellingham Bay, Kansas, Nebraska, Utah and New Mexico.

Formation and Locality. Blackbird Hill, Nebraska. (Dr. Hayden.)

Quercus antiqua. (n. sp.)

Leaves of medium size, lanceolate in outline, acute, often somewhat flexuous; margins serrate-dentate, with strong, obtuse teeth, which are appressed or turned toward the summit; midrib strong, and reaching the apex; lateral nerves numerous, of unequal strength, gently arched upward, terminating in the marginal teeth.

The specimens upon which this description is based are fossilized in a somewhat coarse ferruginous sandstone, which has not preserved the minor details of the nervation; but the generalities of form and structure, which are clearly enough shown, seem to indicate that it represented in the Cretaceous flora the chestnut oaks of the present epoch. Several Tertiary species bear considerable resemblance to it, as *Q. Mediterranea*, Ung., and *Q. Haidingera*, Etts.; but in both these species the marginal dentations are less uniform in size, and, when having a similar outline, are smaller.

Formation and Locality. Lower Cretaceous sandstone, Banks of Rio Dolores, Utah.

Quercus sinuata. (n. sp.)

Leaves small, obovate in general outline, narrowed to the petiole, or slightly decurrent; margins deeply lobed, lobes rounded, broader than the sinuses that separate them, three nearly equal on either side, summit broadly rounded or obscurely lobed, often oblique; nervation strong and simple, midrib straight or slightly flexed, giving off lateral branches, which run to the margins of each lateral lobe.

The general form of this leaf is much like that of one living, *Q. obtusiloba*, though it is smaller and more symmetrical. Among the many fossil species which have been described, there is none which approaches this very closely; most of them bearing either simple, entire leaves, or toothed, rather than lobed ones.

Formation and Locality. Lower Cretaceous strata, Banks of Dolores river, Southern Utah.

THE TERTIARY FLORA OF NORTH AMERICA.

As has been said in regard to the Cretaceous flora, our knowledge of the vegetation which clothed this continent during the Tertiary period has all been gained within a very few years, and is still exceedingly imperfect. The first notice of fossil plants collected from our Tertiary deposits is given by Prof. J. D. Dana, in the Geology of the Exploring Expedition under Capt. Wilkes, U. S. N. This comprises figures and brief descriptions of a number of fossil leaves from Birch Bay, near the mouth of Frazer's River, on the North-west coast. Subsequently the specimens collected by Prof. Dana were examined by myself, and are described more in detail in the Boston Journal of Natural History, vol. 7. No. 4. The plants collected by the Ex. Expedition comprised the following species, viz:

Glyptostrobus Europæus	Br. sp.
Taxodium occidentale	Newb.
Smilax cyclophylla	"
Rhamnus Gaudini?	Heer.
Carpinus grandis?	Ung.

Of these *Taxodium occidentale* is closely allied to *T. dubium* of the Miocene of Europe. The *Glyptostrobus* is apparently identical with the European Miocene plant. *Smilax cyclophylla* is the analogue of *S. orbicularis*, while the *Carpinus* and *Rhamnus* are referred doubtfully to the European species of which the names are given them.

From the strata associated with the coal-beds of Bellingham Bay fossil plants had been collected by several persons, but none had been described from that locality until, in 1859, a series of specimens collected by Dr. Evans, Government Geologist for Oregon, were placed in the hands of Mr. Lesquereux, and described by him in the American Journal of Sciences, (vol. xxvii. second series, p. 359.) The following list includes the species which are possibly, but not probably, Tertiary, viz: *Planera dubia*, (Lesqx.), *Quercus Evansii*, (Lesqx.), *Q. Gaudini*, (Lesqx.), *Cinnamomum crassipes*, (Lesqx.) *Persoonia oviformis*, (Lesqx.), *Diospyros lancifolia*, (Lesqx.) *Acer trilobatum?* (Al. Br.). In the next volume of the Journal of Science, p. 85, is published a letter from Prof. Oswald Heer, Zurich, Switzerland, containing some notes on these fossil plants, of which sketches had been sent him by Mr. Lesquereux.

In these notes *Planera dubia*, (Lesqx.), is regarded by Prof. Heer as identical with *P. Ungeri*, of Europe; *Cinnamomum crassipes*, (Lesqx.), is said to be hardly distinguishable from *C. Rossmassleri*, (Heer); *Quercus Benzoin*, (Lesqx.) is referred to *Oreodaphne Heeri*, (Gaud.); *Quercus Gaudini*, (Lesqx.) is said to be identical with a species from the Italian Tertiaries.

By Prof. Heer, the coal strata of Vancouver's Island and the opposite coast of Washington Territory—strata which contain the plants—are all regarded as unquestionably of "Miocene age."

In 1863, I characterized, in the Boston Journal of Nat. Hist., the fossil plants collected by the N. W. Boundary Commission. Among them the following species were enumerated: *Equisetum robustum*, (Newb.), *Sabal Campbellii*, (Newb.), *Taxodium occidentale*, (Newb.), *Quercus flexuosa*, (Newb.), *Q. Banksiafolia*, (Newb.), *Q. elliptica*, (Newb.), *Populus flabellum*, (Newb.), derived from the main land on the North-west coast, and supposed to be Tertiary.

At a later period, a number of fossil plants, obtained from the Eocene and Miocene beds of the Valley of the Mississippi, and from the lignite deposits of Brandon, Vermont, were examined by Mr. Lesquereux: descriptions of portions of which have been published.

From the Eocene beds he obtained *Cinnamomum Mississippiense* (Lesqx.), *Calamopsis Danai*, (Lesqx.), and a number of fossil fruits, among which he recognised *Carya*, *Fagus*, *Aristolochia*, *Sapindus*, *Cinnamomum*, *Cissus*, *Carpinus* and *Nyssa*. (American Journal of Science, 2nd Ser. vol. xxxii., p. 355). From the Miocene beds of Mississippi Lesquereux reports having obtained species, not yet described, of *Quercus*, *Cassia*, *Laurus*, *Persea*, *Rhamnus*, *Terminalia*, *Magnolia*, *Sabal*, *Cinnamomum*, *Ficus*, *Smilax*, (with the living species *Cornus sericea* and *Magnolia acuminata*,) *Magnolia rotundifolia* (Lesqx.), and *Populus rhomboidea* supposed to be identical with one before described from the Cretaceous strata of Vancouver's Island. From the Miocene (?) Tertiary, Somerville, Tenn., Mr. Lesquereux enumerates *Laurus Caroliniensis*, *Prunus Caroliniana*, *Quercus myrtifolia*, *Fagus ferruginea*, living; *Salix densinervis*, (Lesqx.), *Quercus* (?) *crassinervis*, (Ung.), *Quercus*

Saffordii, (Lesqx.), *Andromeda dubia*, (Lesqx.), *Andromeda vaccinifolia*, *Eleagnus inequalis* (Lesqx.), extinct; from Mississippi *Rhamnus marginatus*, (Lesqx.), *Quercus Saffordii*, (Lesqx.), and *Magnolia Hilgardiana*, (Lesqx.).

From some Tertiary beds in New Jersey, supposed by Prof. Cook to be Pliocene, I have received a small collection of plants, which include a three-lobed *Liquidambar*, a *Cercis* and one or two species of oak.

By far the largest representation of our Tertiary flora is, however, contained in the collections made by Dr. Hayden on the upper Missouri, of which the greater number of species are described in the present memoir. These plants are from the lignites proved by the associated fossils to be of Miocene age. They were collected at various points on the Missouri River, at Fort Clarke, at Red Spring, thirteen miles above, at Fort Berthold at Crow Hills, one hundred miles below Fort Union, at the mouth of the Yellowstone, on O'Fallon's Creek one hundred miles above the mouth of the Yellowstone, and in the Valley of that stream.

Some of the species are common to several of these localities, and there can be no doubt of the parallelism of the beds which contain them. The molluscous fossils which accompany them have been carefully studied by Mr. Meek, and are considered by him indicative of Miocene age. The list of the species obtained from this horizon by Dr. Hayden is as follows:

Glyptostrobus Europæus,	Br.
Sequoia Langsdorfii,	Br. sp.
Thuya gracilis,	Newb.
Taxodium occidentale,	"
Tilia antiqua,	"
Psilotum inerme,	"
Platanus Haydeni,	"
" nobilis,	"
" Raynoldsii,	"
" heterophylla,	"

Cornus acuminata,	Newb.
Quercus dubia,	"
Carya antiquorum,	"
Negundo triloba,	"
Carpolithus lineatus,	"
Sapindus affinis,	"
" membranaceus,	"
Calycites polysepalus,	"
Aralia triloba,	"
Amalanchier affinis,	"
Aristolochia cordifolia,	"
Planera microphylla,	"
Rhus nervosa,	"
Rhamnites elegans,	"
Viburnum asperum,	"
" lanceolatum,	"
Alnus serrata,	"
Phyllites venosus,	"
" carneosus,	"
" cupanioides,	"
Sabal Campbelli,	"
Populus rotundifolia,	"
" smilacifolia,	"
" cordata,	"
" cuneata,	"
" acerifolia,	"
" Nebrascensis,	"
" genetrix,	"
" nervosa,	"
Corylus grandifolia,	"
" orbiculata,	"
" Americana,	
" rostrata,	living.
Onoclea sensibilis,	

These fossils are generally well preserved in a calcareoargillaceous rock, of a light drab color, upon which the leaves are delineated with a distinctness which renders them pleasant objects of study, as well as attractive specimens for the cabinet. They are usually detached with their petioles in such numbers and form as indicate maturity and a common cause of fall, such as an annual frost. The mollusks associated with them show that they were deposited in the sediment which accumulated at the bottom of fresh water, and they are generally spread out smoothly, and so entire, that it is evident that no violence, not even the action of a rapid current, could have been attendant upon their deposition.

The explorations of Dr. Hayden prove that this Miocene lignite formation occupies the beds of extensive lakes which formed basins on the surface of the continent when it had but recently emerged from the Cretaceous sea. As has been remarked elsewhere, the lower members of the series contain a few estuary shells, showing the access of salt water at that period, but during the deposition of by far the greater portion of these beds the water of the ocean was entirely excluded from the basins in which they accumulated. There is, therefore, every reason to believe that the debris of ligneous plants which compose this collection were derived from trees which grew along the shores of the lakes and streams of the Tertiary continent; that then, as now, alternations of seasons prevailed, by which the foliage of these trees was detached by an autumnal frost, and that falling into the water beneath or near them, and sinking to the bottom, they were enveloped in mud, precisely as leaves of our sycamores, willows, oaks, &c., accumulate at the bottoms of our streams and lakes at the present day.

In comparing the group of plants here presented to us with those now living upon the surface of the earth, any one will be at once struck with the resemblance which they present to the flora of the temperate zone, and particularly to that of our own country. In their study, I have constantly found that on making comparisons with the plants of remote and especially tropical countries, an entire want of resemblance or affinity at once discovered itself, and the only instructive comparisons made were with the present vegetation of our country, with that of the Miocene Tertiaries of Europe, and with the living plants of China and Japan. There is every reason to believe that future observations will make immense additions to this flora, and satisfactory comparisons and generalizations will only be possible when a far more complete series of its plants can be subjected to study. It is also true that as yet little other than the leaves of these plants have been collected and employed in the deductions made from them. From the character of the sediments which enclose the leaves, it is quite certain that the fruits and seeds are also preserved, but as these are less conspicuous and noticeable than the leaves, they are little likely to be found unless specially sought; and it will only be when they are made the objects of search that they will be discovered, and lend their important assistance in the solution of the problems which the leaves present. For the want of such assistance as these organs would furnish, some of the material included in the collection does not now admit of satisfactory classification; and the reference of some of these leaves to the genera under which they are placed, must be regarded as provisional, and liable to modification by further research. Quite a number of these plants are, however, so largely represented in the collection, so well preserved, and so clearly allied to the genera and species with which we are familiar, that they constitute fair material from which to infer the general characters and affinity of the flora of which they formed part. In this list may be mentioned the *Glyptostrobus*, of which the stems, bearing the leaves of different forms, the cones, and the sterile *capitula*, are all present, and so closely resemble the specimens obtained by Prof. Heer from the Miocene of Europe, that they might almost be considered the originals from which his figures were taken. The *Taxodium* described is evidently a close analogue of *Taxodium dubium*.

of the Miocene of Europe; differing from that well-known species only in the uniform rounding of the bases and summits of the leaves. The plant which has been doubtfully referred to *Sequoia Langsdorfii*, would probably be accepted by foreign botanists as identical with that species, but, for the reasons given in the remarks upon that plant, it seems to me quite doubtful whether it was a *Sequoia*, and more probable that it was a *Taxodium* allied to our deciduous cypress.

The great fan palm collected by Dr. Hayden seems to be a representative of *Sabal major* of the European Tertiaries and *Sabal palmetto* of our Southern States. From both these, however, it is distinguished by the larger number of folds in the leaves, and from *S. major* by its flat, unkeeled petiole.

The numerous species of *Populus* of which descriptions are now given will not fail to attract the attention of those whose interest runs in this direction. Several of them seem to be new to science, and show, for the most part, a greater affinity with the foreign poplars, *P. alba*, &c., than with the species more common on this continent; though a single one, *P. genetrix* N., evidently belongs to the group of which our balsam poplar may be taken as the type. The little species described under the name of *P. rotundifolia* presents some anomalies in form and structure as compared with most of our poplars, but its resemblance to another species contained in this collection, *P. elliptica*, and to one contained in the collection of the North-west Boundary Commission, described under the name of *P. flabellum*, has induced me to class them together. Among living species it has a striking analogue in *Populus pruinosa*, now growing in *Songaria*.

The several species of *Platanus*, which the collection contains, form a striking and interesting portion of this group of plants, and all seem distinct from the fossil species hitherto described, and from any now living. Of our American sycamores, the leaves of *P. occidentalis* are much more toothed, while those of *P. racemosa* are more deeply lobed than any of these. *P. aceroides*, a species from the Tertiaries of Europe, is more closely allied to our living ones than these seem to be. The largest and finest of those now described, in its smoothness of surface, its crowded and parallel nervation, departs more widely from the typical species of *Platanus* than the others, and has more the appearance of a tropical plant. An extensive series of comparisons have, however, suggested no affinities closer than those with the living *Platanus;* and I have little doubt that in these leaves, of which the collection contains a large number, we have representatives of the noblest and most beautiful species of the genus.

Two of the species of *Corylus* present no characters by which they can be distinguished from the two now distributed over the temperate portions of our continent, *C. rostrata* and *C. Americana;* and I have therefore not felt justified in considering them distinct. The *Carya* described seems to me clearly to belong to this genus, and to be closely allied to one of our living species. The *Tilia*, also, is not far removed from the southern variety of our common living species, while the *Negundo*, *Sapindus*, &c., seem to be the representatives of the genera and species now growing in the region from which these fossils come.

From this flora, considering it the analogue and progenitor of that which now occupies our territory, we miss some important elements, which we may confidently expect will be supplied by future collections. Among the most striking of these deficiencies may be mentioned *Acer*, *Quercus*, *Liriodendron*, *Liquidambar*, *Sassafras*, etc., some of which, we know, began their life upon the continent during the Cretaceous period, and all of them were members of the Miocene flora of the Old World. *Liquidambar*, *Quercus*, and *Magnolia* occur in the Pliocene beds of New Jersey; *Magnolia* and *Quercus* in the Miocene strata of the Mississippi Valley. *Fagus*, also, which is wanting in this collection, has been obtained from the Eocene by Mr. Lesquereux.

The notes on some of the species contained in the collection made by Dr. Hayden, *Sequoia Langsdorfii*, *Sabal Campbelli*, *Onoclea sensibilis*, &c., have a bearing on the general questions to which reference has been made in the preceding pages, but the occurrence of an *Onoclea* among these Miocene plants, and a species which I cannot distinguish from the living one, seems to me a fact of so much importance as to require some additional comments.

The fern frond found by the Duke of Argyle, in the leaf beds of the Island of Mull, and figured by Prof. E. Forbes, in the Journal of the Geological Society of London, vol. vii. (1851), p. 103, pl. ii. figs. 2a, 2b, and named by him *Filicites* (?) *Hebridicus*, is unquestionably identical with this. The specimen, from which the figures to which I have referred were taken, seems to have puzzled Prof. Forbes somewhat, for he even doubted if it were a fern; and Prof. Heer, in his reference to the fossil plants of the Island of Mull (Flor. Tert. Helvet. vol. iii. p. 314), says: "The most remarkable species is *Filicites* (?) *Hebridicus*, a fern, which by its nervation differs greatly from those of the continent." All these facts give this fossil special interest, for in addition to its relation to its living representatives, of which we cannot but consider it the progenitor, it adds another to the list of plants common to the Miocene strata of Europe and America. Of these, either representative or identical species, the number is now so great that they plainly indicate a land connection between the continents at that period; and since many genera, and this, with probably some other species at that time common to the Old and New Worlds, have disappeared from Europe, while they continue to flourish here, it would seem to follow that these were *American* types which had colonized Europe by migration, and that when their connection with the mother country was severed, they were overpowered and exterminated by the present flora of Europe, which, as Prof. Gray has shown, is mainly of N. Asiatic origin.

The fact to which reference has just been made, viz.: the occurrence of *Onoclea sensibilis* on the Island of Mull, off the West coast of Scotland, while it has not been found in the Tertiary beds of other parts of Europe, is indicative, so far as it goes, not only of an American connection during the Miocene period, but of an American origin for that species, and so by inference of the other genera and species common to the two continents during that epoch.

If this inference should be confirmed by future observation, we should then see that the Eocene tropical or sub-tropical flora of Europe, was crowded off the stage by the temperate flora of the Miocene, which, accompanying a depression of temperature, had migrated from America, while the Eocene flora retreated South and East, and is now represented by the living Indo-Australian flora, characterized by its species of *Hakea*, *Dryandra*, *Eucalyptus*, &c., which form so conspicuous an element in the Eocene flora of Europe. This theory would account for the presence of these tropical forms in the Lower Miocene of Europe, while so far as yet obtained they are entirely absent from the Miocene flora of America. In Europe a few of the Eocene forms lingered behind in the grand exodus of that flora, and mingled with the more boreal and occidental barbarians by which the country was overrun; while in America those which we now call Asiatic forms never had an existence. That this bridge between America and Europe was in a temperate climate is proved by the character of the plants which passed over it. On referring to a terrestrial globe, it will be seen that by way of Greenland, Iceland, and the Hebrides, there are no very wide gaps to be spanned; but a connection by that route would carry us so far into the Arctic zone that none of the plants which we suppose to have made the journey could have withstood the cold of the climate had it been the same as at present. We have conclusive evidence, however, that it was not so, for on Mackenzie's River, Disco Island, on Iceland and the Island of Mull, we have, in the recurrence of parts of the very flora under consideration, proof not only of a warmer climate at the far North during the Miocene epoch, but that a part of the plants which formed the Miocene flora of Europe, actually did travel that road (at least visited all these localities); and in the buried remains of generations which were never to see the promised land, we have imperishable records of their presence and of the reality of this migration.

That we cannot, without further study of the facts, assign a *cause* for this great change of climate in the northern part of the continent, is no argument against its existence, for the facts are incontrovertible.

DESCRIPTIONS OF SPECIES.

Psilotum inerme (n. sp.)

In the collections made by Dr. Hayden are several groups and masses of a dichotomously branching plant, which could hardly have been anything else than a *Psilotum*. The stem and branches are flattened and smooth, both on the surfaces and sides, and show no organs of fructification. In size and general appearance this plant may be compared with *Ps. complanatum* of the Sandwich Islands, but differs from that in having the edges of the leaves smooth, while in the living species they are remotely toothed. We have now but a single species of *Psilotum* growing within the limits of the United States, *Ps. triquetrum* of Florida, a more slender plant than this, with triangular and toothed branches or leaves.

Formation and Locality. Miocene strata. Fort Union. (Dr. Hayden.)

Phragmites (sp.)

Among the plants collected by Dr. Hayden, from the Miocene beds near Fort Union, are numerous fragments of what seems to be a species of *Phragmites*. These consist of portions of broad, unkeeled, flag-like leaves, marked by numerous longitudinal nerves, of which there are eight or nine more strongly marked, and between these about seven much finer, connected by alternate cross-bars. No keel is shown in any of these fragments. In general structure these leaves closely resemble those of *P. Oeningensis*, Heer (Flor. Tert. Helvet i. S. 64. Taf. xxiv.); but the material is not sufficient to determine whether our species is identical with that.

Formation and Locality. Fort Union, Dacotah. (Dr. Hayden.)

Onoclea sensibilis. L.

Frond pinnate, large; pinnæ, lanceolate in outline, with waved margins, more or less deeply-lobed or pinnatifid, connate at their bases, forming a broad wing on the rachis of the frond; nervation strongly marked, more or less reticulated, the nerve of each lobe or pinnule springing from a common trunk having a dendroid form with waving branches, which often unite to form elongated *lacunæ*, of which the largest border the rachis of the pinnæ on either side, and are formed by the nerve branches of each lobe reaching over and touching, or closely approaching, the base of the nervation of the next superior lobe or pinnule.

The collection of Dr. Hayden contains a great number of examples of this beautiful fern, showing the upper and under surface of the frond, the variation of form of the pinnæ of different fronds, and different parts of the same frond.

The robust habit of this plant, the strong, waved and reticulated nervation and broadly winged rachis, which seem to distinguish it at a glance from all known fossil species, suggested a comparison with some of the strong-growing tropical ferns; and it was only after a laborious examination of all the genera of exotic ferns contained in the herbaria to which I had access, or described by authors, that I was led to turn my eyes nearer home.

The common form of *Onoclea sensibilis* grows abundantly in all parts of our country, and is one of the first plants collected by the youthful botanist. In this we have the rachis of the frond more or less winged, and a nervation on the same general plan with that of the fossil before us, but more distinctly reticulated. By this I was at first misled, but in examining Dr. Torrey's var. *obtusilobata*, I found in some specimens the exact counterpart of our fossil in the lobation of the pinnæ and nervation. The gradation of characters in this variety is very great and interesting. In some specimens we have a distinctly bipinnate frond; the pinnæ composed of numerous remote, even obovate, pinnules, and the nervation not reticulated, the nerves of the pinnules radiating and forked, but never joining. This is the extreme form, but even here the rachis of the frond is more or less winged. In an intermediate form we find the rachis winged, the pinnæ deeply lobed, and precisely the nervation of the fossil. Even in the common form the nervation is similar in plan, and the elongated spaces, destitute of nerval branches, on either side of the rachis of the pinnæ, form a noticeable feature in both.

There is little room for doubt, therefore, that during the Miocene age a species of *Onoclea* flourished in the interior of our continent, of stronger habit than either of the living varieties, and holding a middle position between them. This fact suggests the question, whether they could not have been differentiated from it.

Varying, as the living *Onoclea* does, in the size, outline, and nervation of the sterile frond—from six inches to three feet in height, from a finely reticulated to an open, dichotomous nervation; from a bi-pinnate frond with remote, obovate pinnules, to a pinnate form with wave-margined pinnæ and broadly alate rachis—it plainly includes all the characters of the fossils before us, and I therefore find it impossible to separate them.

What has been predicated of this species has been based on observations of the sterile frond only. No fertile frond has yet been found, and since in *O. sensibilis*, var. *obtusilobata*, the "sterile" frond is sometimes fruit-bearing, we may find that such was the case with the fossil. This is apparently the plant described by Prof. E. Forbes (Jour. Geo. Soc. Lon. vol. vii. p. 103), under the name of *Filicites* (?) *hebridicus*, and obtained by the Duke of Argyle, from the Island of Mull.

Formation and Locality. Miocene Argil. limestone. Fort Union, Dacotah. (Dr. Hayden.)

Sabal Campbellii (n. sp.)

S. Campbellii N. Journal Bost. Nat. Hist. Soc., Vol. vii. No. 4.

Leaf very large, 8–10 feet diameter with 50 to 80 folds; petiole long, 1½ to 2 inches wide, flat above, without a central keel above or below, unarmed; nerves numerous and fine, about 50 in each fold, six principal ones on each side of the midrib, with three intermediate ones between each pair, the middle one being strongest.

In general character the leaves of this palm have a strong resemblance to those of *Sabal major*, Ung. sp. (Chloris Prot. S. 42, Taf. xiv. fig. 2; Flor. Tert., Helvet 1, S. 88, Taf. xxxv. xxxvi. figs. 1, 2); the size of the leaf, the number of folds, and the character of the nervation being approximately the same, but in our plant the average size of the leaf is greater, the number of folds larger, and the petiole is without a keel. The form of the spindle, or terminal point of the petiole on the under side of the leaf, as exhibited in the numerous specimens collected by Dr. Hayden, seem to be shorter (more abruptly acuminated by a concave lateral excavation) than in the examples of *S. major* which have been figured or described. This character has little value, however, as it varies considerably in the different leaves. This species was first described from a series of specimens collected near Bellingham Bay, W. T., by Geo. Gibbs, Esq., Geologist to the U. S. N. W. Boundary Commission, of which the figures are not yet published. They showed only the upper side of the leaf, leaving the form of the point of the petiole on the under side to be conjectured. This want has been fully supplied by the collections made by Dr. Hayden, when connected with the expedition under Capt. W. F. Raynolds, U. S. A., as his specimens represent both surfaces of the basal portion of the leaf, and various fragments of its central and outer parts. All these specimens correspond, in every important particular, with those from Bellingham Bay, except that they prove the leaf to have been considerably larger than I had before supposed; larger indeed than any fossil fan-palms hitherto described. In the west coast specimens the petiole is 1¼ inch broad, while in those brought from the upper Missouri, the petiole is from 1½ to 2 inches broad, and all parts of the leaf proportionally strong. All the specimens from both the localities I have mentioned, show the petiole to have been flat, and without the central keel of *S. major* and *S. Lamanonis.* This, with its larger size, leads me to consider our plant as distinct from either of its European representatives. It is at least as much unlike either, as they are unlike each other. But, if specifically distinct, this must be regarded as an interesting representative species, confirming the conclusions derived from the other identical and allied species, of the parallelism of our Tertiary plant-beds with the lower Miocene strata of Europe.

Fan-Palms are a conspicuous feature in the flora of the tropics, growing in the greatest abundance under the equator, but they also spread through the subtropical, and into the temperate zones, being very abundant in the Southern United States. The discovery of fossil Fan-Palms by the party under Capt. Raynolds is an important fact, however, as Dr. Hayden had not found them in his previous explorations of the country bordering the Upper Missouri, though making large and interesting collections of fossil plants from the Miocene Tertiaries.

Formation and Locality. Miocene Tertiary beds. Banks of Yellowstone River. (Dr. Hayden.)

Thuya interrupta (n. sp.)

Branchlets flat, narrow, linear, pinnate, opposite, except at the summit of the branch somewhat remote, connected only by the slender woody axis on which the leaves of the branchlets are not decurrent; leaves in four rows, appressed, those of the upper and lower ranks orbicular or obovate, shortly mucronate, lateral ones longer, subulate, terminating in awn-like points; larger branches naked, or bearing closely-appressed, linear, scale-like leaves.

This is a very distinct and beautiful species, presenting marked differences from any known living or fossil members of the genus.

Its most remarkable character is its slender and graceful habit, and the separation of the pairs of leafy branchlets along the naked and slender branch. The leaves too are less crowded than in most other species, and the lateral ranks are prolonged into acute awn-like points; all of which must have given it an aspect considerably unlike that of any species hitherto described.

I am not aware that a true *Thuya* has before been found fossil. *Thuites Salicornoides* (Ung. Chlor. Prot. Taf. 2, fig. 1, Taf. 20, fig. 8), is regarded by Endlicher and Heer as rather a *Libocedrus*, to which it certainly seems, from the figures and descriptions given of it, to be more closely allied.

Formation and Locality. Miocene Tertiary beds. Fort Union, Dacotah. (Dr. Hayden.)

Glyptostrobus Europæus (Brong.)

Branches slender, bearing many branchlets; leaves of two forms, one short, thick and appressed, the other longer (½ inch), slender, divergent, acute, the shorter form carinated, the longer less distinctly, if ever so; male catkins small, terminal, globular, composed of a few shield-shaped scales; fertile cones larger, ovoid in form, scales narrow, wedge-shaped at base, at summit expanded, semicircular, with waved or crenate margins, the dorsum of each more or less distinctly marked with 10–12 acute, radiating carinæ.

One of the most interesting plants of the European Miocene is the *Glyptostrobus*, first discovered by Brongniart, and subsequently fully illustrated in the magnificent work of Prof. O. Heer (Flora Tertiaria Helvetiæ). The genus is now only represented on the earth's surface by *G. heterophylla* and *G. pendulus* of China, but during the middle Tertiary epoch was widely spread over both hemispheres. Most of the exposures of Miocene strata have furnished specimens of some one of the various phases of what is regarded by Prof. Heer as a single species, but which has been described under the three names of *G. Europæus*, *G. Ungeri*, and *G. Oeningensis.*

What I have regarded as probably but a variety of this same plant was collected by the U. S. Exploring Expedition under Capt. Wilkes, at Birch Bay, near the mouth of Frazer's River, B. C., by Geo. Gibbs, Esq., Geologist to the N. W. Boundary Commission (see Journal of Boston Nat. Hist. Soc., vol. vii. No. 4), and is represented by numerous specimens in the collection of fossil plants made by Dr. Hayden on the Yellowstone and Upper Missouri.

In this country, as in Europe, the foliage of *Glyptostrobus* exhibits two forms wherever the plant is found; the short appressed, and the longer divergent leaves. In addition to this, the specimens from the N. W. coast have a common character by which they may be distinguished at once from those collected by Dr. Hayden. The Western plant is more slender, the appressed leaves sharper and more delicate, the divergent leaves much longer, corresponding more nearly to the European form described as *G. Ungeri*, while those from the Upper Missouri resemble more the variety known as *G. Europæus.* The cones, however, found with the Missouri specimens are more like those of *G. Ungeri* than *G. Europæus*; the dorsum of the scale being marked by short, radiating carinæ, as in *G. Ungeri*, the margin being waved, but not regularly scalloped, as in *G. Europæus.*

From the extreme West we have as yet no cones which can be certainly referred to this plant, so that the most important element in the comparison is wanting, but it would seem that here, as in Europe, the different phases of the plants belonging to the genus *Glyptostrobus* are so linked together, that they should be regarded as forming but a single species. At least we have not yet obtained sufficient material to justify us in attempting to define the limits of other species.

The two living species of *Glyptostrobus*, which Fortune found growing in China, resemble the fossil forms perhaps as much as they do each other, and it is perhaps doubtful whether they should not all be united under the same name. The living and fossil plants are associated with fan-palms, and belong to the flora of the Southern temperate zone, or that of a latitude ten degrees south of the localities where the fossils occur.

Formation and Locality. Fort Union, Dacotah, Washington Territory, and Birch Bay, B. C.

Taxodium occidentale (Newb.)

T. occidentale, Bost. Jour. Nat. Hist. loc. cit.

Branchlets terete, leaves numerous, crowded, sessile or very short petioled, one-nerved, flat, rounded at both ends.

This plant is the American analogue of *T. dubium*, Heer (Flor. Tert. Helv. S. 49, Taf. xvii, figs. 5–15), which it so closely resembles, that at first sight it would probably be considered identical with that species, but in *T. dubium* the leaves are fewer, more obliquely set on the branchlets; are lanceolate in outline and acute at both ends, whereas in the specimens collected by Dr. Hayden on the Upper Missouri, Dr. Cooper in Montana, Mr. Geo. Gibbs near Bellingham Bay, Prof. Dana at Birch Bay, and by Richardson on McKenzie's river, the leaves are all broader, more closely set, rounded at both ends, and sometimes even emarginate at the summit. The specimens brought in by Dr. Hayden and Dr. Cooper are larger and stronger than those from the West coast, but the form of the leaf is the same.

It unfortunately happens that in none of the collections made at the West, containing this plant, are there any cones, which can, with any probability, be supposed to represent its fruit. It is not certain therefore that this is a *Taxodium*, and not a true *Taxus*, but the length of the leaves, sometimes 1¼ inches, and their accurate arrangement in two ranks, all extended in the same plane, give the foliage an aspect unlike that of most of the Yews.

In *Taxus brevifolia* the leaves of the young branches are nearly as distichous as these, but in *T. baccata*, *T. Canadensis*, and usually in *T. brevifolia*, there is manifested a tendency to a many-ranked arrangement. This is especially noticeable in the Irish Yew, in which the leaves surround the stem in much the same way as in the spruces. The branchlets are also more delicate than in the Yews, and the foliage must have been more light and feathery, like that of the deciduous cypress, (*Taxodium distichum*).

The resemblance of our plant to *T. dubium* of the European Miocene strata is so strong, that, even without the fruit, we are fully justified in placing them in the same genus.

Formation and Locality. Miocene Tertiary strata. Banks of the Yellowstone River, &c.

Sequoia Langsdorfii ? Br.

The leaves figured in the report of Col. Raynolds are part of a large number of the same species collected by Dr. Hayden on the Banks of the Yellowstone River. They include two forms of foliage; one, in which the leaves are many-rowed, short, appressed and awl-shaped; in the other, they are two-ranked, much longer, linear, acute or rounded, more or less narrowed, decurrent at the base, and traversed by a strong medial nerve. The first form is confined to the larger (and permanent ?) branches; the other to the terminal (and deciduous ?) branchlets. This foliage closely resembles that of the deciduous cypress of the Mississippi Valley, but the leaves of the branchlets are less crowded, are broader and more noticeably decurrent. Except in this latter character—and that is often not strongly marked—there is also little difference to be distinguished between these fossil leaves and those described by Brongniart, (Prod. pp. 108–208), under the name of *Taxites Langsdorfii*, and figured by Unger (Iconographia T. 15, f. 13), and later more fully illustrated by Prof. Heer (Flor. Tert. Helvet. 2, S. 54, T. xxi. fig. 4) as *Sequoia Langsdorfii*. The correspondence is so close with the plant figured by Heer, that he would doubtless consider them as identical, and, in the absence of distinctive characters, I have thought best to regard them as the same. I am strongly inclined to believe, however, that the leaves before me were derived from a tree more closely allied to our deciduous cypress than to our species of *Sequoia*, and that, whatever its generic affinities may have been, its foliage was deciduous.

A large number of fragments of a shaly, argillaceous limestone were brought in by Dr. Hayden, which are filled, and their surfaces covered, by disconnected branchlets with their leaves attached, and which present the appearance of having been thrown down together precisely as the deciduous branchlets of our cypress are detached by the frost. Among these are a few pieces of larger branchlets, bearing traces of short, appressed leaves, which I have conjectured to be the permanent foliage of the tree. These branches show, at regular intervals, the former points of attachment of deciduous ? branchlets, but none of them are still in their places. They may have been dead twigs; some of which would naturally fall and accumulate with the leaves. The leaf-bearing branchlets, too, are always simple, and though lying together in great numbers, crossing at every angle, they are wholly distinct and disconnected. The probability would therefore seem to be, that the foliage of the tree was deciduous, and although we have as yet no fruit to guide us, we may infer that it was not a *Sequoia*, but a *Taxodium*, closely allied to, and perhaps the progenitor of *T. distichum*.

It has been said above that the leaves of *Sequoia Langsdorfii*, Heer, are very like those under consideration, but if Prof. Heer is correct in considering the plants figured by Unger as *Taxites Langsdorfii* (Iconographia Denkschrift, k. k. Acad. iv. 1852, S. 103, Taf. xxxviii. figs. 12-16) as identical with that figured by him (loc. cit.), we should have additional evidence that these fossils, collected by Dr. Hayden, are at least specifically different from the European ones; for Dr. H.'s specimens nowhere exhibit any very near approach to those figured by Unger (l. c.), which are much broader, more closely set, apparently on permanent branches, and present a very different aspect. Prof. Heer has perhaps sufficient proof of the identity of all the forms that he includes under the name of *S. Langsdorfii*, but the light, feathery and deciduous? foliage, indicated by the impressions before us, could hardly, under any circumstances, have assumed the form of "*Taxites Langsdorfii*," as given in Unger's beautiful work to which I have referred.

Since the above notes were written, Prof. Heer has described a collection of fossil plants, made at Nanaimo, Vancouver's Island, and at Buzzard's Bay, British Columbia, and forwarded to him by Dr. Hooker. Among the plants from Nanaimo are several specimens which he regards as identical with his *Sequoia Langsdorfii*, but this seems hardly possible, as it is clearly proven from the facts published by me in the Bost. Jour. Nat. Hist. (Vol. ii. No. 4, 1863), that the plant beds of Nanaimo are all of Cretaceous age. The plant figured by Prof. Heer is apparently my *Taxodium cuneatum*, and has generally shorter and more spatulate leaves, with narrower bases than those of *Sequoia Langsdorfii*. The plant beds of Buzzard's Bay, like those of Birch Bay, and part of those of Bellingham Bay, are apparently Miocene.

Formation and Locality. Miocene strata, Banks of the Yellowstone River. (Dr. Hayden.)

Amelanchier similis (n. sp.)

Leaves petioled, ovate, obtuse or acuminate, rounded or slightly cordate at the base; margin coarsely toothed, except near the petiole, where it is entire; nervation pinnate, delicate; medial nerve straight, 6–7 pairs of lateral nerves diverging from the midrib at an angle of about 40°, slightly curved upward, especially near the summit, the upper ones nearly simple, but giving off a perceptible branch near the summit on the lower side, which runs into the next tooth below. The lower pair spring from the extreme base of the leaf, are strong and simple, and strike the margin where the dentation commences. The second pair of lateral nerves each send off two or three slender nerves from near the summit to the teeth of the adjacent margin; tertiary nerves very fine, leaving the secondaries at right angles, and forming a fine net-work of which the areolæ are nearly quadrate.

The number of specimens of this species in the collection is small, and all but one imperfect. This one is evidently the impression of a thin, delicate leaf, of which all the details of nervation are preserved as perfectly as they could have appeared in the living plant. The other specimens indicate that the leaves were usually pointed, often acute.

From the nervation and character of dentation of these leaves, I think we may at least say that the plant which bore them was rosaceous, and among the rosaceous genera with which I have compared them they approach most nearly to *Amelanchier;* some of the leaves of *A. Canadensis* being entirely undistinguishable from them in form or nervation.

A. Canadensis now grows over all the temperate parts of the continent, and would seem from its wide range to be as likely to be an old resident of the continent, and to be represented in the Tertiary, as any other of our plants.

Formation and Locality. Lignite Tertiary beds. Banks of Yellowstone River. (Dr. Hayden.)

Rhamnus elegans (n. sp.)

Leaves lanceolate, entire, rounded or abruptly narrowed at the base, long-pointed and acute above, broadest part one-third the distance from the base to apex; nervation regular and sharp, but delicate, midrib strongly marked, lateral nerves 12–15, nearly equidistant on either side, gently arched upward, and terminating in the margins; tertiary nerves numerous, fine, spanning the distance between the branch nerves, and dividing this space into narrow, sub-rectangular areoles.

This is a remarkably neat and symmetrical leaf, both as regards its outline and nervation. Its lines are all graceful, with little of the rigidity that characterizes the leaves of most of the *Rhamnaceæ*, and more of the aspect of the leaf of a Lauraceous tree, but the numerous parallel side-nerves, terminating all in the margins, form a character which the Laurels never have.

Of described species, it most resembles Weber's *R. Dechenii*, (Palaeontographica ii. S. 204, T. 23, fig. 2), but differs from it in having an ovate, lanceolate form, and the nervation is a little more crowded.

Formation and Locality. Miocene sandstone. Belmont, Colorado. (Miss Kate Haymaker.)

Rhamnites concinnus (n. sp.)

Leaves petioled, long ovate, acute, rounded at the base, coarsely and nearly equally mucronate-dentate; nervation pinnate, remarkably precise and parallel throughout; medial nerve straight; lateral nerves, 9–10 pairs diverging at an angle of about 20°, slightly arched upward, parallel among themselves, basilar pair reaching to margin below the middle of the leaf, sending off each about 8 short, simple, slightly curved, parallel branches to the dentations of the baso-lateral margin; superior lateral nerves simple, or once forked at the summit; tertiary nerves very numerous, simple, parallel, connecting the lateral secondary nerves and the branches of the basilar nerves nearly at right angles.

These beautiful leaves are so definite in form and structure, and so perfectly preserved, that we should have no difficulty in referring them to their appropriate genus, if we could find among living trees their precise generic counterpart, but up to the present time I have not been able to satisfy myself that they are generically related to any living plants. The nervation is in some respects very like that of *Berchemia*; e. g. *B. volubilis*, the "Supple Jack" of our Southern States. Nowhere else do I remember to have seen the same parallelism of the secondary and tertiary nerves, but the serration of the margin is coarser than in any of the *Rhamnaceæ* with which I am acquainted, and the development of the basilar pair of lateral nerves is much greater than in *Berchemia*. This latter character is not without example in *Rhamnus*, as it is even more conspicuous in some species of the genus, as for example in *R. celtifolia* of the Cape of Good Hope. A cross between that species and our *Berchemia*, with a greater development of the marginal dentation than either exhibits, would give us the fossil before us.

Considering it to exhibit more of the character of the *Rhamnaceæ* than of any other family, I have placed it doubtfully there.

Formation and Locality. Miocene strata. Fort Union, Dacotah. (Dr. Hayden.)

Sapindus affinis (n. sp.)

Leaves pinnate in many pairs of leaflets, with a single lanceolate terminal one; leaflets smooth, thick, lanceolate, long-pointed, acute, sessile or short-petioled, unsymmetrical, rounded or wedge-shaped at base; nerves fine and obscure, ten or more branches diverging from the midrib on either side at somewhat unequal distances, and of unequal size. These arch upward, giving off several lateral branches at right angles, or nearly so, and die out near the margins, or are carried round in a curve parallel with it, and thus connect.

These leaves are most strikingly like those of *Sapindus*, and taken by themselves would afford perhaps sufficient ground for uniting them with that genus. They are also very like a series of leaves found in the Tertiaries of Europe, figured by Prof. Heer, in the Flor. Tert. Helvet. Taf. cxix. and cxx. under the names of *Sapindus falcifolius*, *S. densifolius*, and *S. dubius*. The nervation is also the same; so there can hardly be a doubt that our plant and those of Prof. Heer are generically identical, and, if the proofs before him of the identity of his fossils with the living genus *Sapindus* are sufficient, we must conclude that the specimens before us are also the representatives of that genus. In our specimens, however, the leaves are constantly shorter and broader than in the species I have mentioned, and are often rounded at the base, so that I have been compelled to regard them as specifically distinct.

Formation and Locality. Lignite Tertiary beds, Mouth of Yellowstone River. (Dr. Hayden.)

Sapindus membranaceus (n. sp.)

Leaves pinnate in many pairs of leaflets, and terminating in a large ovate, often unsymmetrical one; lateral leaflets lanceolate, acute, wedge-shaped at base, unsymmetrical, thin and membraneous, with entire margins; nervation fine and sparse, many pairs of lateral nerves being given off by the midrib (from which also spring many small lateral branchlets), and, these arching upward inosculate near the margin or die out.

This is similar in nervation and in the general form of the lateral leaflets to the preceding species (*S. affinis*), but the whole plant is more delicate, the leaf thinner, the nervation finer, the terminal leaflet several times as large and of a different form.

Formation and Locality. Lignite Tertiary strata. Fort Union, Dacotah. (Dr. Hayden.)

Tilia antiqua (n. sp.)

Leaves 4–5 inches long, nearly as wide, often somewhat unsymmetrical, cordate at base, abruptly acuminate at summit, coarsely and nearly equally toothed; nervation strong, medial nerve straight, bearing 8–9 pairs of lateral nerves, which diverge at an angle of about 45°. The basilar pair of lateral nerves each sending off 5–6 branches on the lower side, which are again branched and terminate in the teeth of the margin. The second pair of lateral nerves have each 4 similar branches, the third pair 3, the fourth pair 2, the fifth pair 1, though there are frequent departures from this rule. The tertiary nerves are strongly marked, leaving the secondary nerves nearly at right angles, crossing directly between the adjacent ones, or anastomosing with some irregularity in the middle of the interspaces.

There are many fragments of these leaves in the collection before me, imbedded in a very fine and hard argillaceous limestone, and very beautifully preserved. They exhibit considerable resemblance to the leaves of *Morus*, especially *M. rubra*, but in that plant the basilar nerves of the leaves are more developed, and reach the margins higher up. The marginal dentation is also generally more acute in the leaves of the mulberry, and the leaves more pointed. The nervation of these fossil leaves is almost precisely that of our common species of *Tilia*, but in that the marginal dentation is much sharper. In a Southern species, however, *T. heterophylla*, I have found leaves which seem to be the exact counterpart of these; leaves with a roughish surface, strong and regular nervation, just after this pattern, and with a coarse, obtuse, and regular dentation. I am therefore inclined to refer these fossils to *Tilia*, and to regard them as the relics of a species closely allied to, if not identical with, *T. heterophylla.*

Formation and Locality. Miocene strata, near Fort Clarke. (Dr. Hayden.)

Rhus nervosa (n. sp.)

Leaves pinnate, leaflets oblong or linear in outline, rounded or cordate at the base, pointed above; margins coarsely and acutely serrate; nervation pinnate, strong; lateral nerves numerous, leaving the midrib at an acute angle, simple or somewhat branched, parallel, gently arched upward, and terminating in the teeth of the border.

The specimens of this species scarcely afford material for satisfactory classification. They bear a strong resemblance to the pinnate leaflets of some of our shrubby species of *Rhus*, especially of *R. copallina* and *R. typhina*. The nervation and marginal serration are essentially the same, and the texture of the leaf would appear to have been similar, but the nerves are stronger and the dentation coarser than in most specimens of these species with which I have compared it. With the trifoliate and oak-leaved species it has little in common, and will not be likely to be confounded with any of the fossil species which have been described.

The general form of the leaf is not unlike *R. Meriani*, Heer (Op. cit. Taf. cxxvi. figs. 5–11), but the margins of the leaves of that species are not as deeply toothed.

Formation and Locality. Miocene strata. Fort Union, Dacotah. (Dr. Hayden.)

Viburnum asperum (n. sp.)

Leaves ovate in outline, rounded or slightly cordate at base, acute and long-pointed above, margins all cut by relatively large acute teeth; nervation strong, crowded; midrib straight; lateral nerves alternate, about nine on each side, the lowest and strongest bearing each 5–6 simple branches on the lower side; the lateral nerves of the middle of the leaf carrying 1–2 branches at the summits, the upper ones simple, all terminating in the marginal teeth; tertiary nerves numerous, connecting the secondaries nearly at right angles, and generally parallel.

The nervation of these leaves is strong, regular and crowded. The marginal serration is simple, coarse and sharp, much like that of the leaves of many species of *Viburnum.*

Formation and Locality. Miocene strata. Fort Union, Dacotah. (Dr. Hayden.)

Viburnum lanceolatum (n. sp.)

Leaves small, narrow, ovate or ovate-lanceolate, rounded or slightly wedge-shaped at the base, pointed above, coarsely and sharply serrate-dentate throughout; nervation strong; midrib straight; lateral nerves about 5 pairs, diverging from the midrib at an angle varying from 15° to 20°, all slightly and uniformly arched upward, the basilar pair each throwing out at an acute angle about six simple branches which terminate in the teeth of the margin, the upper branches supporting each one or two similar branches near the summits; tertiary nervation fine, and undistinguishable in the fossil state.

In the regularity and precision of the nervation, these leaves resemble those of *Carpinus*, but in most species of that genus the serration of the margins is double, while here it is single, and, except in one or two old-world forms, the nervation of the leaves of the living species of that genus is considerably different, the basilar pair of lateral nerves being much shorter, and simple or less branched.

The style of nervation observable in these fossils occurs in one or two species of *Rhamnus*, but is there very exceptional, and the marginal serration of *Rhamnus* is rarely if ever so coarse as in the plant before us.

In *Zizyphus* we have a similar nervation; and not a dissimilar style in *Celtis*, but in neither of these have we such marginal teeth. In *Viburnum*, however, we have some examples of leaves exhibiting a closer resemblance to the fossils than any I have cited above, as in *Viburnum erosum*, Thurnbg. from Corea, and *V. odoratissimum* of Japan. In both these plants we find leaves with a great development of the basilar pair of nerves, and a coarse, acute, and regular dentation of the margin.

Formation and Locality. Miocene beds. Fort Union, Dacotah. (Dr. Hayden.)

Alnus serrata (n. sp.)

Leaves oval or elliptical, slightly cordate at the base, rounded or sub-acute at summit; margins serrate throughout, serrations fine, sharp and appressed below, coarse and double above; nervation pinnate, strongly marked; basilar pair of lateral nerves short and simple, upper ones branched near the extremities.

These leaves have nearly the form of *Alnus Kefersteinii*, Ung. (Chloris, Prot. Taf. 33, figs. 1–6), and a nervation similar in kind but more crowded. The marginal serration is also coarser.

Formation and Locality. Miocene strata. Banks of Yellowstone River. (Dr. Hayden.)

Planera microphylla (n. sp.)

Leaves very small, ovate-lanceolate, generally unsymmetrical, curved or falcate, cordate at base, pointed but rarely acute, coarsely and bluntly toothed; nervation strong; lateral nerves diverging at an angle of about 50° in 5–6 pairs, bending toward the summit, and inosculating along the margins; tertiary nerves strong, leaving the secondaries nearly at right angles, much branched and anastomosing to form a coarse and irregular network.

In its general form this leaf has a striking resemblance to

Planera Ungeri, Ettings. (Tert. flor. der Œstr. Monarch, p. 14, Taf. ii. figs. 5–18). *Ulmus Zelkovæfolia*, Ung. (Chloris Protogæa Taf. xxiv. figs. 7–12, etc.), but it is apparently considerably smaller, narrower, and more coarsely toothed.

Formation and Locality. Miocene strata. Fort Union, Dacotah. (Dr. Hayden.)

Catalpa crassifolia (n. sp.)

Leaves large, fleshy, ovate, heart-shaped at base, pointed above, sometimes unsymmetrical; margins entire; nervation strongly developed; midrib straight or flexuous; lateral nerves about 7 pairs; lower pair strongest, not reaching the middle of the leaf, giving off each about 4 branches on the lower side, of which the lower ones spring from the base of the laterals and are much branched; upper laterals branched at their summits, branches uniting to form a festoon somewhat remote from the margin; tertiary nervation invisible.

In its general aspect this leaf bears a marked resemblance to those of the common *Catalpa* which grows spontaneously in Kentucky and Tennessee, and is generally cultivated throughout the Northern States. The leaves of the *Catalpa* are, however, broader, and the basilar pair of lateral nerves are stronger, reaching to and sometimes above the middle of the margin. The number of lateral nerves is also less, but they branch at their summits, and form a marginal festoon very much in the same way as in the fossil.

The leaves of some species of *Ficus*, of *Gonolobus*, and *Aristolochia* exhibit considerable resemblance to this, but scarcely as much as do those of *Catalpa*. In *Gonolobus* and *Aristolochia* the nervation is lighter, more open, radiate and waved, while in the broad-leaved species of *Ficus* (*F. tiliæfolia*, *F. populina*, etc.), the basilar nerves are much more developed, and the marginal festoon nearer the margin. In *F. Morloti*, on the contrary, the basilar nerves are less strong. *Catalpa*, therefore, seems to offer the greatest resemblance to the fossil, and I place it provisionally in that genus. This is so conspicuous a feature in the flora to which it belongs, that it requires to be figured and described. Future observations will determine whether it has been correctly referred to its living allies.

Formation and Locality. Miocene strata. Banks of Yellowstone River. (Dr. Hayden)

Negundo triloba (n. sp.)

Leaves thin and delicate, but distinctly nerved, pinnate in one or more pairs, leaflets lanceolate or lance-ovate, long-pointed, rounded or slightly cordate at base, short-petioled; margins coarsely, remotely, and irregularly toothed; terminal leaflet trilobate, the margins toothed or serrated; nervation of lateral leaflets pinnate, nine or ten pairs of lateral nerves diverging from the midrib at an angle of about 50°, arching upward, more or less branched toward the summit. Of these the basal pair are shortest and simple, following the course of the adjacent margin; the second pair are strongest, and throw off each three or four curved branches on the lower side.

The general aspect, including texture, form, dentation, and nervation of the lateral leaflets, is strikingly like that of the corresponding parts of the leaf of the living *Negundo aceroides*. The genus *Negundo* is represented among living plants by but a single species, and this is so like *Acer* in all but its leaves, that Prof. Gray intimates that it should hardly be considered distinct from that genus. A fossil species has been discovered in the Tertiaries of Europe, *N. Europeum*, Heer (Flor. Tert. Helvet. 3, S. 60, Taf. cxviii. figs. 20–22), but it would seem to have been a smaller species than the living one, and had obovate wedge-based leaves, quite different from those before us.

If in the light of more and better material, it should prove that a species of *Negundo* lived on the American continent during the Miocene Tertiary Epoch, it would be a fact of no little interest, and would strengthen the claims of *Negundo aceroides* to a distinct generic place in the botanical series. In that case, however, its trilobate terminal leaflet would still further indicate its acerine affinities.

Formation and Locality. Near Fort Union. (Dr. Hayden.)

Aralia triloba. (n. sp.)

Leaves pinnate or ternate; lateral leaflets long-oval, rounded, or slightly heart-shaped, and unequal at base, pointed at summit, sharply serrate throughout; nervation pinnate; texture thin; surfaces smooth.

Trilobate leaf similar in surface, texture, nervation and marginal serration, but unequally three-lobed; lobes acute, long-pointed.

The character of these leaves is very well shown in the specimens before me. They seem plainly to indicate a species of *Aralia*, and have a marked resemblance to some of the leaves of our two most common species, *A. racemosa* and *A. nudicaulis*. The trilobate leaf is not commonly found in our Aralias, but there is always a tendency to the production of such a form, and I have frequently remarked it in *A. racemosa*, as it grows at the West. That is, however, generally a much larger and stronger plant than this.

Formation and Locality. Miocene strata. Fort Clarke. (Dr. Hayden.)

Corylus orbiculata. (n. sp.)

Leaves small, orbicular, or nearly so, slightly and unequally cordate at base, blunt-pointed above; margins set with fine and nearly equal teeth; nervation strong; midrib curved and slightly sinuous; lateral nerves about 7 pairs, mostly straight and nearly parallel among themselves, lower pair sending off each 7–8 short, simple or forked branches which terminate in the teeth of the edge; second pair supporting each about three branches of similar character; upper lateral nerves simple, or having each 2–3 branches near the summit; tertiary nerves parallel, distinct.

This is another hazel-like leaf, of which the classification, without the fruit, must be somewhat doubtful. The general form is more like that of the leaves of *Tilia* (*T. Americana* and *T. Europæa*); being much rounder than those of any species of *Corylus* with which I am familiar.

The nervation is however different from that of *Tilia*, and is in fact altogether that of *Corylus*. In *Tilia*, the leaves are usually broadly cordate; the nervation of the base and lateral portions of the leaf being supplied from the first or basal pair of lateral nerves, which are largely developed, much branched, and reach considerably above the middle point of the lateral margin. In *Corylus*, on the contrary, the basal nerves are short and supply only the basal margins; the second pair of lateral nerves is relatively more developed than in *Tilia*, *Morus*, etc., and in the number and parallelism of the lateral nerves they approach more nearly to the strictly feather-veined leaves of *Fagus*, *Alnus*, etc.

Formation and Locality. Miocene Tertiary strata, Fort Union, Dacotah. (Dr. Hayden.)

Corylus grandifolia. (n. sp.)

Leaves large (5–6 inches long), short-petioled, unequally cordate at the base, pointed above, coarsely and unequally dentate; nervation strong; midrib straight or curved, not sinuous; lateral nerves, 6–7 pairs; lower pair diverging at a larger angle than the upper ones, and supporting a number of short, generally simple, branches, on the lower side, which terminate in the basal margin; second pair diverging at an angle of 45°, reaching the margin about the middle, supporting about 4 branches on the outside; upper pair simple or branched once, rarely twice.

This was evidently a large, thick, roughish leaf, having more the aspect and texture of the leaves of the mulberry than of the hazel. The nervation is, however, much nearer that of the latter genus. Indeed, in all essential characters it is the same as that of the three species of *Corylus* with which it is associated. The dentation of the margin, also, is acute, unequal, partially double, much more like that of the leaves of *Corylus* than of any of those with which I have compared it.

Formation and Locality. Lignite Tertiary beds. Fort Union, Dacotah. (Dr. Hayden.)

Corylus Americana. (Walt.)

Among the variety of specimens of the leaves of *C. Americana* with which I have compared these fossils, there are some which, if fossilized, would form impressions absolutely undistinguishable from them, and I have therefore found it impossible to fix upon any characters by which they can be separated. As compared with the fossils which I have referred to *C. rostrata*, these leaves are a little more rounded in outline, the nervation somewhat more open and delicate, the marginal teeth more nearly equal in size, and more obtuse.

Of all the species of *Corylus*, living or fossil, which have been described, there is none of which the leaves so much resemble these, as *C. Americana*.

Formation and Locality. Miocene Tertiary strata. Fort Union, Dacotah. (Dr. Hayden.)

Corylus rostrata. (Ait.)

These leaves offer no characters by which they can be distinguished from those of the living "Beaked Hazel-nut." They are clearly those of a Hazel, and show such a perfect correspondence with those of one of the species living in the region where these fossils occur, that until the fruit shall be found, and the question definitely settled, I have thought it best to consider them as identical.

Formation and Locality. Miocene strata. Fort Union. (Dr. Hayden.)

Populus cordata (n. sp.)

Leaves orbicular or round-heart-shaped, deeply cordate at the base; margins strongly toothed, except the inner border of the lobes of the base; nervation radiate; medial nerve straight, simple below, branched near the summit; lateral nerves, 3 pairs diverging at nearly equal angles, from a common point of origin; lower lateral nerves small, simple, arched upward at their summits, terminating in the margins; second pair of lateral nerves springing from the basal point of radiation nearly at right angles with the midrib, arching upward as they approach the lateral margins, and supporting each about three branches on the inner side; third pair of lateral nerves diverging from the midrib at its base at an angle of about 45°, bearing one or two lateral branches, and terminating in the margin above the middle of the leaf.

Of this neat species there are no complete specimens in the collection; none of them showing the summit of the leaf. Enough is, however, discernible in them to show that they represent a species of *Populus* different from any other in the collection; and from any before described. Of the species at present growing on the North American continent, the leaves of *P. heterophylla* approach most nearly to these, but the nervation of the leaves of that tree is never so distinctly radiate.

In the character of its marginal dentation this species resembles *P. mutabilis*, var. *crenata*, Heer, but is clearly distinguished from that by its cordate base, and corresponding radiate venation.

Formation and Locality. Miocene Tertiary strata. Banks of Yellowstone River. (Dr. Hayden.)

Populus nervosa (n. sp.)

Leaves rounded in outline, margins nearly entire, or slightly serrate at the base, sharply but not deeply toothed on the sides, on the summit strongly doubly serrate, with a tendency to become three-lobed; nervation strongly marked and crowded; basal nerves springing from the midrib above the margin, given off at an angle of 30° or more, reaching the margin above the middle, where they terminate in the most prominent teeth or lobes; from these basilar nerves are given off five or six strong lateral nerves, which arch upward and, more or less forked, terminate in the marginal teeth; above the basilar nerves three or four pairs of strong lateral nerves are given off from the midrib, which run parallel with the basilar pair, and terminate, like them, in the compound teeth of the upper margin. The lateral nerves are connected by numerous strong secondary nerves, which are generally simple and slightly arched, sometimes broken, and anastomosing with each other. This latter character gives a lattice-like appearance to the leaf, to a degree unusual in the genus.

The strong nervation of this species is one of its most marked characters, and has suggested the name given it. By this and the double dentation of the superior margin, as well as by their acerine form, these leaves are easily distinguishable from any of those with which they are associated and any hitherto described.

Formation and Locality. Lignite Tertiary beds. Banks of Yellowstone River. (Dr. Hayden.)

Populus nervosa (n. sp.)

Var. B. *elongata.*

Leaves ovoid or oblong in outline, wedge-shaped at base, abruptly pointed at summit, basal margins entire, sides rather finely toothed, superior margin, coarsely, somewhat doubly dentate; nervation strongly marked, less crowded than in var. A.; basal nerves springing from the midrib above the basal margin nearly straight, reaching the sides above the middle and terminating in the first large dentations of the upper margin; exterior lateral nerves of the basal pair, three or four in number, remote, nearly simple, curved upward, and terminating in the lateral teeth; secondary nerves above basal pair, three on each side of the midrib, parallel with the basal pair, and connected with them, each other, and the midrib, by numerous strong, generally simple, lattice nerves.

The nervation of these leaves is essentially the same as that of those last described, and which, notwithstanding the difference of form that they present, I am inclined to consider as belonging to the same species. This diversity of form is not greater than may be seen in the leaves of any poplar tree, and the differences of dentation are not greater than those observed in different leaves of many living and fossil species. The origin of the large basilar nerves *above* the base of the leaves, the strong and latticed nervation, and the dentation of the same general character, with the fact that all the specimens are from the same locality, all combine to lead me to consider the two forms as specifically identical.

Formation and Locality. Lignite Tertiary strata. Yellowstone River. Nebraska. (Dr. Hayden.)

Populus Nebrascencis (n. sp.)

Leaves long-petioled, 2–3 inches long, ovate, pointed, regularly rounded at the base, coarsely and irregularly toothed, except near the base, where the margins are entire; nervation strong, radiating from the base of the leaf; medial nerve straight, simple (or supporting very small nerves), except near the summit, where two or three larger branches rise from it; lateral nerves, two pairs on each side, springing from a common point of origin; lower pair arched upward, nearly parallel with the margin of the leaf to which they send off one or more simple branches; second pair of laterals diverging from these at an angle of 30°, arching upward, and running parallel with the midrib, terminating in the margin near the summit, each giving off about three exterior branches, which curve upward, and terminate in the dentations of the border.

This species by its general form and nervation, approaches closely to *P. Smilacifolia*, but the base is rounded (sometimes slightly wedge-shaped), never distinctly cordate; the superior lateral nerves are not quite so much drawn together toward the summit, and the margins are differently and much more coarsely dentate.

A large number of specimens of this species present constant and distinctive characters. They exhibit considerable variation in size, being from 1 to 3 inches in length, but in form, nervation, and marginal dentation, they are alike.

These specimens are derived from different localities, and without doubt represent a distinct species which was spread over the Tertiary Continent.

By the character of the impressions left on the stone, as well as by the coarse and unequal dentation of the margins, we may infer an affinity between this and the downy-leafed poplars of the present epoch, such as *P. alba* of Europe, etc., while in the smooth surface and finely denticulate or entire margin of *P. Smilacifolia*, we have evidence of resemblance to *P. tremuloides*.

There is no fossil species for which this can well be mistaken. Some of the forms of *P. crenata*, Unger (Foss. Flor. v. Sotzka, S. 167, Taf. xxxvi. figs. 2–5), resemble these leaves, but they are not so distinctly radiate-nerved. Unger represents the teeth of the margin as more acute, and more like those of *P. tremula*, with which he compares his fossil species.

Formation and Locality. Ferruginous shale. Banks of Yellowstone River. (Dr. Hayden.)

Populus cuneata. (n. sp.)

Leaves small, obovate, somewhat wedge-shaped at the base, obtusely pointed at the summit, coarsely, obtusely, and irregularly dentate on the margins, three-veined, basilar nerves given off at an acute angle, terminating above the middle of the margin; secondary nerves few-forked, and often inosculating.

This species is represented by numerous specimens in the collection made by Dr. Hayden on the Yellowstone. It will be seen to be distinctly separable from any of the species published with it, and the same may be said in regard to those published elsewhere. In general form it bears some resemblance to *P. attenuata*, Al. Braun (Flor. Tert. Helvet. 2. S. 15. Taf. lvii. and lviii.), also to some forms of *P. mutabilis* H.; but the nervation is less crowded than in those species, and both are acuminate-pointed.

Formation and Locality. Lignite Tertiary beds. Banks of Yellowstone River. (Dr. Hayden.)

Populus genetrix. (n. sp.)

Leaves large, cordate in form, acuminate; margins serrate, with rather small appressed teeth; three-nerved; nervation sparse but strong; midrib straight, with few small branches; basilar nerves very strong; given off at an acute angle, much branched at the summit, reaching nearly to the margin far above the middle; from each of the basilar-lateral nerves spring 5–6 exterior branches, the lower ones very strong and branched, the upper slender and simple.

In general aspect this leaf is very similar to that of the living *P. balsamifera*, and apparently differs from it only in its nervation. It is more decidedly three-nerved than those of any of the living group which it may be supposed to represent —*P. balsamifera*, *P. candicans*, *P. monilifera*, etc.,—yet one may occasionally find a leaf of either of these species which in this respect approaches the fossil before us. The dentation of the margin is essentially that of *P. balsamifera*, and it can hardly be doubted that we have here the progenitor of one or more of the group of poplars with which I have compared it, and which now grow in the region where these fossil plants were collected.

The different species of *Populus*, among the Miocene plants collected by Dr. Hayden, are far more generally three-nerved than are the living species which now inhabit this country. In this respect they resemble more the foreign *P. alba*; and it may be said that the majority of species described in this memoir are more closely allied to the section *Coriaceæ* than to the *Balsamitæ*.

Formation and Locality. Lignite Tertiary beds. Banks of Yellowstone River. (Dr. Hayden.)

Populus Acerifolia. (n. sp.)

Leaves long-petioled, broad-ovate in outline, often somewhat three-lobed, obtuse, slightly cordate at base, margins coarsely and unequally crenate; nervation radiate, strong; medial nerve straight, giving off one pair of lateral nerves near the centre of the leaf, and above these about three smaller ones on each side. From the base of the midrib spring two pairs of lateral nerves on each side. Of these the lower and smaller pair diverge at an angle of 60°–70° with the midrib, are nearly straight, give off numerous short branches on the lower side, and terminate in the lateral margin below the middle. The second and larger pair of laterals diverge from the midrib at an angle of about 35° to 45°, are straight or slightly curved upward, terminating in the margins above the middle, or in the lobes, when lobes are developed; from these spring three or four branches on the outside, which, simple or branching, terminate in the scallops of the border. The tertiary nervation, shown very distinctly in some of the specimens, forms a network similar to that of the leaves of living species of *Populus*, of which the areolæ exhibit considerable diversity of form and size, being polygonal with a roundish outline, or quadrangular.

The general aspect of these leaves is much like that of some of the living maples, but they are less distinctly trilobate; the crenation of the margin is coarse, irregular, and obtuse or rounded, as is usually the case with the leaves of a group of poplars, the leaves of which in other respects most resemble these. The surface is, in many specimens, somewhat roughened, as though in the living leaf it was canescent; also a common character among poplars, but rare or unknown among maples. The leaves of the maples are generally thin, and the network of the tertiary nerves is remarkably fine and uniform, affording a reliable generic character. This is visible in the leaves of all the recent maples, and is beautifully shown in the impressions of the leaves of *A. pseudoplatanus*, given in Ettingshausen and Pokorny's *Physiotypia Plant. Austria*, Taf. xvii., fig. 10.

Among fossil species this perhaps resembles most *P. leucophylla* (Foss. Flor. v. Gleichenberg Denkschrift, k. k. Acad., vol. viii., 1854, p. 177, Taf. iv., figs. 6–10), but is much more distinctly crenate-toothed on the margin. The teeth of *P. leucophylla* are either obsolete or remote and acute, making a sinuate-dentate margin.

Formation and Locality. Lignite Tertiary beds. Fort Union, Dacotah. (Dr. Hayden.)

Populus Smilacifolia. (n. sp.)

Leaves ovate, pointed, slightly cordate at the base; margins finely and obtusely crenulated; nervation radiate, delicate, and sparse; medial nerve straight, giving off only fine and scarcely perceptible lateral nerves below, and two or three longer branches near the summit; two pairs of lateral nerves radiate with the medial nerve from the same point at the base of the leaf; of these the lower two are small, nearly simple, and arched evenly upward; the other two, nearly as strong as the midrib, spring from the base at an angle of about 25°, and, after diverging to the middle of the leaf, curve upward toward the summit, near which they terminate in the margins. These lateral nerves support four or five simple or once-forked branches, each given off exteriorly, which curve upward, and terminate in the lateral margins. The tertiary nerves are given off nearly at right angles from the secondaries, and form a delicate polygonal or quadrangular network over the surface of the leaf.

The lower pair of lateral nerves should properly be considered as branches of the larger ones, so that the leaf is more distinctly three-veined than that of any living species of *Populus*. This character, with the smooth surface and nearly entire margins, gives these leaves the general aspect of those of *Smilax*, and suggested the name given them. Their nervation, however, is sufficiently distinct from that of *Smilax*, and is clearly that of *Populus*, though in a somewhat exaggerated form. In *Smilax* three or five nerves radiate from the base of the leaf, and *terminate together at the summit*, which those of the leaves of *Populus* never do. In *Smilax*, too, the principal nerves give off no large branches, but all the interspaces are filled with a labyrinth of anastomosing veins, forming a very different network from that of *Populus*.

The marginal serration of the present species would seem to have been much like that of the leaves of the living *P. tremuloides*, but still finer, while the size of the leaf was considerably larger.

Formation and Locality. Miocene Lignite Tertiary. Fort Union, Dacotah. (Dr. Hayden.)

Platanus nobilis. (n. sp.)

Leaves large, one and a half feet in length and breadth, petioled, 3 lobed, or sub 5 lobed, lobes acute, margins of lobes and base entire, or near the summits of the lobes delicately sinuate-toothed; nervation strongly marked, generally parallel; medial nerve straight, two basilar nerves of nearly equal length and strength diverge from it at an angle of 30°–35°, are straight throughout and terminate in the apices of the principal lateral lobes. Above the basilar nerves about 16 pairs of lateral nerves are given off from the midrib at about the same angle; these are nearly straight and parallel, terminating in the teeth of the margin. From each of the basilar nerves diverge about the same number of pairs of branches as from the midrib, and these are also nearly straight and parallel, and terminate directly in the margin. Of these the second or third exterior one on each side is often much the strongest of the series, and is then prolonged into a small but distinct lateral, triangular, acute lobe, giving the leaf a somewhat pentagonal form. From this basilar branch of the lateral nerves, 12 or more short, generally simple, branchlets spring on the lower side, and 4–5 on the upper side near the summit, all of which terminate in the margins. The tertiary nerves connect the adjacent secondary nerves nearly at right angles; sometimes they are straight and parallel, but oftener more or less broken and branching where they meet, near the middle of the interspaces. Where the systems of nervation of the lateral and middle lobes come in contact, the tertiary nerves are stronger, and form a somewhat irregular network, of which the areolæ are large and sub-quadrate.

In general aspect these magnificent leaves are considerably unlike those of any known species of *Platanus*, and I have felt considerable hesitation in referring them to that genus. The texture was evidently thicker and the surfaces smoother than in the leaves of most Sycamores, and, on the whole, they recall the leaves of *Cecropia*, or some other of the broad, leathery, polished leaves, borne by the trees of the tropics. On close examination, however, they are found to present the radical structure of the leaves of *Platanus*, and, aside from their association with so many genera plainly belonging to the flora of the temperate zone, their form and nervation seem to me to afford at least presumptive evidence that they were borne by a tree of that genus. They will, perhaps, suggest to the fossil botanist the leaves described by Unger under the names of *Platanus Hercules*, *P. Jatrophæfolia*, etc. (Chloris Protogæa, p. 137, T. xlv., figs. 6–7, etc.), and which he subsequently removed from that genus; but those palmate, many-lobed leaves were very unlike these now before us, and resemble much more the leaves of *Jatropha* or *Sterculia*, than those of *Platanus*.

The crowded, somewhat heavy, and regular nervation of these leaves, their thick texture and polished surface, must have given the tree on which they grew an aspect quite different from that of *P. occidentalis*; but *P. orientalis*, and sometimes *P. racemosa*, have thick and polished leaves, and the deviation from the common form is not so great in these fossils as in the living species I have named, or the fossil species named by Unger *P. grandifolia* and *P. Sirii* (Chlor. Protogæa and Foss. Flor. v., Sotzka).

In size, these leaves exceed those of any known species of sycamore, and if we are correct in referring them to *Platanus*, they may be considered the only relics we have of by far the noblest species of the genus. Some of the leaves are a foot and a half in length, and of about equal breadth, and yet they do not so far exceed the ordinary size of the leaves of the Sycamores as do the leaves of *Acer macrophyllum* those of other species of maple.

Formation and Locality. Miocene Tertiary beds. Near Fort Clark, on the Upper Missouri. (Dr. Hayden.)

Platanus Raynoldsii (n. sp.)

Leaves of large size, sub-orbicular or rudely triangular in outline, more or less rounded below, three-pointed above, often decurrent on to the petiole, margins at base entire, on the sides and above, coarsely and obtusely double-serrate, the lobes of the upper margin short and broad, less produced than in most other species; nervation strong but open, having the general character of *P. occidentalis* and of the fossil species *P. aceroides.*

The younger leaves are rounded in outline, and decurrent on the petiole. Those more fully developed (which are sometimes fifteen inches in length and breadth), more triangular in form, not always decurrent, and having the lobes more produced, offer considerable resemblance to those of *P. aceroides*, an extinct species from the Miocene of Europe; the nervation being similar in kind, and not greatly different in degree. The leaf is, however, always less angular than in *P. aceroides* and *P. Haydenii*, and the character of the marginal serration is essentially different from that of any known species. In *P. aceroides* the margins are set with long, acute, curved, simple teeth, as in the living *P. occidentalis;* in *P. Haydenii* the margins are for the most part only sinuate; and in *P. nobilis* the middle lobe only is toothed, and that but slightly; while in the species before us, with the exception of the basal margin, the whole outline is marked by a broad, strong, double dentation.

In texture the leaf was apparently similar to that of *P. occidentalis*, rather thin and more or less roughened.

Formation and Locality. Miocene Tertiary deposits. Banks of Yellowstone River. (Dr. Hayden.)

Platanus Haydenii. (n. sp.)

Leaves large, long-petioled, when mature three, perhaps rarely five lobed; lobes nearly equal, long-pointed, acute; on either side of the middle lobe five to eight obtuse teeth; margins of the lateral lobes sinuately toothed to near the base; younger leaves ovate, acuminate, coarsely toothed throughout except near the base, which is slightly decurrent; nervation strong, radiate from the base, primary nerves three, which are nearly straight and terminate in the three lobes of the border. From the midrib spring seven or eight pairs of lateral nerves above the basilar pair; these diverge at an angle of about 35°, are slightly flexed at the base, straight or nearly so above, where they are somewhat truncated, their branches terminating in the marginal teeth. The basilar nerves diverge from the midrib at an angle of about 35° and run nearly straight to the extremities of the lateral lobes. They each give off on the lower side seven or eight branches, of which the second or third is strongest. These are more or less curved and branched, the branches terminating in the teeth of the margin. Fruit 2–3 lines long, prismatic, clavate.

This fine species, which is well represented in the collection, is closely related to *Platanus aceröides*, so common in the Miocene strata of Europe. There are, however, noticeable differences which seem to me to have a specific value. The leaves of *P. aceroides*, though exhibiting great variety of form, are I believe always acutely toothed, while in the specimens before us, the teeth are never acute except those which in the young leaves represent the lateral lobes of the mature form. In *P. aceroides* also, according to Heer (Flor. Tert. Helvet. v. 3, p. 71, Taf. lxxxvii. and lxxxviii.), the nervation is more sparse, the angle of divergence of all the nerves greater, the number of lateral branches of the midrib less, and the number of marginal teeth considerably greater. Prof. Heer says (loc. cit.) that in *P. aceroides* the middle lobe of the leaf has 2–4 dentations on either side, while in *P. Haydenii* the mature leaf has 8–10 teeth on each side of the middle lobe. The difference before specified in the form of the marginal teeth is very marked and strikes the eye at a glance. In *P. aceroides* they are few, long and acute, sometimes even uncinate, while in *P. Haydenii* they are more numerous, less prominent and always obtuse, sometimes merely giving a wavy outline to the margin of the leaf.

Detached seeds are all that we have of the fruit, and these, though plainly derived from a *Platanus*, in their condition of fossilization, afford no good characters with which to compare this species with the two now living on this continent, or with the living and fossil species of the Old World.

P. aceroides, according to Heer, had fruit in racemes like the Mexican plane tree, while, as every one knows, the fruit of *P. occidentalis* is single. In general aspect, the species now before us is more like the Eastern than the Western of our American sycamores, to the former of which it has considerable likeness, and may very well have been its progenitor.

Formation and Locality. Miocene strata. Banks of the Yellowstone River. (Dr. Hayden.)

Cornus acuminata. (n. sp.)

Leaves ovate or ovate-lanceolate, long-pointed, acute, entire, narrowed at the base and slightly decurrent; midrib distinct, straight or curved toward the summit, following the course of the frequently deflexed point; lateral nerves numerous, regular and nearly parallel, simple, lower ones straight with a slightly curved summit, upper ones becoming progressively more arched upwards, when near the apex of the leaf curved in so as nearly to join the extremity of the midrib; tertiary nervation so fine as to be hardly perceptible in the fossil state.

The specimens of these leaves contained in the collection of Dr. Hayden, are quite numerous and pretty well preserved. Although there is no fruit of *Cornus* associated with them, there can be little doubt that they are properly referred to that genus. The aspect of the leaves of *Cornus* is peculiar, and such as is usually readily recognizable at a glance. This *facies* is given by the outline as well as the nervation. The outline is usually more or less accurately oval, the margin entire, the base rounded or slightly wedge-shaped, the summit pointed and laterally flexed. The nervation is very clearly defined, the midrib strong at the base, tapering gradually till it reaches the extreme point of the apex; the lateral nerves pinnate, approximated below, more remote above; all simple, arched upward, those near the summit being drawn in to join the midrib.

This latter characteristic is visible in all the species of *Cornus* known, and is particularly noticeable in the common herbaceous species *C. Canadensis.* It is also very marked in *C. Florida*, *C. sericea*, *C. alternifolia*, etc.

The tertiary nervation is generally delicate and sparse, the tertiary branchlets running across obliquely, but with nearly a straight course, between the adjacent lateral nerves. In all these characters, as far as they are retained in the fossils before us, we find an entire correspondence with the living genus *Cornus*, and refer these leaves to that place in the botanical series with as much confidence as the foliary appendages alone can give.

Formation and Locality. Fine laminated sandstone, with *Platanus Haydenii* and *Populus Nebrascensis.* Yellowstone River. (Dr. Hayden.)

Carya antiquorum. (n. sp.)

Leaves pinnate, large, leaflets lanceolate, long-pointed, acute, sessile, finely serrate, middle leaflet broadly lanceolate, widest above the middle, narrowed to the base, which is somewhat unequal; lateral leaflets narrow, lanceolate, unsymmetrical throughout, somewhat falcate; nervation sharply defined, conspicuously parallel, medial nerve straight in the terminal leaflets, more or less curved in the lateral ones; secondary nerves springing from the midrib at a large angle, numerous, sub-parallel, all arched upward, their extremities prolonged parallel with the margins of the leaf; the upper ones strongly arched, but terminating more directly in the margins; tertiary nerves distinct, mostly simple, straight, and parallel among themselves, connecting adjacent secondary nerves nearly at right angles.

The form, serration and nervation of these leaves are entirely those of *Carya*, and while without the fruit it may not be possible to fix their place in the series more definitely than to say that they represent the genus *Juglans* as formerly constituted, including *Carya*, we may at least refer them with confidence to a place within the limits of that genus. The leaves of the species of *Carya* and *Juglans* are very similar; so much so that some of the Caryas, such as *C. olivæformis*, have leaves that could in the fossil state hardly be distinguished from those of *Juglans*.

The specimens before us, however, seem to me to be more widely separated from those of the known species of *Juglans* than are those of the Pecan; and there seems little doubt that the tree if now living would fall within the limits of *Carya*.

In some specimens, the lateral nerves are remarkably straight and numerous, giving to the leaf very much the aspect of those of *Æsculus*; but from a comparison of the many leaves of this plant in the collection of Dr. Hayden, I infer that they were not palmately grouped, but pinnate, the form of the bases of the leaves indicating this.

The tertiary nervation is also quite different from that of *Æsculus*. In the latter genus it usually forms an exceedingly fine network filling the interspaces between the secondary nerves, in which the straight transverse lattice-like bars, so characteristic of the fossils before us, are wanting. At least this is the case with our American "Buckeyes." In *Æ. Hippocastanum* of the Old World something of the kind is visible, but in prevalence and regularity very unlike that in the fossil.

Formation and Locality. Tertiary strata. Mouth of Yellowstone River. (Dr. Hayden.)

Aristolochia cordifolia. (n. sp.)

Leaves petioled, heart-shaped, pointed, entire; nervation sparse, midrib strong at base, vanishing above, basilar lateral nerves supplying the lower half of leaf, much branched, upper laterals small, branched, branches connecting.

This leaf has essentially the form and nervation of our living species of *Aristolochia*, resembling most *A. tomentosa*. Without more material, it is impossible to say whether it is distinct from that species or not, as the form of the leaves must vary somewhat, and one specimen can hardly serve for making an intelligent comparison. Waiting the collection of other examples of this plant, and not having satisfactory evidence of identity, I have given it a distinctive name.

The genus *Aristolochia* is represented in the Tertiary and probably in the Cretaceous rocks, but by species with which this is not likely to be confounded.

Formation and Locality. Lignite Tertiary beds. Banks of Yellowstone River. (Dr. Hayden.)

Phyllites Cupanioides. (n. sp.)

Leaves large, fleshy, ovate, elliptical in outline, rounded at base, sub-acute at summit, margins coarsely and obtusely toothed above, simple or waved below; nervation pinnate, strong; midrib straight or flexuous, lateral nerves, about six on each side, crowded below, more remote above, basilar pair short and simple, uniting above with the tertiary branches of the second pair to form a marginal festoon, middle secondaries each bearing one or two branches near the summits, upper one simple; tertiary nervation distinct, forming lattice-like bars connecting the secondary nerves at right angles.

These fine leaves exhibit a resemblance in their texture and crenate margins to those to which I have given the name of *Ph. carneosus.* They are, however, of different form, and have a more simple and rectilinear nervation. The collection of Dr. Hayden contains a great number of fragments of this species, but, up to the present time, I have failed to find among living plants any which afford a satisfactory comparison with them. A general similarity in form and nervation to *Cupania*, and especially to *C. Americana*, has suggested the name adopted, but it cannot be said that the correspondence is very close.

Formation and Locality. Miocene strata. Fort Union. Dacotah. (Dr. Hayden.)

Phyllites venosus. (n. sp.)

Leaves thick and fleshy, irregularly oval in outline, rounded or slightly heart-shaped at base, blunt-pointed above, unsymmetrical throughout, margins entire or serrate, nervation strong, pinnate, midrib flexuous, lateral nerves arched upward, branching at summit.

I have been able to detect no relationship between these leaves and those of any living plants, and publish the figures and description given, in hopes that others may be more successful. They have the general aspect of those of a Lauraceous tree, but I suspect they are related to those now described under the names of *Ph. carneosus* and *Ph. Cupanioides.*

Formation and Locality. Fort Union, Dacotah. (Dr. Hayden.)

Phyllites carneosus. (n. sp.)

Leaves large, fleshy, and strongly nerved, orbicular in outline, cordate or rounded, often unsymmetrical at the base, obtuse at summit, margins wavy or coarsely and deeply scalloped; nervation strongly marked throughout; medial nerve straight, or nearly so, frequently produced into a long and strong petiole; lateral nerves in six to eight pairs, all more or less forked; lower pair short and curving downward soon after leaving the midrib; second pair also curved outward near the base, and reaching the baso-lateral margin by a course nearly at right angles to the line of the midrib; third pair strongest, much branched on the lower side above the middle; upper pairs once or twice forked near the summit; tertiary nerves parallel, simple, straight or gently arched, given off at right angles from the secondary, which they connect.

Up to the present time I have failed to identify these leaves with those of any genus known, living or fossil. In general form they resemble those of *Coccoloba*, and must have belonged to some plant having much the habit of *C. uvifera;* but the leaves of that plant are entire, and the nervation is quite different. One of the other species of *Coccoloba*, which grows in the West Indies, *C. diversifolia*, has leaves with a marginal serration, and a nervation more like that of the leaves before us, but both the margins and nerves are unlike.

The leaves which I have designated by the name of *Phyllites Cupanioides*, as it seems to me, should be generically united with these.

Formation and Locality. Miocene strata. Fort Union. (Dr. Hayden.)

II. *Notes on certain* Terrestrial Mollusca, *with Descriptions of* New Species.

By Thomas Bland.

(*Continued from Vol. VIII., p.* 170.)

Read April 27th, 1868.

The genus *Cylindrella* (Pfeiffer, 1840), as generally accepted, embraces a great number of species of very diverse forms, belonging chiefly to the faunas of Mexico and the islands of Cuba, Haiti and Jamaica. With reference to the shell, the animal being little known, the genus has been placed in *Helicidæ* between *Pupa* and *Clausilia.*

In 1855, Schmidt (*Stylommatophora*) stated that *Cylindrella* (*Urocoptis*) has no jaw, and that the teeth resemble those of *Glandina* and *Daudebardia*, but differ in having two teeth on a common base.

Morch in 1859 (*Malak. Blatt.* p. 109) proposed an arrangement of the *Pulmonata*, the divisions characterized by the presence and form, or absence of jaw,—one of such divisions being *Agnatha*, in which the jaw is wanting. This method of classification was subsequently further elaborated by Morch (*Journ. de Conch.* v. 1865), who, referring to Schmidt's statement, placed *Cylindrella* in *Agnatha*.

Gray (*Ann. & Mag. Nat. Hist.* vi. 267. 1860) suggested a division of the *Pulmonata Geophila* into two sections, viz.:

Sect. I. VERMIVORA. Buccal mass very large; elongate, projectile like a proboscis. Jaw none; teeth numerous, slender, conical, distant. Mantle well defined. Subterraneous; carnivorous, or worm-eating.

Sect. II. PHYLLOVORA. The buccal mass small, ovoid, not produced. Jaw distinct, horny; teeth numerous, four-sided, close together on the lingual membrane. Herbivorous.

In the first Section, which seems to be equivalent to Morch's *Agnatha*, Gray placed the *Oleacinidæ*, *Streptaxidæ* and *Testacellidæ*,—in the second, *Helicidæ*, *Arionidæ*, etc., etc.,—he did not specially refer to *Cylindrella*. Albers and Von Martens (*Die Heliceen*, 2 ed. 1861) have *Cylindrella* in *Testacellea*, giving as generic characters, on the authority of Schmidt, "Maxilla nulla. Dentes radulæ in lineis utrinque obliquis dispositi, bini basi conjuncti." He adopts several subgenera, one of which is *Urocoptis* Beck, comprising *C. Ghiesbreghti* Pfr. and other large Mexican species, as well as the smaller allied forms of the West Indies.

In November, 1865, I published (*Ann. Lyc.* viii. 161) the annexed figure of the lingual dentition of *C. scæva* Gund. of Cuba, with the remark "the rows of teeth are about 130 in number, the formula being 26–2–26. The central plate is small, obtusely pointed, laterals uncinated, joined two by two, upper edge fringed." The expression *joined two by two* was inadvertently used, and Morse has since called my attention to it, in fact *each* plate (lateral) has two cusps.

Fig. 1.

Lingual dentition of *Cylindrella scæva*, Gund.

Guppy (*Ann. & Mag. Nat. Hist.* January, 1866) thus described the animal and teeth of *C. Trinitaria* Pfr. of Trinidad:

"The animal is ashy gray, becoming nearly black about the head and tentacles. Foot elongate, narrow; tentacles (4) slender. Lingual ribbon very long and narrow; teeth 3–1–3; medians narrow, bicuspid, with two tubercles on the base; first and second laterals with simple round cusps, outer lateral inconspicuous, rather claw-shaped."

Mörch has since observed (*Jour. de Conch.* vii. 257, 1867) that my figure of *C. scava* appears to confirm the accuracy of the observation of Schmidt and of Guppy's description. I agree, however, with Crosse and Fischer (*Jour. de Conch.* vi. 223, 1866), that the similarity of structure of the lingual armature in *Cylindrella* and *Testacella*, referred to by Schmidt, is more apparent than real, being confined to the oblique arrangement of the lateral teeth.

An unlooked-for discovery was announced by Crosse and Fischer in a very interesting paper in the January number (1868) of the *Journal de Conchyliologie*. After remarking that authors have repeated the assertion of Schmidt that *Cylindrella* has no jaw, and explaining that an opportunity had recently occurred of examining the animal of *C. Ghiesbreghti* Pfr., Crosse and Fischer give the result in a passage of which the following is a translation:

"We have proved the presence in this species of a jaw, arcuate, horseshoe shaped, very finely striated longitudinally, with an obsolete, slightly indicated median projection at the inferior margin, and a rounded plate or support projecting beyond the edge of the superior margin.

"The lingual armature is, moreover, very remarkable. The lingual denticulations are disposed in *rectilinear* transverse series, numerous and all of the same type, with apices scarcely extending beyond their base, the single median or rachidian tooth is a little smaller than the others, and tricuspid. The dental formula is (32–1–32) x 110.

"Considering the nature of its teeth the animal must be herbivorous and not zoophagous. The classifications which have placed the molluses of this group with the *carnivorous* Pulmonates are then erroneous and altogether defective. The reserve which we have shown in this respect in our Journal was clearly justifiable.

"In the Cylindrellæ of the Antilles, on the other hand, the rows of teeth are so oblique that they appear to have a quincuncial arrangement; each row composed of a small number of teeth of peculiar palmated form; the rachidian tooth is of a very different type, extremely narrow and enlarged at one of its extremities. We have not been able to find the jaw in *C. sanguinea* Pfr. of Jamaica, which we have examined, and of which the dental formula is (12-1-12) x 115.

"Considering these important anatomical differences, we think it consistent to separate from the genus *Cylindrella*, the group, very natural, moreover, with reference to zoological geography, of large species from Central America (Mexico and Guatemala), of which *C. Ghiesbreghti* is the type. We would at the same time observe, with reference to conchological characters, that these species have nearly the same *facies*, they have generally an obsolete, filiform carina on the last whorl, and almost all have a columellar fold more or less developed, situated deeply within the aperture, and continued the whole length of the axis around which it revolves."

After some remarks on different forms of *Cylindrella*, etc., Crosse and Fischer propose the new genus *Eucalodium* for the group of which the following species are mentioned as the principal representatives, viz.: *C. Ghiesbreghti*, *decollata*, *Mexicana*, *grandis*, *splendida*, *turris*, *clava*, *speciosa* and *Boucardi*. The genus is characterized as follows:

Genus Eucalodium, *Crosse and Fischer*. Animal maxilla arcuata, longitudinaliter tenuissime striata, parte marginis inferi media obsolete prominula, margine supero radicem rotundatam emittente, instructum. Radula seriebus transversis, rectilinearibus, numerosis, uniformibus constituta, acie uncinorum basin subquadratam vix superante; dens medianus uncinis paulo minor, acie tricuspide. Animal cæterum ad familiam Helicidarum omnino referendum.

Testa subrimata, turrita, cylindrellæformis (in adultis speciminibus) late truncata: ultimus anfractus breviter solutus, dorso angulatus, plus minusve filo-carinatus: columella intus plerumque uniplicata, plica columnam internam ambiente,* in vicinio aperturæ evanida. Typus: *Cylindrella Ghiesbreghti* Pfeiffer.

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* I have directed the attention of M. Crosse to the fact that in *C. turris* and *C. clava* the axis as described by me (*Ann. Lyc.* viii. 160) is a highly polished tube.

In February, 1867, a number of shells were collected by Mr. W. M. Gabb, in Lower California, and among them two species described by him as *Cylindrella Newcombiana* and *C. irregularis*, and figured in the American Journal of Conchology, iii. 237–238, pl. 16, figs. 3–4.

Several months ago, Dr. Newcomb sent to me a specimen of the former species; from its general aspect I doubted its being a Cylindrella, and suggested to him that the presence or absence of a jaw would determine the question. Recently Mr. Tryon kindly forwarded to me three specimens containing, to my surprise, the living animals. Having perused the paper of Crosse and Fischer on *Eucalodium*, and my attention having been directed to the different characters of the land shell faunas of Lower California and Mexico east of the Gulf, I examined the animal of Gabb's, *C. Newcombiana*, with much interest. I obtained the jaws and lingual ribbons from two of the specimens, and have little hesitation in placing the species in the genus *Eucalodium*. The following is a copy of Gabb's description, and the annexed figure (fig. 2) was drawn by Morse from one of the living specimens:

Fig. 2.

C. Newcombiana, Gabb.

Cylindrella (*Urocoptis*) *Newcombiana* Gabb.

"Shell moderately large, not decollate, slender, tapering more rapidly below than near the apex, the first three whorls being of the same size; whorls 11½, flattened on the side, body whorl subangular below, detached from the penultimate whorl for a short distance, and acutely angular above; suture impressed; aperture slightly advanced and surrounded by broadly expanded lips, producing a trumpet-shaped appearance; inner margin straight, and ending in an angle above and below; outer margin curved, wider in advance than behind, lips continuous, broadly expanded, and somewhat thickened; surface light horn color, marked by fine, irregular, undulating and occasionally broken ribs, radiately and

the exterior of which is distantly but strongly ribbed, diminishing in diameter towards and terminating at the base in a point, the umbilicus being imperforate. I have since noticed the same structure in *C. filicosta* Shuttl.

obliquely disposed, and with the interspaces crossed by microscopic revolving lines.

"Animal light gray, equalling in length the aperture and penultimate whorl; foot short, and regularly rounded posteriorly.

"*Dimensions.*—Length 1.9 in., length of aperture .45 in., width of aperture .4 in., width of body-whorl .35 in.

"*Locality.*—Hidden under loose volcanic rocks in the high table lands of the interior of Lower California, especially about Molejé. This and its congener (*C. irregularis* Gabb) are essentially mountain species, being only found in the highest regions.

"*Observations.*—This shell resembles *U. costata* Gould, as figured by H. and A. Adams in Gen. Recent. Moll., pl. 76, fig. 7. It differs, however, in being more regularly tapering, and in being proportionally more slender."

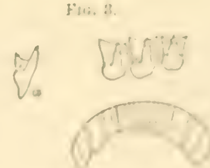
It is evident from Gabb's comparison of his shell with the little Barbados species *C. costata** Guilding (not Gould), that he did not know the latter, and was misled by the magnified figure given by H. and A. Adams. (*Genera*, pl. lxxvi.)

Gabb remarks that *C. irregularis* and *C. Newcombiana* are without doubt congeneric, and that an examination of the animal of the latter shows it to be a true *Urocoptis*,—meaning, I presume, that in general external characters it looked very like H. and A. Adams' figure of the animal of that genus.

From an examination of the shell of *C. irregularis*, I believe it to belong to *Cylindrella*, but the other species must, in my opinion, as already stated, be placed in the genus *Eucalodium*.

A study of the animal of the latter, in which I was aided by my friend Mr. W. G. Binney, enables me to give the following particulars:

Fig. 8.



Jaw and teeth of E. Newcombianum, Gabb.

Animal with highly developed mantle, foot short, blunt before and pointed behind, with a longitudinal groove along the centre of its base. The dead animal, as removed entire, had 9-10 volutions; when living it occupied the whole shell with the exception of the

* The lingual dentition of *C. costata* is very similar to that of *C. Trinitaria* as described by Guppy. The ribbon is very long, having 180 rows of teeth.

last, and perhaps the apicial, whorl. Jaw (fig. 3) arcuate, with a slight median projection, distinctly, longitudinally costate, the costæ, 9–10 in number, flattened, their terminations scarcely produced at the anterior or cutting margin, parallel with which are a few fine striæ.

In the jaw of the second specimen examined, the number of costæ was found to be 13, and the cutting margin very perceptibly crenulated by their extension.

At first sight, under the microscope, the jaw of *E. Newcombianum* appears to consist of a series of plates, the costæ formed by their overlapping edges; and indeed Binney, after carefully examining it, justly remarked that the structure of the jaw of other species may have been incorrectly described. The jaw is, in fact, so thickened in various parts and with such general regularity, as to give the impression that it is composed of separate plates, while portions have additional thickness, producing what I have called flattened costæ.

At or near to the central part of the superior margin of the jaw of *E. Newcombianum* there is an attachment, which I supposed to be similar in character to that mentioned by Crosse and Fischer in their description of the genus, "*margine supero radicem rotundatam emittente.*" To this appendage I directed the attention of Morse, who wrote as follows: "I noticed at the outset the process to which you refer, and the jaw of *Succinea* immediately occurred to me, but on further examination I satisfied myself that it is only the more dense condition of the buccal muscles. I may be wrong, but do not see any evidence of a process separate from the muscles,—not like that in *Succinea*, which can be cleared as readily from the integuments as the cutting plate itself." Mörch, in the description of his division *Elasmognatha* which embraces *Succinea*, mentions the existence of a *membranous* attachment to the jaw of *Dryptus Blainvilleanus* (*Jour. de Conch.* v. 391, 1865), but it is of a very different character to that observed in *E. Newcombianum.*

The teeth of *E. Newcombianum* (fig. 3) in arrangement and form agree very closely with those of *Eucalodium*, as described by Crosse and Fischer, and the formula 32–1–32 x 126 is remarkably similar. In my figure the median and adjoining lateral teeth, and also the extreme lateral tooth (fig. 3, *a*), are shown. The teeth in general character may be compared with those of *H. alternata* Say (*Morse, Terr. Pulmon. of Maine*, pl. 4, fig. 16).

With respect to the shell of *E. Newcombianum*, I should mention that the axis has not the revolving fold described as generally present in *Eucalodium*,—indeed Gabb's species is, in internal structure, more like *Achatina*.

The genus *Eucalodium*, looking at the form of jaw and teeth, must go into Gray's section *Phyllovora*. Considering the station of the West Indian Cylindrellae, so far as I am acquainted with them, and other circumstances, I believe with Crosse and Fischer, and also Pfeiffer, that the genus *Cylindrella* itself cannot be associated with the *Vermivora*.

It is worthy of notice that Mörch places *H. concava* Say, from the form of jaw (*see Terr. Moll.* I. xii. fig. 11), in his division *Oxygonatha*, the teeth of which (laterals subulate) indicate, he says, "que l'animal avale de grands morceaux, et donc que c'est un carnivore qui vit de proies vivantes," and adds, "les *Agnathes*, qui avalent leur proie entière et vivante, ont toutes les dents subulées." (*Jour. de Conch.* v. 377, 1865.) The fact is that the animal of *H. concava*, having one median tooth and subulate laterals (*Morse*, l. c. pl. 5), devours the living animals of other species,* while *Cylindrella* without jaw (*Agnatha*), has no subulate teeth!

After the foregoing pages were in type, I discovered that the shell under consideration was described by Pfeiffer (*Proc.*

* "The animal is voracious in its appetite, almost always preying upon other species with which it may be kept, and so certainly destroying them that I have been obliged to keep them by themselves." (*Binney, Terr. Moll.* II. 165.)

Zool. Soc. 1861, p. 27, pl. ii. fig. 7), from a specimen in Cuming's collection, as follows:

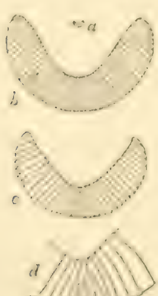
CLAUSILIA* (BALEA?) TAYLORI, Pfr. T. profunde rimata, turrita, solidula, conferte plicato-striata, corneo albida; spira regulariter attenuata, apice acutiuscula; sutura simplex; anfr. 11, convexiusculi, ultimus basi vix attenuatus, infra medium obtuse carinatus; antice solutus, descendens et dorso acute carinatus; apertura magna, obliqua, intus semicircularis; lamellæ obsoletæ; plicæ nullæ; perist. continuum, undique late expansum. Long. 47, diam. 8½ mill. Localitas ignota.

The species will, therefore, bear the name of *Eucalodium Taylori* Pfr., with that of *Cylindrella Newcombiana* Gabb, in the synonymy.

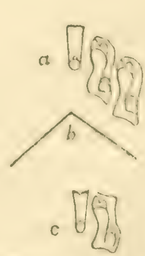
Von Martens (*Die Heliceen*, 2 ed. p. 268, 1861)† places in *Pupacea* the genus *Macroceramus*, dividing it into three subgenera, *Macroceramus* of which *M. signatus* Guild. is the type, and *Anoma* and *Lia*, embracing species included by Pfeiffer and H. and A. Adams in *Cylindrella*, the type of the former being *C. tricolor* Pfr., and of the latter *C. Maugeri* Wood.

In 1865 (*Ann. Lyc.* viii. 162) I published the annexed figures

FIG. 4.



Buccal Plate of M. signatus, Guild., Tortola.



Lingual Dentition of Macroceramus signatus, Guild.

of the jaw and teeth of *M. signatus*, which show that the genus

* The jaws of *Clausilia* and *Balea* are described (*Die Heliceen*) as being very similar,—that of the former "arcuata, subtiliter striatula, medio sæpius prominula," and of the latter "parum arcuata, subtiliter striatula, medio prominula."

† Albers (*Die Heliceen*, 1 ed. 207, 1850) placed *Leia* in *Cylindrella*

Macroceramus Guilding, as Mörch remarks (*Journ. de Conch.* vii. 257, 1867), belongs to his division *Goniognatha*, the jaw being composed, as in *Orthalicus*, of oblique plates. The teeth are arranged in the same manner as those of *Cylindrella*.

Pfeiffer (*Malak. Blatt.* p. 233, 1867), in his review of the classification in the *Die Heliceen*, expresses his belief that *Anoma* and *Lia* belong rather to *Cylindrella* than *Macrocera-mus*, but remarks that the animal is unknown.

During the last two years M. Crosse has repeatedly called my attention to the importance of examining the animal of some species of the group to which *C. Maugeri* belongs. Lately, I obtained from my friend Nath. Wilson, the distinguished Botanist of Jamaica, several specimens of *C. Blandiana* Pfr., placed by Von Martens in the subgenus *Lia* of *Macroceramus*. Although the animals were dead, I secured the lingual ribbons. I found no jaw, and seeing the character of the teeth, believe that none exists.

From the accompanying figure (by Morse), it will be seen that in form and arrangement the teeth are decidedly of *Cylindrella* type. The median tooth is long and narrow, terminating in a single cusp. The laterals are bicuspid; posterior margin of the plates fringed; anterior cusp fringed, posterior cusp bluntly notched. The formula 55–1–55 x 145.

FIG. 5

Lingual dentition of C. Blandiana, Pfr. *a*, side view of extreme lateral.

This seems to establish the fact that *Lia*, and I believe *Anoma* also, must be separated from *Macroceramus*, and that, in accordance with the views of Pfeiffer and H. and A. Adams, they belong to *Cylindrella*.

III.—*A Catalogue of the Birds found in Costa Rica.*

By Geo. N. Lawrence.

Read Feb. 17th, 1868.

The fine collections of birds received by the Smithsonian Institution from Costa Rica, and which by the courtesy of Prof. Henry have been placed in my hands for examination, form the basis of this Catalogue.

These collections include most of the species heretofore recorded as from that State, and likewise many of the interesting novelties recently obtained there and described in European and American scientific journals.

Species not in the Museum of the Smithsonian Institution, which I have found noted as inhabiting Costa Rica, are also included, and the source given whence the information was derived.

It is within the last few years only that special attention has been directed to the avi-fauna of the Southern portion of Central America. Occasional small collections secured by travellers engaged in various pursuits, gave an intimation of the valuable discoveries likely to result from a systematic exploration of any portion of that region. I allude particularly to the interesting collection brought from Chiriqui, in 1850, by the botanist Warszewicz, and described by Mr. Gould in the *Proc. Zool. Soc. of London*, and to other specimens brought subsequently from the same Province and from Veraguas.

The first collections of any importance from Costa Rica were those forwarded to the Berlin Museum by Dr. von Frantzius, Dr. Hoffmann and Dr. Ellendorf, being the results of their own explorations. Dr. J. Cabanis, in the *Journal für Ornithologie*, under the title, "*Review of the Birds from Costa Rica found in the Berlin Museum*" (commencing at page 321, Vol. viii. 1860), began a series of papers enumerating the species sent by the above-named gentlemen; many of them proved new to science and were of much interest; the whole number of species given in these papers amounted to one hundred and fifty.

Dr. Hoffmann unfortunately died in Costa Rica. Dr. Ellendorf returned home, but Dr. von Frantzius yet remains in the country, located at San José.

To the Hon. C. N. Riotte, late U. S. Minister to Costa Rica, the Smithsonian Institution is deeply indebted, not only for his own contributions of specimens of Natural History, but for bringing it into communication with Dr. von Frantzius, Mr. Julian Carmiol, and his son, Mr. F. Carmiol, from whom the valuable additions to the Museum of the Institution have mainly been acquired; it has many specimens, also, which have on their labels the names of J. Cooper and J. Zeledon as collectors.

A small but interesting collection of Humming Birds was received at the Smithsonian in the summer of 1867, from Mr. A. R. Endrés.

Since the publication of Dr. Cabanis' papers, Mr. Osbert Salvin has described many new Costa Rican species in the *Proc. of the Zool. Soc.*, under the following titles: "*On a new species of Calliste*," viz., *C. dowii*, 1863, p. 168; "*Descriptions of Thirteen New Species of Birds from Central America*," 1863, p. 186—two of these came from Costa Rica, viz., *Vireo pallens* and *Elainea arenarum*; "*Descriptions of Seventeen New Species of Birds from Costa Rica*," 1864, p. 579.

We are also indebted to Mr. P. L. Sclater for two additions to the Costa Rican fauna, viz., *Leucopternis princeps* P. Z. S., 1865, p. 429, and *Tetragonops frantzii*, *Ibis*, Vol. vi. p. 371.

Many new species from Costa Rica have been described by American ornithologists.

Prof. Baird, in "*Review of American Birds*," adds the following species: *Parula inornata*, *Basileuterus melanogenys*, *Setophaga aurantiaca*, *Stelgidopteryx fulvigula*, and *Vireo carmioli*; also in the *Annals of the N. Y. Lyceum of N. H.*, Vol. viii. p. 478, he described *Pheucticus tibialis*.

Mr. John Cassin characterized several new species in the *Proc. of the Phil. Acad. of Sciences;* in 1865, p. 91, *Chrysomitris bryantii*, and at page 169, in a paper entitled, "*On some Conirostral Birds from Costa Rica in the collection of the Smithsonian Institution*," he enumerated twenty-two species, three of which were new to science, viz., *Arremon dorsalis*, *Buarremon crassirostris*, and *Euphonia annae;* in 1867, p. 51, he described a new Icterus, *I. Salvini.*

Within the past three years twenty-two species from Costa Rica have been described as new by myself in the *Annals of the N. Y. Lyceum of N. H.*, and three species in the *Proceedings of the Phil. Academy.*

In the examination of specimens for the present catalogue, I find several other species, which appear to be new to science, and they are accordingly so characterized.

There are several portions of Costa Rica as yet unexplored, from which many additional species may reasonably be expected, as every collection received adds to the fauna, not only known species, but also others not before described.

Many birds are recorded from the neighboring Provinces of Chiriqui and Veraguas, which have not yet been found in Costa Rica, but as they doubtless will be discovered, I have thought best to give lists of them, and of the Northern species which have been received from Panama, and which consequently must pass through Costa Rica in their migrations.

No representative of the Family *Cypselidæ* has been sent from Costa Rica, but *Chatura zonaris* should be found there, as it is a South American bird and occurs in Guatemala.

The present Catalogue embraces all the families of the land birds; those of the water birds it is my intention to give hereafter in a separate paper.

Species noted from Chiriqui which may be found in Costa Rica:

Cœreba lucida, Scl. & Salv.
Ramphocelus dimidiatus, Lafr.
Spermophila collaris, Lawr.
Tyrannulus elatus (Spix).
Elainea chiriquensis, Lawr.
" semiflava, Lawr.
Myiozetetes columbianus, Cab. & Hein.
Geotrygon chiriquensis, Scl.

Species noted from Veraguas likely to occur in Costa Rica.

Microcerculus luscinia, Salv.
Thryothorus rutilus, Vieill.
Anthus parvus, Lawr.
Hylophilus viridiflavus, Lawr.
Pyranga hepatica, Sw.
Oryzoborus funereus, Scl.
Spermophila semicollaris, Lawr.
Cacicus microrhynchus, Scl. & Salv.
Icterus giraudii, Cassin.
Sclerurus mexicanus, Scl.
Synallaxis albescens, Temm.
Phylidor fuscipennis, Salv.
Dendrornis lachrymosa, Lawr.
Dysithamnus puncticeps, Salv.
Myrmotherula menetriesi, D'Orb.
Ramphocænus rufiventris, Bonap.
Formicarius rufipectus, Salv.
Grallaria guatemalensis, Prev.
Pittasoma michleri, Cass.
Colopterus pilaris, Cab.
Serpophaga cinerea (Strick.).
Mionectes oleagineus, Licht.
Rhynchocyclus flavo-olivaceus, Lawr.
Myiobius nævius (Bodd.).
Lipangus unirufus, Scl.
Pipra leucocilla, Linn.
" cyaneocapilla, Hahn.
Klais guimeti, Bourc. & Muls.
Erythronota niveiventris, Gould.
Neomorphus salvini, Scl.
Pteroglossus erythropygius, Gould.
Capito maculicoronatus, Lawr.
Campephilus hæmatogaster, Tsch.
" malherbei, Gray & Mitch.
Chloronerpes ceciliæ, Malh.
" caboti (Malh.).
Columba rufina, Temm.
Geotrygon veraguensis, Lawr.

Northern species which have been obtained in Panama, but not yet observed in Costa Rica.

Turdus fuscescens, Steph.
Galeoscoptes carolinensis, Linn.
Dendrœca cærulea (Wils.).
" maculosa (Gm.).
" castanea (Wils.).
Myiodioctes mitratus (Gm.).
Petrochelidon lunifrons (Say).
Vireo flavifrons, Vieill.
Melopiza lincolnii (Aud.).
Sclerurus guatemalensis, Hartl.
Todirostrum schistaceiceps, Scl.
Contopus brachytarsus, Scl.
Tyrannus intrepidus, Vieill.
Chordeiles virginianus (Briss.).
Pionus menstruus (Linn.).
Cassidix mexicanus, Less.

Sub-class I. INSESSORES.

Order Passeres.

(*Section Oscines.*)

Family Turdidae.

1. *Catharus melpomene* (*Cab.*).

Quebrada Honda (Dr. A. von Frantzius); San José (J. Carmiol); Grecia (F. Carmiol).

2. *Catharus frantzii*, *Cab.*

San José (Dr. A. von Frantzius); Rancho Redondo (F. Carmiol).

3. *Catharus gracilirostris*, *Salvin*, P. Z. S., 1864, p. 580.

San Mateo (J. Cooper).

4. *Catharus mexicanus* (*Bonap.*).

"Enrique Arcé." Collection of Mr. O. Salvin.

5. *Catharus fuscater* (*Lafr.*).

Cervantes. April, 1867.

A single female specimen of what I suppose to be the above species has lately been received from Dr. Frantzius. I have compared it with the type in the Museum of the Boston Soc. of N. H., and find it differs from it, in being much blacker above, and in having the central part of the breast and abdomen pale-yellowish fulvous, instead of white, as in the type; the ridge of the upper mandible is black as far down as on a line with the nostrils, the remainder of the bill is bright orange; in the type, the black color on the upper mandible extends much nearer to the edges; these with the under mandible are yellowish-white. The type may have faded, but as they agree in size and in distribution of colors, they are probably identical. Possibly the difference in colors may be seasonal.

Mr. O. Salvin (*P. Z. S.*, 1867, p. 132) notices apparently the same species, received from Veraguas, which he says: "Agrees closely with Mr. Sclater's example from Ecuador. The bill, however, is somewhat larger, and in this fresh specimen, of a brighter orange-color."

Mr. Sclater (*P. Z. S.*, 1859, p. 324) describes his specimen as having the middle of the abdomen white, in which it agrees with the type.

6. *Turdus swainsoni*, *Cab.*

Barranca, Frailes and Cervantes (J. Carmiol).

7. *Turdus aliciae*, *Baird.*

San José (Dr. A. von Frantzius).

8. *Turdus grayi*, *Bonap.*

San José & Barranca (J. Carmiol); Quebrada Honda (Dr. Frantzius).

9. *Turdus leuchauchen*, *Scl.*

Navarro (J. Cooper); Dota (F. Carmiol).

10. *Turdus plebeius*, *Cab.*

Dota, San José and La Palma (Dr. Frantzius).

Grecia and Cervantes (J. Carmiol).

11. *Turdus nigrescens*, *Cab.*

Volcan Yrazei (Juan Cooper); Dota (F. Carmiol).

12. *Turdus obsoletus*, *Lawr.*

Cervantes, April, 1867 (J. Carmiol).

A single specimen only of this species has been as yet received at the Smithsonian Institution: it differs in plumage from the type, solely in not having the larger wing-coverts tipped with pale rufous.

When Mr. Sclater saw the type, he considered it to be the female of a black species. Mr. Salvin (*P. Z. S.*, 1867, p. 135), in noticing a specimen from Veraguas, expresses the same opinion. The two specimens before me, from Panama and Costa Rica, came labelled as males. Mr. Salvin's specimen had not the sex indicated.

It seems to me to be a species allied to *T. grayi* and *T. plebeius*, in which the sexes show no material variation of plumage; the most marked character in which *T. obsoletus* differs from them, is in having the crissum white,—in the others it corresponds in color with the abdomen.

13. *Mimus gracilis*, *Cab.*

"Dr. Hoffmann" Cab. J. f. O., Vol. viii. p. 410.

Fam. Cinclidae.

14. *Cinclus ardesiacus*, *Salv.*, *Ibis*, 1867, *p.* 121.
Dota (J. Zeledon).

Fam. Sylviidae.

15. *Polioptila superciliaris*, *Lawr.*
Angostura, Atiro and Guiatil (J. Carmiol).

Fam. Troglodytidae.

16. *Rhodinocichla rosea* (*Less.*).
Fide Prof. S. F. Baird.

17. *Campylorhynchus capistratus* (*Less.*).
San Mateo (J. Cooper).

18. *Campylorhynchus zonatus*, *Less.*
Turrialba and Cervantes (J. Carmiol); Tucurriqui (J. Zeledon).

19. *Cyphorinus leucostictus*, *Cab.*
Angostura and Turrialba (F. Carmiol).

20. *Cyphorinus leucophrys* (Tschudi).
San Jose (Dr. Frantzius).

21. *Cyphorinus lawrencei*, *Scl.*
Angostura (J. Carmiol).

22. *Pheugopedius fasciativentris* (*Lafr.*).
San Mateo (J. Cooper).

23. *Pheugopedius atrogularis*, *Salv.*
"Tucurriqui (Enrique Arcé)." Salv. P. Z. S., 1864, p. 580.

24. *Thryophilus rufalbus* (*Lafr.*).
San Mateo (J. Cooper).

25. *Thryophilus pleurostictus*, *Scl.*
"Gulf of Nicoya." Collection of Mr. O. Salvin.

26. *Thryophilus modestus* (*Cab.*).
San José and Guiatil (J. Carmiol); San Mateo (J. Cooper).

27. *Thryophilus thoracicus* (*Salv.*).
Santa Rosa (J. Carmiol); Tucurriqui (J. Zeledon).
28. *Thryophilus castaneus* (*Lawr.*).
Pacuare (J. Carmiol); Angostura (F. Carmiol).
29. *Troglodytes intermedius*, *Cab.*
San Jose and Barranca (J. Carmiol).
30. *Troglodytes inquietus*, *Baird.*
"Enrique Arcé." Collection of Mr. O. Salvin.

Mr. Salvin (*P. Z. S.*, 1867, p. 135) states that Mr. Sclater and himself had compared this species with the type specimen of *T. tessellatus*, Lafr. et D'Orb., from the Museum d'Histoire Naturelle of Paris, and found no "appreciable differences."

In the Lafresnaye Collection, now in the Museum of the Boston Soc. of N. H., are two specimens of *T. tessellatus* marked "type;" a comparison with these showed the two species to be quite distinct. The color of *tessellatus* above is of a darker brown with more of a reddish cast, the entire under-plumage is of a reddish fulvous brown, whereas *T. inquietus* has the throat, breast, and upper part of abdomen white, tinged with fulvous, and above has a tinge of olive; the wing of *tessellatus* is much longer.

I do not know how to reconcile the difference between the specimens in the Lafr. Coll. and the one in the Paris Museum, except by supposing the latter to be incorrectly labelled—therefore for the present I must adhere to the probable accuracy of Baron Lafresnaye's types in his own collection; his specimens came from Peru.

Fam. Sylvicolidae.

31. *Mniotilta varia* (*Linn.*).
San José, Barranca and Juiz (J. Carmiol).
32. *Parula gutturalis*, *Cab.*
Volcan Yrazei (J. Cooper).
33. *Parula inornata*, *Baird.*

Barranca and Dota (F. Carmiol); Angostura (J. Carmiol).

34. *Protonotaria citrea* (*Bodd.*).

Punta Arenas (Capt. J. M. Dow).

35. *Helminthophaga chrysoptera* (*Linn.*).

Barranca (J. Carmiol).

36. *Helminthophaga peregrina* (*Wils.*).

San José and Grecia (J. Carmiol).

37. *Helmitherus vermivorus* (*Gm.*).

San José (J. Carmiol).

38. *Dendrœca virens* (*Gm*).

Grecia and Barranca (F. Carmiol); Rancho Redondo (J. Carmiol).

39. *Dendrœca coronata* (*Linn.*).

Angostura (F. Carmiol).

40. *Dendrœca blackburniæ* (*Gm.*).

San José and Atiro (J.Carmiol); Barranca (F. Carmiol).

41. *Dendrœca pennsylvanica* (*Linn.*).

Grecia and Barranca (F. Carmiol).

42. *Dendrœca æstiva* (*Gm.*).

San José (J. Carmiol).

43. *Dendrœca vieilloti*, *Cassin.* (*ruficeps*, *Cab.*)

"Dr. Ellendorf" Cab. J. f. O., Vol. ix. p. 326.

44. *Seiurus aurocapillus* (*Linn.*).

Barranca (J. Carmiol).

45. *Seiurus noveboracensis* (*Gm.*).

San José (Dr. Frantzius); Angostura (J. Carmiol).

46. *Seiurus ludovicianus* (*Aud.*).

Barranca (F. Carmiol).

47. *Oporornis formosus* (*Wils.*).

Dota (F. Carmiol).

48. *Geothlypis trichas* (*Linn.*).

"Dr. Frantzius," Cab. J. f. O., Vol. ix. p. 84.

49. *Geothlypis philadelphia* (*Wils.*).

Angostura and Dota (F. Carmiol).

50. *Geothlypis macgillivrayi* (*Aud.*).

Barranca (F. Carmiol).

51. *Icteria virens* (*Linn.*).

"Dr. Hoffmann," Cab. J. f. O., Vol. viii. p. 403.

52. *Myiodioctes canadensis* (*Linn.*).

Dota (F. Carmiol).

53. *Myiodioctes pusillus* (*Wils.*).

Barranca and Grecia (J. Carmiol); San José (Dr. Frantzius).

54. *Basileuterus culicivorus* (*Licht.*).

Barranca and Guiatil (J. Carmiol); Grecia and Dota (F. Carmiol).

55. *Basileuterus mesochrysus*, *Scl.*

San José, Grecia and Guiatil (J. Carmiol).

56. *Basileuterus uropygialis*, *Scl.*

Angostura and Juiz (J. Carmiol).

57. *Basileuterus melanogenys*, *Baird.*

San José (Dr. A. v. Frantzius).

58. Basileuterus melanotis. sp. nov.

Male. There is a black stripe on each side of the crown which extends from the bill to the nape, central stripe dull pale orange with ashy tips to the feathers; supra-ocular stripe grayish ash; there is a black spot in front of the eye, and a line of the same color below it, also behind the eye a broad mark of black which extends over the ear; upper plumage olive green; tail feathers olive brown with their margins colored like the back; quill feathers dark brown edged with olive green; under wing coverts pale yellow; throat whitish with just a tinge of pale fulvous on the chin, and of pale yellow on the throat; upper part of breast and sides of the body olive green, lighter than the back; lower part of breast and middle of abdomen of a clear pale yellow; under tail coverts light dull yellow; upper mandible light brown, the under whitish; "candle yellow;" feet pale yellow. Length (fresh) $5\frac{1}{2}$ in.; wing $2\frac{3}{8}$; tail $2\frac{1}{4}$; bill $\frac{3}{8}$; tarsi $\frac{13}{16}$.

Habitat. Cervantes. Collected by J. Carmiol, April 1867.

Type in Mus. Smithsonian Institution, No. 47408.

There is another specimen, also a male, sent by Dr. von Frantzius, collected at Birris; they are precisely alike.

Remarks. It differs from all the allied species in the decided black coloring behind the eye, in the supra-ocular stripe being of a clear ash without any tinge of yellow or greenish, and in its paler under-plumage.

59. *Setophaga ruticilla* (*Linn.*).

Angostura (J. Carmiol); Turrialba (F. Carmiol).

60. *Setophaga aurantiaca*, *Baird.*

Grecia and Barranca (F. Carmiol); Dota (J. Carmiol).

61. *Setophaga torquata*, *Baird.*

San José and La Palma (Dr. Frantzius).

Fam. Hirundinidae.

62. *Progne leucogaster*, *Baird.* *Rev. Am. Birds*, *p.* 280.

San José (Dr. A. von Frantzius).

63. *Atticora cyanoleuca var. montana*, *Baird.*

San José and Barranca (J. Carmiol).

64. *Cotyle riparia* (*Linn.*).

Dr. J. Cabanis, J. f. O., Vol. ix. p. 93.

65. *Stelgidopteryx fulvigula*, *Baird.*

Atiro (J. Carmiol).

Fam. Vireonidae.

66. *Vireosylvia olivacea* (*Linn.*).

San José (J. Carmiol).

67. *Vireosylvia flavo-viridis*, *Cassin.*

San José (Dr. Frantzius); Aterias (J. Cooper).

68. *Vireosylvia philadelphica*, *Cassin.*

San José (J. Carmiol); Grecia and Dota (F. Carmiol).

69. *Vireosylvia josephae*, *Scl.*

Barranca (J. Carmiol); Rancho Redonda and Dota (F. Carmiol).

70. *Lanivireo flavifrons* (*Vieill.*).

San José (J. Carmiol).

71. *Vireo pallens, Salv. P. Z. S.,* 1863, *p.* 188.
"Punta Arenas." Salvin.

72. *Vireo carmioli, Baird.*
Dota (J. Carmiol).

73. *Hylophilus ochraceiceps, Scl.*
Angostura (J. Carmiol).

74. *Hylophilus decurtatus* (*Bonap.*) (*cinereiceps, Scl.*).
"Enrique Arcé." Collection of Mr. O. Salvin.

75. *Hylophilus pusillus, Lawr.*
Dota and Angostura (J. Carmiol).

76. *Cychloris flaviventris, Lafr.*
"Gulf of Nicoya." Collection of Mr. O. Salvin.

77. *Cychloris subflavescens, Cab.*
San José (Dr. Frantzius); Dota (F. Carmiol).

78. *Vireolanius pulchellus, Scl. & Salv.*
Angostura (J. Carmiol).

Fam. Ampelidae.

79. *Ptilogonys caudatus, Cab.*
San José (J. Carmiol); Volcan Yrazei (J. Cooper).

80. *Myiadestes melanops, Salv.*
La Palma (Dr. Frantzius); San José (J. Carmiol); Navarro (J. Cooper).

Fam. Coerebidae.

81. *Diglossa plumbea, Cab.*
Quebrada Honda and San Juan (Dr. v. Frantzius).

82. *Dacnis venusta, Lawr.*
Dota (J. Carmiol).

83. *Dacnis ultramarina, Lawr.*
Angostura (J. Carmiol).

84. *Chlorophanes spiza var. guatemalensis, Scl.*
Juiz and Turrialba (J. Carmiol).

85. *Cœreba cyanea* (*Linn.*).
"Dr. A. v. Frantzius," Cab. J. f. O. Vol. ix. p. 2.

It differs from females of the allied species in the plumage being of a clearer olive and less brown.

112. Phœnicothraupis carmioli. sp. nov.

Entire upper plumage of a yellowish olive green; tail feathers olive green with black shafts; inner webs of the quills brownish black, the outer webs colored like the back; under plumage olivaceous yellow, brighter or more yellow on the throat, and somewhat dusky on the sides; upper mandible black, the under blackish brown; "irides brown;" feet dark reddish brown.

Length (fresh) 7½ in.; wing 3½; tail 2¾; bill ¾; tarsi ⅞.

Habitat. Angostura, collected by F. Carmiol 11th March, 1865. Type in Mus. Smithsonian Institution, No. 39039.

There is in the collection only one other specimen, collected by J. Carmiol, April 4th, 1867.

Remarks. The two specimens agree in plumage and are marked as males, judging from analogy I should consider them to be females, but in coloring they are quite unlike the females of any other species of the same genus; the head is uniform in color with the back, and has no indication of a crown spot; the coloring above is of a clear green and below yellowish, without any tinge of fulvous brown, which color prevails in the plumage of the females of all the other species.

I consider it without doubt to be a *Phœnicothraupis*, and if the sex is determined correctly, the coloration is of a very abnormal character.

I have dedicated this species to Mr. F. Carmiol, as a proper acknowledgment of his efficiency as a collector.

113. *Lanio leucothorax*, *Salv.*

Tucurriqui, Angostura and Pacuare (J. Carmiol).

114. *Eucometis spodocephala* (*Bonap.*).

Scl. and Salv. P. Z. S., 1864, p. 350.

115. *Tachyphonus luctuosus*, *Lafr.*

Angostura and Juiz (J. Carmiol).

116. *Tachyphonus delattrei*, *Lafr.*

Payua (J. Carmiol).

117. *Tachyphonus cassinii, Lawr.*

Angostura (J. Carmiol).

118. *Tachyphonus propinquus, Lawr. Proc. Phil. Acad.* 1867, p. 94.

Angostura (J. Carmiol).

119. *Tachyphonus tibialis, Lawr.*

San José and Dota (J. Carmiol); Volcan Yrazu (J. Cooper); Rancho Redondo (F. Carmiol); Quebrada Honda (Dr. Frantzius).

120. *Chlorospingus albitemporalis (Lafr.).*

San José (Dr. Frantzius): Turrialba and Barranca (J. Carmiol); Dota (F. Carmiol); San Mateo (J. Cooper).

121. *Chlorospingus pileatus, Salv.*

Poas (J. Carmiol); Rancho Redondo (F. Carmiol).

122. *Buarremon brunneinuchus (Lafr.).*

San José (Dr. Frantzius); Barranca and Dota (J. Carmiol); Grecia (F. Carmiol).

123. *Buarremon assimilis (Boiss.)?*

Guiatil (J. Carmiol).

The single specimen in the collection which I refer to this species, differs from two examples from Bogota in having a much larger bill, in the ashy gray behind the eye being without any tinge of olive (as in the Bogota specimens) and the cheeks being of a deeper black; the only other noticeable difference is, that the bird from Costa Rica has the tarsi somewhat shorter and more darkly colored.

Pezopetes capitalis is not in the collection, but the description of it does not agree with the specimen before me.

124. *Buarremon chrysopogon (Bonap.).*

Quebrada Honda (Dr. Frantzius); San José and Dota (J. Carmiol).

125. *Buarremon crassirostris, Cass. (mesoxanthus, Salv.).*

Barranca (J. Carmiol).

126. *Pezopetes capitalis, Cab.*

"Dr. A. v. Frantzius." Cab. J. f. O., Vol. viii. p. 415.

127. *Arremon aurantiirostris, Lafr.*

San Mateo (J. Cooper); Dota (J. Zeledon); Guiatil (F. Carmiol).

128. *Arremon rufidorsalis, Cass.*

Turrialba (F. Carmiol).

129. *Saltator atriceps, Less.*

Pacuare (J. Carmiol).

130. *Saltator magnoides, Lafr.*

Turrialba (F. Carmiol); San José and Angostura (J. Carmiol).

131. *Saltator grandis, Licht.*

San José (Dr. Frantzius); Catargo (J. Cooper).

132. *Pitylus grossus (Linn.).*

Payua (J. Carmiol).

133. *Pitylus poliogaster, Du Bus.*

Angostura (J. Carmiol).

Fam. Fringillidae.

134. *Pheucticus tibialis, Baird. Ann. N. Y. Lyc., Vol. viii. p.* 478.

Tucurriqui and Cervantes (J. Carmiol); San José (Dr. Frantzius); Rancho Redondo (F. Carmiol); Cervantes (J. Cooper).

135. *Hedymeles ludovicianus (Linn.).*

San José (J. Carmiol); La Palma (J. Zeledon).

136. *Guiraca cærulea (Linn.).*

Angostura (F. Carmiol).

137. *Guiraca concreta (Du Bus.).*

Turrialba and Angostura (J. Carmiol).

138. *Spermophila morelleti (Puch.).*

San José (J. Carmiol); Grecia (F. Carmiol).

139. *Spermophila hoffmanni, Cab.*

"Dr. Hoffmann." Cab. J. f. O., Vol. ix. p. 6.

140. *Spermophila corvina, Scl.*

Angostura and Pacuare (J. Carmiol); Turrialba (F. Carmiol).

141. *Volatinia jacarina* (*Linn.*).

San José (Dr. Frantzius); Barranca (J. Carmiol); Grecia (F. Carmiol).

142. *Phonipara pusilla* (*Sw.*).

San José (Dr. Frantzius); Sachi (J. Carmiol).

143. *Cyanospiza cyanea* (*Linn.*).

Barranca, San José and Dota (J. Carmiol).

144. *Cyanospiza ciris* (*Linn.*).

Fide Prof. S. F. Baird.

145. *Amaurospiza concolor*, *Cab.*

"Dr. Frantzius." Cab. J. f. O., Vol. ix. p. 3.

146. *Zonotrichia pileata* (*Bodd.*).

San José (J. Carmiol).

147. *Coturniculus passerinus* (*Wils.*).

"Dr. Frantzius." Cab. J. f. O., Vol. viii. p. 411.

148. *Euspiza americana* (*Gm.*).

Tabacales (Dr. Frantzius); San José and Dota (J. Carmiol).

149. *Embernagra striaticeps*, *Lafr.*

Angostura (J. Carmiol).

150. *Embernagra superciliosa*, *Salv.*

"Nicoya (Enrique Arcé)." Salv. Proc. Zool. Soc., 1864. p. 582.

151. *Pyrgisoma biarcuatum* (*Prev.*).

"San José (Dr. Hoffmann)." Cab. J. f. O., Vol. viii. p. 412.

152. *Pyrgisoma keineri*, *Bonap.*

San José (J. Carmiol); Grecia (F. Carmiol).

153. *Melozone leucotis* (*Cab.*).

San José, Angostura, and Guiatil (J. Carmiol); San Juan (Dr. Frantzius).

154. *Chrysomitris mexicana* (*Sw.*).

Barranca and San José (J. Carmiol); San José (Dr. Frantzius).

155. *Chrysomitris columbiana*, *Lafr.*

San José (Dr. Frantzius).

156. *Chrysomitris bryantii*, *Cass.*

Dota (J. Carmiol).

Fam. Icteridae.

157. *Ocyalus wagleri* (*Gray & Mitch.*).

San José, Turrialba and San Carlos (J. Carmiol).

158. *Ostinops montezumae* (*Less.*).

San Carlos and Angostura (J. Carmiol).

159. *Amblycercus prevosti* (*Less.*).

San José (J. Carmiol); Turrialba (F. Carmiol).

160. *Icterus pectoralis* (*Wagl.*).

"Dr. Hoffmann." Cab. J. f. O., Vol. ix. p. 9.

161. *Icterus salvini*, *Cass. Proc. Phil. Acad.* 1867, *p.* 51.

Turrialba and San Carlos (J. Carmiol).

162. *Pendulinus prosthemelas* (*Strickland*).

"Enrique Arcé." Collection of Mr. O. Salvin.

163. *Hyphantes baltimore* (*Linn.*).

San José (J. Carmiol).

164. *Xanthornus spurius* (*Linn.*).

San José (Dr. Frantzius and J. Carmiol).

165. *Molothrus aeneus* (*Wagl.*).

San José (Dr. Frantzius).

166. *Agelaius phœniceus* (*Linn.*).

"Gulf of Nicoya." Collection of Mr. O. Salvin.

167. *Quiscalus macrurus*, *Sw.*

"Dr. Ellendorf." Cab. J. f. O., Vol. ix. p. 82.

168. *Sturnella ludoviciana* (*Linn.*).

San José (J. Carmiol).

Fam. Corvidae.

169. *Psilorhinus morio* (*Wagl.*).

San José and Turrialba (J. Carmiol).

(Section *Clamatores.*)

Fam. Dendrocolaptidae.

170. *Synallaxis erythrops, Scl.*

Barranca and Dota (F. Carmiol); Birris (J. Zeledon).

171. *Synallaxis nigrifumosa, Lawr.*

Payua (J. Carmiol).

172. Synallaxis rufigenis. sp. nov.

Sides of the head, ear coverts, lores and superciliary stripe of a rather light cinnamon red, the stripe extends back from the eye as far as the occiput, and that part of it is of a paler cinnamon; crown and entire upper plumage olivaceous brown, with a cinnamomeous shade, the front is tinged with cinnamon; tail of a clear cinnamon red, a little paler underneath; wing coverts and outer margins of quills deep bright cinnamon, the inner webs of the quill feathers brownish black, except the inner margins, which are pale salmon color; under wing coverts light yellowish cinnamon; under plumage olivaceous washed with pale cinnamon, the latter color prevailing on the throat, breast and middle of abdomen, the sides of the neck and of the breast are more olivaceous; upper mandible black, the under pale yellowish white, black at the end; feet blackish brown.

Length (skin) 6 in.; wing $2\frac{1}{2}$; tail $2\frac{7}{8}$; bill $\frac{7}{16}$; tarsi $\frac{3}{4}$.

Type in my collection. Received from Costa Rica by A. C. Garsia, Esq. There is no specimen in the Smithsonian collection.

Remarks. This species somewhat resembles *S. erythrops*, Scl., but in that species instead of the crown being olive colored as in S. rufigenis, it is dark cinnamon uniform in color with the sides of the head; in the color of the back they are much alike, but *S. erythrops* is below without the pale cinnamon on the throat and breast, and has the chin grayish white, it has also darker under wing coverts and a larger bill; the coloring of the tail in the new species is of a lighter shade, and the feet are much darker.

173. *Philydor rufobrunneus*, *Lawr.*

Barranca (J. Carmiol); San José (Dr. Frantzius).

174. *Philydor virgatus*, *Lawr.*

Angostura (J. Carmiol).

175. *Automolus cervinigularis*, *Scl.*

Angostura (J. Carmiol).

176. *Automolus pallidigularis*, *Lawr.*

Pacuare and Guiatil (J. Carmiol); Angostura (F. Carmiol); Catargo (J. Cooper).

177. *Automolus rufescens*, *Lawr.*

Birris (J. Zeledon).

178. *Anabazenops variegaticeps*, *Scl.*

Dota (J. Carmiol); Barranca (F. Carmiol).

179. *Anabazenops lineatus*, *Lawr.*

Angostura (J. Carmiol); Birris and Cervantes (J. Zeledon).

180. *Xenops mexicanus*, *Scl.*

Angostura, San José and Payua (J. Carmiol); Grecia (F. Carmiol).

181. *Oxyrhynchus flammiceps*, *Temm.*

San José (Dr. Frantzius).

I can see no difference between these specimens and others from Brazil.

182. *Sittasomus sylvioides*, *Lafr.*

Dota (J. Carmiol).

183. *Margarornis brunnescens*, *Scl.*

San José (Dr. Frantzius); Rancho Redondo and Barranca (F. Carmiol); San Mateo (J. Cooper); Birris (J. Zeledon).

184. *Margarornis rubiginosa*, *Lawr.*

San José (Dr. Frantzius); San Mateo (J. Cooper).

185. *Glyphorhynchus pectoralis*, *Scl. & Salv.*

"Enrique, Arcé." Collection of Mr. O. Salvin.

186. *Dendrocolaptes sancti-thomæ*, *Lafr.*

San José (Dr. Frantzius).

187. *Dendrocolaptes multistrigatus*, *Eyton.*

Navarro (J. Cooper).

188. *Dendrornis pardalotus, Vieill.*

Tucurriqui (J. Carmiol).

189. *Dendrornis erythropygia, Scl.*

Angostura and Pacuare (J. Carmiol); Barranca (F. Carmiol).

190. *Picolaptes affinis, Lafr.*

San José and Dota (J. Carmiol); Barranca (F. Carmiol).

191. *Picolaptes compressus, Cab.*

"Dr. Ellendorf." Cab. J. f. O., Vol. ix. p. 243.

192. *Picolaptes lineaticeps, Lafr.*

"Gulf of Nicoya." Collection of Mr. O. Salvin.

Fam. Formicaridae.

193. *Cymbilanius lineatus, Vieill.*

Angostura (J. Carmiol).

194. *Thamnophilus melanocrissus, Scl.*

"Enrique Arcé." Collection of Mr. O. Salvin.

195. *Thamnophilus doliatus (Linn.).*

"Dr. A. von Frantzius." Cab. J. f. O., Vol. ix. p. 242.

196. *Thamnophilus affinis, Cab. et Hein.*

San José (Dr. Frantzius); San Mateo and Sachi (J. Cooper).

197. *Thamnophilus punctatus, Cab.*

"Dr. Hoffmann." Cab. J. f. O., Vol. ix. p. 241.

198. *Thamnophilus nævius (Gm.).*

Angostura and Payua (J. Carmiol).

199. *Thamnophilus bridgesi, Scl.*

San Mateo (J. Cooper).

200. *Thamnistes anabatinus, Scl. & Salv.*

Angostura (J. Carmiol); Tucurriqui (J. Zeledon).

201. *Dysithamnus semicinereus, Scl.*

Turrialba, Dota and Grecia (F. Carmiol); Guaitil (J. Carmiol).

202. *Dysithamnus striaticeps, Lawr.*

Angostura (J. Carmiol).

203. *Myrmotherula melæna, Scl.*

Angostura, Payna and Pacuare (J. Carmiol).

204. *Myrmotherula fulviventris*, *Lawr.*

Angostura (J. Carmiol).

205. *Myrmotherula albigula*, *Lawr.*

Angostura (J. Carmiol).

206. Myrmotherula modesta. sp. nov.

Male. Upper plumage of a greenish olive brown, the front, crown and hind neck tinged with dull rufous; tail of a liver colored brown, the outer webs margined with dull rufous; inner webs of quills blackish brown, the outer webs and the wing coverts rufous brown, the margins of the latter brighter rufous; the under wing coverts and inner edges of quills pale salmon color; the under plumage is of a dull ferruginous, quite pale on the throat and of a brighter rufous on the breast and middle of the abdomen; the under tail coverts dull rufous; upper mandible black with the cutting edges pale yellow, under mandible dusky yellowish white; feet dark brown.

Length (fresh) $4\frac{1}{2}$ in.; wing $2\frac{1}{4}$; tail $1\frac{1}{2}$; bill $\frac{7}{16}$; tarsi $\frac{5}{8}$;

Habitat. Grecia, collected by F. Carmiol, 9th Oct. 1865.

There is also a female from the same collector, obtained at Dota, 3d Oct. 1866; this differs from the male only in the upper plumage inclining more to olive brown, and the breast and abdomen being of a brighter rufous.

Types in Mus. Smith. Institution, Nos. 41432 and 47486.

Remarks. This species does not much resemble any other of the genus, it is of about the size of *M. fulviventris*, but has a much narrower and weaker bill, with longer wings; it has no spots on the wing coverts.

207. *Formicivora boucardii*, *Scl.*

Angostura, San José and Pacuare (J. Carmiol).

208. *Formicivora schisticolor*, *Lawr.*

Turrialba and Barranca (F. Carmiol).

209. *Ramphocænus semitorquatus*, *Lawr.*

"Val." (J. Carmiol).

This specimen as in the type has no postocular spot, but is darker on the breast, where it is of a blackish gray.

210. *Gymnocichla nudiceps* (*Cassin*).

"Enrique Arcé." Collection of Mr. O. Salvin.

211. *Cercomacra tyrannina*, *Scl.*

Angostura (J. Carmiol).

212. *Myrmeciza immaculata*, *Scl. & Salv. P. Z. S.*, 1864, *p.* 357.

Payua and Angostura (J. Carmiol).

The distinctness of this species from *M. exsul* is mainly based upon its having the wing coverts without spots, *M. exsul* "has wing coverts distinctly spotted with white." The single specimen in the collection has the wing coverts almost unspotted, but in my specimens from Panama they are very distinctly marked with small white spots. In one Panama specimen the entire under plumage is black, a little plumbeous on the abdomen.

Two examples, male and female, in the S. Inst. Mus., collected on the Atrato, and labelled as *M. exsul* by Mr. Cassin, have the wing coverts marked with larger and more conspicuous spots; in the Panama specimens the spots are confined to the small coverts, but in those from the Atrato the spots occupy the ends of all the wing coverts; the Atrato birds are lighter colored and appear as if they had been exposed to the weather; these may be the true *M. exsul*.

213. *Myrmeciza læmosticta*, *Salv.*

"Tucurriqui (Enrique Arcé)." Salv. Proc. Soc., 1864, p. 582.

214. *Myrmeciza stictoptera*, *Lawr.*

Angostura (J. Carmiol).

215. *Hypocnemis nævoides* (*Lafr.*).

Angostura (J. Carmiol); Turrialba (F. Carmiol).

216. *Pithys bicolor*, *Lawr.*

Angostura (J. Carmiol).

217. *Phlogopsis macleannani*, *Lawr.*

Angostura (J. Carmiol).

218. *Formicarius analis* (*Lafr. et D'Orb.*).
"Enrique Arcé." Salv. P. Z. S., 1866, p. 74.

I ascertained some time since that the species from Panama referred by me (*Ann. N. Y. Lyc.*, Vol. vii. p. 326) to *F. analis* was not that species, but *F. hoffmanni*; the same in the Mus. of the Phil. Acad. is labelled *F. analis*. *F. hoffmanni* has a white spot in the lores, whereas in *F. analis* the lores are entirely black.

219. *Formicarius hoffmanni*, *Cab.*
"Dr. Hoffmann." Cab. J. f. O., Vol. ix. p. 93.
220. *Grallaria perspicillata*, *Lawr.*
Angostura (J. Carmiol).
221. *Grallaria dives*, *Salv.*
"Tucurriqui (Enrique Arcé)" Salv. Proc. Zool. Soc. 1864, p. 582.
222. *Grallaricula costaricensis*, *Lawr.*
Barranca (F. Carmiol).

Fam. Tyrannidae.

223. *Attila sclateri*, *Lawr.*
Guiatil (J. Carmiol).
224. *Sayornis aquatica*, *Scl. & Salv.*
Julian Carmiol.
225. *Copurus leuconotus*, *Lafr.*
San José and Pacuare (J. Carmiol).
226. *Platyrhynchus cancrominus*, *Scl.*
Navarro (J. Cooper).
227. *Platyrhynchus superciliaris*, *Lawr.*
"Val." (J. Carmiol).
228. *Todirostrum cinereum* (*Linn.*).
Turrialba and Pacuare (J. Carmiol).
229. *Todirostrum nigriceps*, *Scl.*
Angostura (J. Carmiol).
230. *Todirostrum ecaudatum* (*Lafr.*).

Angostura (J. Carmiol).

231. *Oncostoma cinereigulare, Scl.*

Angostura (J. Carmiol).

232. *Euscarthmus squamicristatus, Lafr.*

Cervantes (J. Carmiol); Dota (J. Zeledon); Grecia (F. Carmiol).

233. *Mionectes oleagineus, Licht.*

"Enrique Arcé." Collection of Mr. O. Salvin.

234. *Mionectes assimilis, Scl.*

Angostura, Guiatil and Payua (J. Carmiol).

235. Mionectes olivaceus. sp. nov.

Entire upper plumage clear olive green; tail feathers of a light umber brown, with their outer margins yellowish green; quills dark brown with their outer edges yellowish green and the inner pale salmon color; under wing coverts yellowish buff; throat, breast and sides olive green, each feather with a pale yellowish white stripe along the shaft; abdomen and under tail coverts bright pale yellow; upper mandible and end of lower black, base of lower mandible light reddish brown; feet light brown.

Length (fresh) $5\frac{1}{2}$ in.; wing $2\frac{11}{16}$; tail 2; bill $\frac{1}{2}$; tarsi $\frac{5}{8}$.

Habitat. Barranca and Dota, collected by J. Carmiol.

Types in Mus. Smith. Inst., Nos. 42923 and 33421.

The sexes are alike in plumage.

Remarks. This species differs from *M. striaticollis* in being without the fuliginous coloring which extends over the front, crown, cheeks and throat of that species, the abdomen is of a clearer yellow, it is smaller in its measurements, and has a longer and narrower bill.

Four specimens all agree in differing from *M. striaticollis* as above stated.

236. *Tyrannulus brunneicapillus, Lawr.*

Angostura (J. Carmiol).

237. *Tyranniscus villissimus, Scl. & Salv.*

Angostura and Dota (J. Carmiol); Turrialba and Barranca (F. Carmiol).

238. *Tyranniscus parvus, Lawr.*

"Turrialba (Enrique Areé)." Salv. P. Z. S., 1867, p. 147.

239. *Elainea subpagana, Scl. & Salv.*

San José (J. Carmiol).

240. *Elainea placens, Scl.*

Barranca and Guiatil (J. Carmiol); Grecia (F. Carmiol).

241. *Elainea frantzii, Lawr.*

San José (Dr. A. v. Frantzius); Barranca and Dota (J. Carmiol).

242. *Elainea arenarum, Salv. P. Z. S.*, 1863, *p.* 190.

"Punta Arenas."

243. *Legatus albicollis* (*Vieill.*).

San José, Guiatil and Turrialba (J. Carmiol).

244. *Legatus variegatus, Scl.*

Dr. A. von Frantzius.

245. *Myiozetetes texensis* (*Giraud*).

San José and Angostura (J. Carmiol); Cartago (J. Cooper).

246. *Myiozetetes granadensis, Lawr.*

Orose (J. Carmiol).

247. *Myiozetetes marginatus, Lawr.*

Julian Carmiol.

248. *Rhynchocyclus sulphurescens* (*Spix*).

Angostura (J. Carmiol).

249. Rhynchocyclus griseimentalis. sp. nov.

Female. Upper plumage of a yellowish olive green; tail olive brown margined on the outer webs of the feathers with olive green; wing coverts and quills blackish brown edged with greenish yellow; inside of wings and inner margins of quills very pale yellow; under plumage olive green, with the chin grayish and the middle of the abdomen yellow; upper mandible black, the under whitish; tarsi and toes dark brown.

Length (fresh) 7 in.; wing 3; tail $2\frac{7}{8}$; bill $\frac{9}{16}$; tarsi $\frac{11}{16}$.

Habitat. Dota. Collected by J. Carmiol, Feb. 27th, 1867. Type in Smith. Institution, No. 47501.

Two specimens are in the collection marked as females and precisely alike.

Remarks. This in its general appearance is much like *R. olivaceus* from Brazil, but above is a little more of a yellowish cast of plumage, with the breast much darker and the middle of the abdomen of a brighter and clearer yellow, it is without the fulvous edgings to the wing coverts and has a larger bill, this being longer than that of *R. olivaceus* and equally as broad.

From *R. brevirostris*, Cab., it differs not only in its larger bill, but by its more grayish chin, darker breast, and having the yellow more restricted to the centre of the abdomen; *R. brevirostris* has the whole under plumage more suffused with yellow, and the upper more of a yellowish green; the new species in its upper coloring is intermediate between *R. olivaceus* and *R. brevirostris.*

R. mesorhynchus, Cab., from Guatemala is described as differing from the Mexican *R. brevirostris*, though much like it, by its much larger bill, in which it much resembles *R. olivaceus*, but in brightness of coloring it corresponds with *brevirostris*.

I have before me a specimen of *R. brevirostris* from Mexico, labelled by the Messrs. Verreaux, likewise four specimens from Guatemala; one sent to the Smith. Inst. by Mr. Salvin and labelled *R. brevirostris*, has the bill larger than the Mexican specimen; of the others, one has the bill agreeing in size with that of the Mexican bird, the remaining two have very much smaller bills; in plumage the birds from both countries closely agree; the difference in size of the bills between the two extremes is very marked; in the specimen from Mr. Salvin, the bill is nearly as large as that of *R. olivaceus*, in which it agrees with Dr. Cabanis' description of *R. mesorhynchus*. The size of the bill would therefore seem not to be a reliable character, as all the Guatemala specimens are clearly one species.

I do not decide that *R. brevirostris* and *R. mesorhynchus* are the same, as I have not seen the types, but would suggest the comparison of a large series from each country.

250. *Pitangus derbianus* (*Kaup.*).

Santa Ana (M. Lopez).

251. *Myiodynastes nobilis*, *Scl.*

Barranca (J. Carmiol); San Mateo (J. Cooper).

252. *Myiodynastes luteiventris*, *Bonap.*

Barranca (J. Carmiol); Turrialba (F. Carmiol); Birris (J. Zeledon).

253. *Myiodynastes hemichrysus*, *Cab.* (*superciliaris*, *Lawr.*).

Soon after describing this species (*Ann. N. Y. Lyc.*, Vol. viii. p. 470), I found it had been recorded from Costa Rica by Dr. Cabanis (*J. f. O.*, *Vol. ix. p.* 246) as *M. chrysocephalus*, Tschudi; in his remarks he speaks of there being some points of difference between them, and proposes to call it *M. hemichrysus* should it afterwards prove to be a distinct species; believing it to be so, Dr. Cabanis' name consequently has priority.

254. *Megarhynchus mexicanus* (*Lafr.*).

Barranca and San José (J. Carmiol); Turrialba and Grecia (F. Carmiol).

255. *Muscivora mexicana*, *Scl.*

Atonas (Dr. A. v. Frantzius).

256. *Myiobius sulphureipygius*, *Scl.*

Angostura (J. Carmiol).

257. *Myiobius erythrurus*, *Cab.*

Angostura and Pacuare (J. Carmiol).

258. *Myiobius capitalis*, *Salv.*

Tucurriqui (Enrique Arcé)." Salv. P. Z. S., 1864, p. 583.

259. *Mitrephorus phæocercus*, *Scl.*

"Enrique Arcé." Collection of Mr. O. Salvin.

260. *Mitrephorus aurantiiventris*, *Lawr.*

Tabacales and La Palma (Dr. Frantzius); Dota (J. Carmiol).

261. *Empidonax traillii* (*Aud.*).

Dota (F. Carmiol).

262. *Empidonax flaviventris*, *Baird.*

Grecia (J. Carmiol); Navarro (J. Cooper).

263. *Empidonax flavescens*, *Lawr.*

Quebrada Honda (Dr. Frantzius); Barranca and Grecia (J. Carmiol).

264. *Contopus virens* (*Linn.*).

"Dr. Hoffmann." Cab. J. f. O., Vol. ix. p. 248.

265. *Contopus borealis* (*Sw.*).

"Dr. Hoffmann." Cab. J. f. O., Vol. ix. p. 248.

266. *Contopus richardsoni* (*Sw.*).

San José (Dr. Frantzius); Frailes (J. Carmiol); Barranca (F. Carmiol).

Mr. Sclater considers *C. plebeius*, Cab., to be the same as this species.

267. *Contopus lugubris*, *Lawr.*

Barranca, Birris and Dota (J. Carmiol).

268. *Myiarchus crinitus* (*Linn.*).

J. Carmiol.

269. *Myiarchus panamensis*, *Lawr.*

"Enrique Arcé." Collection of Mr. O. Salvin.

270. *Myiarchus lawrencii* (*Giraud*).

Angostura and Sachi (F. Carmiol); Pacuare (J. Carmiol).

271. *Myiarchus nigricapillus*, *Cab.*

San José (J. Carmiol); Barranca and Grecia (F. Carmiol).

This species, if distinct from the preceding, is barely separable. Mr. Cabanis seems to have been doubtful about it, as he says, "The difference may depend on season and on fresh moulting." A specimen from Mexico, which is unquestionably *M. lawrencii*, has the gray coloring of the throat extending over the breast, this is also the case in several examples from Guatemala; some of the specimens from Costa Rica agree in this character, while others have this color confined to the throat; in labelling them I have made this the point of difference; in those with the gray restricted to the throat and considered to be *M. nigricapillus*, the crowns seem to be of a little deeper brown, but this last character is not very decided.

272. *Tyrannus melancholicus, Vieill.*

San José and Grecia (J. Carmiol); Sachi and Barranca (F. Carmiol).

273. *Milvulus tyrannus (Linn.).*

San José (J. Carmiol).

274. *Milvulus forficatus (Gm.).*

"Dr. A. von Frantzius." Cab. J. f. O., Vol. ix. p. 252.

Fam. Cotingidae.

275. *Tityra personata, Jard. & Selby.*

San José (Dr. Frantzius); Guiatil and Barranca (J. Carmiol).

276. *Tityra albitorques, Dubus.*

Pacuare (J. Carmiol.)

277. *Hadrostomus aglaiæ (Lafr.).*

"Dr. Ellendorf." Cab. J. f. O., Vol. ix. p. 252.

278. *Pachyrhamphus cinereiventris, Scl.*

Barranca, Angostura and San Mateo (J. Carmiol).

279. *Pachyrhamphus cinnamomeus, Lawr.*

San José, Angostura and Turrialba (J. Carmiol); Tucurriqui (J. Zeledon).

280. *Lipaugus holerythrus, Scl.*

Angostura (F. and J. Carmiol).

281. *Lipaugus rufescens, Scl.*

Barranca (F. Carmiol); Tucurriqui (J. Zeledon).

282. *Heteropelma veræ-pacis, Scl.*

Angostura and Cervantes (J. Carmiol).

283. *Piprites griseiceps, Salv.*

"Tucurriqui (Enrique Arcé)" Salv. *P. Z. S.* 1864, p. 583.

284. *Pipra mentalis, Scl.*

Angostura and Paiz (J. Carmiol); Tucurriqui (J. Zeledon).

285. *Pipra leucorrhoa, Scl.*

Cervantes and Angostura (J. Carmiol); Guiatil (F. Carmiol).

286. *Chiroxiphia linearis, Bonap.*

San Mateo (J. Cooper); El Berilla (J. Zeledon); Grecia (F. Carmiol).

287. *Chiromachœris candei* (*Parzud.*).

Turrialba and Angostura (J. Carmiol).

288. *Cotinga amabilis*, *Gould.*

San José (Dr. Frantzius).

289. *Querula cruenta* (*Bodd.*).

Angostura and Payua (J. Carmiol).

290. *Carpodectes nitidus*, *Salv.*

"Tucurriqui (Enrique Arcé)." Salv. P. Z. S. 1864, p. 583.

291. *Chasmorhynchus tricarunculatus*, *J. & E. Verreaux.*

San José, Dota and Cervantes (J. Carmiol; Turrialba (J. Cooper).

292. *Cephalopterus glabricollis*, *Gould.*

San José (Dr. Frantzius); Angostura and Dota (J. Carmiol).

This species was brought from Veraguas by Dr. J. K. Merritt in 1852; he informed me that in certain localities in the mountains it was quite common, and that at any time when in want of a breakfast, a sufficient number for the purpose could easily be procured.

Order Strisores.

Fam. Momotidae.

293. *Momotus martii*, *Spix.*

Pacuare (J. Carmiol).

294. *Momotus lessoni*, *Less.*

San José and San Carlos (J. Carmiol); Dota and Grecia (F. Carmiol).

295. *Prionirhynchus platyrhynchus*, *Leadb.*

Atiro, Barranca and Angostura (J. Carmiol).

296. *Eumomota superciliaris* (*Jard. & Selb.*).

"Dr. Ellendorf." Cab. J. f. O., Vol. ix. p. 255.

Fam. Alcedinidae.

297. *Ceryle torquata* (*Linn.*).

"Dr. Frantzius." Cab. J. f. O., Vol. x. p. 162.

298. *Ceryle amazona* (*Lath.*).

"Dr. Frantzius." Cab. J. f. O., Vol. x. p. 161.

299. *Ceryle alcyon* (*Linn.*).

Navarro and Catargo (J. Cooper).

300. *Ceryle cabanisi* (*Tsch.*).

San José and San Carlos (J. Carmiol); Catargo (J. Cooper).

301. *Ceryle superciliosa* (*Linn.*).

"Dr. Ellendorf." Cab. J. f. O., Vol. ix. p. 256.

Fam. Galbulidae.

302. *Galbula melanogenia*, *Scl.*

Payua and San Carlos (J. Carmiol); Turrialba (J. Cooper).

Fam. Bucconidae.

303. *Malacoptila veræ-pacis*, *Scl.*

Pacuare and Guiatil (J. Carmiol).

304. *Malacoptila inornata* (*Du Bus*).

Angostura (J. Cooper); Dota (F. Carmiol).

305. *Malacoptila costaricensis*, *Cab.*

San Mateo (J. Cooper).

306. *Monasa peruana*, *Scl.*

San Carlos, San José, Pacuare and Payua (J. Cooper).

In these specimens the wings measure from $5\frac{1}{2}$ to $5\frac{3}{4}$ inches and the tails $5\frac{1}{2}$, instead of 5 and $4\frac{1}{2}$ respectively, as given by Mr. Sclater; otherwise they do not differ from his description.

Fam. Trogonidae.

307. *Trogon puella*, *Gould.*

Dota and Turrialba (J. Carmiol); San José (Dr. Frantzius).

308. *Trogon caligatus*, *Gould.*

San Mateo and Turrialba (J. Cooper); Birris and San Juan (J. Zeledon).

309. *Trogon aurantiiventris*, *Gould.*

Barranca (J. Carmiol).

310. *Trogon tenellus, Cab.*

Angostura, Guiatil, Pacuare and Barranca (J. Carmiol).

Several specimens are in the collection, all differing from *T. atricollis* in the characters pointed out by me, *Ann. Lyc., Vol. viii. pp.* 3 *and* 184.

311. *Trogon concinnus, Lawr.*

San Juan (J. Zeledon).

312. *Trogon massena, Gould.*

Angostura (J. Carmiol); Tucurriqui (J. Zeledon).

313. *Trogon clathratus, Salv. P. Z. S.*, 1866, p. 75.

San Mateo (J. Cooper).

A single female specimen is, I think, without doubt of this very distinct species; this sex has not been heretofore noticed, Mr. Salvin having only the male; the entire upper plumage, with the neck, breast and sides, is dark plumbeous slate, much the same in color as the female of *T. massena;* belly and under tail coverts of a light vermilion; the wing coverts are black crossed with very narrow waving white lines, the quills are vandyke brown, the outer webs of the primaries minutely toothed with white; the four central tail feathers are of a fine vandyke brown, the three lateral on each side black, with transverse white bars towards their ends, more strongly marked than those on the wings, the white lines on both are rather widely separated; bill blackish, the sides of the mandibles dusky white.

314. **Trogon bairdii,** sp. nov.

Male. Entire head, hind neck, throat and upper part of breast black, with a tinge of deep blue on the occiput and hind neck; back greenish blue; the rump and upper tail coverts, and a narrow nuchal band, are of a rich deep violet blue, this color extending round on the lower part of the sides of the neck; two central tail feathers greenish blue, the next two pairs on each side are of this color on the outer webs, but black on the inner, all have a narrow black terminal band, the three lateral feathers on each side are black at the base for half their length, then pure white to the end; wings black; lower part of breast, abdomen and under tail coverts of a fine scarlet or bright vermilion; thighs black; upper mandible pale yellowish white, the lower of the same color with a dusky greenish tinge.

Length (skin) 11 in.; wing 6; tail 6¾; bill, following curve 1.

Habitat. San Mateo. Collected by J. Cooper, April, 1866.

Type in Mus. Smith. Institution, No. 43018.

Remarks. There are two specimens (males) obtained at the same point by Mr. Cooper and precisely alike. It comes nearest to *T. melano-cephalus*, above they are much alike, but as that species has the abdomen yellow, they differ widely in their under plumage; the white in the tail of the new species is quite different, being much greater in extent, for when the tail is viewed underneath, the feathers show no black, and the white markings have not the quadrate form existing in the other species; the bill is much larger and stronger than that of *T. melano-cephalus.*

It gives me much pleasure to compliment my friend Prof. S. F. Baird, by conferring his name upon this fine species.

315. *Pharomacrus mo-cinno*, *De la Slave.*

"Dr. Frantzius." Cab. J. F. O., Vol. x. p. 175.

Fam. Caprimulgidae.

316. *Nyctibius jamaicensis* (*Gm.*) ?

San José (J. Zeledon).

One specimen only (a nestling) which I think is this species.

317. *Chordeiles brasilianus* (*Gm.*).

"Dr. Hoffmann." Cab. J. F. O., Vol. x. p. 165.

318. *Chordeiles texensis*, *Lawr.*

El Rio Tiribi (J. Zeledon).

319. *Antrostomus carolinensis* (*Gm.*).

Las Cruces de Candelaria (J. Zeledon).

320. *Nyctidromus albicollis* (*Gm.*).

San José and Angostura (J. Carmiol).

Fam. Trochilidae.

321. *Eutoxeres aquila* (*Loddiges*).

"Tucurriqui (E. Arcé)." Salv. P. Z. S., 1867, p. 152.

322. *Glaucis ruckeri* (*Bourc.*).

A. R. Endrés.

323. *Glaucis æneus, Lawr. Proc. Phil. Acad.*, 1867, *p.* 232.

A. R. Endrés.

324. *Phæthornis longirostris* (*Delattre*).

"Val." (J. Carmiol); (A. R. Endrés).

325. *Phæthornis emiliæ* (*Bourc.*).

Angostura and Barranca (J. Carmiol).

326. *Pygmornis adolphi* (*Bourc.*).

Angostura (J. Carmiol); A. R. Endrés.

327. *Campylopterus hemileucurus* (*Licht.*).

"Dr. Frantzius." Cab. J. F. O., Vol. x. p. 162.

328. *Phæochroa cuvieri* (*Delatt. and Bourc.*).

"Gulf of Nicoya." Collection of Mr. O. Salvin.

329. *Eugenes spectabilis*, *Lawr.*

Rancho Redondo (J. Carmiol).

This specimen was received just after my description of the species was published, it agrees with the type in every particular of plumage and dimensions. I placed it in *Heliomaster*, but Mr. Gould considers it a species of *Eugenes*, in which opinion I concur. Both the specimens are probably females.

330. *Lampornis prevostii* (*Less.*).

"Gulf of Nicoya." Collection of Mr. O. Salvin.

331. *Lampornis veraguensis*, *Gould.*

"Costa Rica." Gould, Intr. Troch. p. 65.

332. *Doryfera ludoviciæ* (*Bourc. and Muls.*)?

Cervantes (J. Carmiol).

One specimen only is in the collection, which differs from Bogota examples in having a longer bill, this being just intermediate between those of *D. ludoviciæ* and of *D. rectirostris*. Mr. Salvin received a specimen from Veraguas which differed in a similar manner; he says (*P. Z. S.*, 1867, p. 153): "The shining forehead is considerably darker and of a bluer shade, the bill longer, and the under plumage blacker than in a New

Granadian specimen of *D. ludovicia* before me; the wings too are shorter. Should the receipt of additional specimens confirm the constancy of these distinctions, I propose for this race the name of *Dorifera veraguensis*."

The Smithsonian specimen is without the bright spot on the front; the under plumage is scarcely darker, and the wings are a little longer than in my specimens of *D. ludovicia*.

333. *Chalybura melanorrhoa*, *Salv.* (*C. carmioli*, *Lawr.*).

Angostura and Pacuare (J. Carmiol).

334. *Chalybura isauræ*, *Gould.*

"Bocca del Toro." Gould, P. Z. S., 1861, p. 199.

335. *Heliodoxa jacula*, *Gould* (*henryi*, *Lawr.*).

Angostura and Juiz (J. Carmiol).

Mr. Salvin states, *P. Z. S.*, 1867, p. 154, that he and Mr. Gould consider my *H. henryi* to be immature and identical with *H. jacula*. I have now seen five specimens from Costa Rica all alike, and not one with a bright frontal or throat spot.

336. *Thalurania venusta*, *Gould.*

Angostura (J. Carmiol); Tucurriqui (J. Zeledon); A. R. Endrès.

337. *Florisuga mellivora* (*Linn.*).

A. R. Endrès.

338. *Microchera albocoronata* (*Lawr.*).

Capt. J. M. Dow, fide S. F. Baird.

339. *Microchera parvirostris* (*Lawr.*).

Angostura (J. Carmiol).

My name for this species was proposed for the female, the male since received is very beautiful, of which I add the following description.

Front and crown pure white, lores black; the rest of the plumage above and below is of an exceedingly rich purplish crimson; upper tail coverts coppery red; the two central tail feathers are coppery bronze, the others are of a whitish gray for about half their length, gradually becoming purplish black, the extreme ends white; wings brownish purple; bill and feet black.

Length (fresh) 3 in.; wing $1\frac{5}{8}$; tail $\frac{7}{8}$; bill $\frac{7}{16}$.

Remarks. Although resembling *M. albocoronata* in its white crown, this species is quite different in coloring; in *M. albocoronata* the plumage is black, washed with carmine, in some lights appearing to be entirely black; in *M. parvirostris* the plumage is clear and uniform in color, not appearing black in any position; the tail is rounding and the black coloring at the end is quite different from that of *M. albocoronata*, in which the tail is even, and it has a strongly defined subterminal black band.

340. *Gouldia conversi* (*Bourc.*).

"Enrique Arcé." Collection of Mr. O. Salvin.

341. *Trochilus colubris*, *Linn.*

Las Cruces de Candelaria (J. Zeledon).

342. *Selasphorus scintilla*, *Gould.*

Barranca (F. Carmiol); Cervantes (J. Carmiol); Las Cruces de Candelaria (J. Zeledon).

343. *Selasphorus flammula*, *Salv.*

"Volcan de Catargo (E. Arcé)," Salv. P. Z. S., 1864, p. 586.

344. *Doricha bryantæ*, *Lawr.*, *Ann. N. Y. Lyc.*, *Vol. viii. p.* 483.

Dota (J. Carmiol); Las Cruces de Candelaria (J. Zeledon).

I have the female of this species, which I found in the collection received from Costa Rica by A. C. Garsia, Esq. It is of a dark coppery green above, the two central tail feathers are dark bronzy green dusky at the ends, the next, on each side, green with the ends largely black, the pair next in order are chestnut at base, then green on the outer webs and terminating in black, the exterior two pairs on each side are chestnut at base, then green for a short distance, succeeded by a black band and ending with chestnut; lores black, bordered above with chestnut; a white mark behind the eye; sides of the head and of the neck blackish brown; throat and breast pale chestnut, sides of the abdomen of a deeper chestnut, middle of abdomen whitish. It somewhat resembles the female *D. evelynæ*, but is much darker in its coloring.

345. *Panterpe insignis, Cab.*

La Candelaria (Dr. Frantzius); Volcan Yrazei (J. Cooper).

346. *Anthocephala castaneiventris, Gould.*

La Candelaria (Dr. Frantzius); San José (J. Carmiol); Volcan Yrazei (J. Cooper).

I wrote Dr. Frantzius requesting his opinion, whether this bird was entitled to be considered a valid species or not; in a letter dated in February he replies as follows:

"In my opinion *Anthocephala castaneiventris*, Gould, is the female of *Panterpe insignis*. My grounds for believing so are the following: I have always received both from the same place, La Candelaria. All the specimens of the former now in my possession are females, and all the specimens of the *Panterpe* are males. The bright crown in both is identical, as likewise the shape of their bills."

This coincides with the opinion expressed by me (*Ann. N. Y. Lyc., Vol. viii. p.* 45), but from which Mr. Salvin dissented.

Since the receipt of Dr. Frantzius' letter, I have had my opinion unsettled by specimens of *Oreopyra calolæma* received lately from the Smith. Inst., and now under examination, there are two pairs apparently ♂ and ♀; one pair marked with same date and locality. Mr. Salvin under *O. calolæma* suggests that *A. castaneiventris* may be the female of that species, or possibly distinct as given by Mr. Gould. I must confess that with numerous specimens before me I am unable to arrive at a definite conclusion as to the true status of the bird described as *A. castaneiventris*. A pair of birds previously received, which came together and are marked with same locality and date, I considered to be ♂ and ♀ of *P. insignis*, yet the female differs in no perceptible character from eight other specimens; it is possible that the females of *P. insignis* and *O. calolæma* may resemble each other so nearly as not to be separable. But few specimens have the sex indicated, but where it is, they are marked as females, they differ in the lustre on their fronts, but this may vary with age; the wings of the chestnut-bellied bird are of the same length or a little shorter than those of *P. insignis*, and invariably shorter than those of *O. calolæma*, say from ¼ to ⅜ of an inch.

I have, therefore, let *A. castaneiventris* remain as a species for the present, not doubting that its true position will be ascertained hereafter.

347. *Oreopyra leucaspis, Gould.*

"Volcano of Chiriqui," Gould P. Z. S., 1860, p. 312.

348. *Oreopyra hemileuca, Salv.*

"Turrialba and Tucurriqui (E. Arcé)." Salv. P. Z. S., 1864, p. 584.

349. *Oreopyra salolœma, Salv.* (*O. venusta, Lawr.*).

Rancho Redondo (J. Carmiol); Las Cruces de Candelaria (J. Zeledon).

Mr. Gould wrote me, on seeing my type, that it is identical with Mr. Salvin's species.

350. *Oreopyra cinereicauda, Lawr.*

In my collection (A. C. Garsia).

351. *Heliothrix barroti* (*Bourc.*).

Angostura and Cervantes (J. Carmiol).

352. *Petasophora cyanotis* (*Bourc.*)?

Barranca and Dota (J. Carmiol); Catargo (J. Cooper).

Mr. Cabanis (*J. f. O., Vol.* x. p. 162) speaks of the bird from Costa Rica as occupying a middle form between *P. cyanotis* and *P. thalassina*, and says: "The fine blue coloring on the ears appears to be broader, the subterminal dark tail band on the outer web of the outer feather is not so distinctly marked, but since Mr. Gould has indicated an extended locality and speaks of variations of this kind, and having but few examples (two) for comparison, I feel bound to leave the separation of the bird from Costa Rica for future comparison."

There are before me nine examples from Costa Rica of both sexes; at first sight this species might be taken for *P. thalassina*, but in fine specimens the colors are darker, with the tail of a deeper blue; it is, however, quitedistinct; as pointed out by Mr. Cabanis the blue coloring under the eyes and on the ears is more extended than in *P. cyanotis*, but the tail bands vary in distinctness; it is of a deeper green than *P. cyanotis*, and has the blue on the cheeks to extend as far as the forward part of the eye, while in *cyanotis* this color extends only as far as on a line with the middle of the eye; in *thalassina*, the blue color is continuous as far as the bill and covers the chin also, there is likewise a patch of blue on the breast of *thalassina*, not found in *cyanotis*; in fine plumaged males of the bird from Costa Rica, there is just a perceptible tinge of blue on the breast. The size is about the same as that of *thalassina*, and apparently larger than *cyanotis*.

Should these differences be considered sufficient to constitute it a new species, I propose for it the name of *Petasophora cabanisii*.

353. *Heliomaster constanti* (*Delatt.*).

(J. Carmiol); (Dr. Frantzius).

354. *Heliomaster longirostris* (*Vieill.*).

"Enrique Arcé." Collection of Mr. O. Salvin.

355. *Heliomaster pallidiceps*, *Gould.*

"Gulf of Nicoya." Collection of Mr. O. Salvin.

356. *Heliomaster sclateri*, *Cabanis.*

San José (Dr. Frantzius); Angostura (J. Carmiol).

There are three specimens from Costa Rica, but one of which is adult and has the crown of a deeper and more decided blue than any specimen I have seen of *H. longirostris*, this being the most marked characteristic on which its distinctness as a species rests, I have included it as being so; there is, however, a greater extent of black on the tail feathers than exists on those of *longirostris;* but this last character is not so extended as in my *H. stuartæ* (from Bogota), which Mr. Salvin states (*P. Z. S.*, 1867, *p.* 155), that Mr. Gould now considers together with *H. sclateri* not to differ from *longirostris*, in which view he agrees. As pointed out by me in the description of *H. stuartæ*, it differs from *longirostris* in the greater width of the bill at base, and in its black tail, which is bronzed green only for a short distance at the base, whereas in *longirostris*, the bill is narrow at the base, and the tail bronzed green for the greater part of its length, black at the end only. These differences seem to me to constitute a claim to specific separation, even more than that of *H. pallidiceps*, which is admitted upon the paler tint in the green coloring of the crown.

357. *Pyrrhophæna riefferi* (*Bourc.*).

San José and Angostura (J. Carmiol); Catargo (J. Cooper).

358. *Erythronota edwardi* (*Delatt. et Bourc.*).

"Costa Rica." Gould, Intr. Troch. p. 161.

359. *Saucerottia sophiæ* (*Bourc.*); (*Hemythylaca hoffmanni*, *Cab.*).

San José and Dota (J. Carmiol).

Mr. Gould considers Dr. Cabanis' species to be identical with *S. sophiæ*.

360. *Eupherusa eximia* (*Delatt.*).

Cervantes and Barranca (J. Carmiol).

361. *Eupherusa chionura* (*Gould*). *E. niveicauda* (*Lawr.*).

Dota (J. Carmiol).

362. *Eupherusa cupreiceps*, *Lawr.*

Barranca (J. Carmiol).

363. *Eupherusa nigriventris*, *Lawr.* *Proc. Phil. Acad.*, 1867, *p.* 232.

A. R. Endrès.

364. *Chrysuronia eliciæ* (*Bourc. et Muls.*).
A. R. Endrès.
365. *Juliamyia typica*, *Bonap.*
Julian Carmiol.
366. *Damophila amabilis* (*Gould*).
Pecuare (J. Carmiol).
367. *Sapphironia cœruleigularis* (*Gould*).
"Costa Rica." Gould, Intr. Troch. p. 172.
368. *Chlorolampis salvini*, *Cab.*
San José (J. Carmiol).
369. *Chlorostilbon assimilis*, *Lawr.*
Cartago (J. Cooper).

Order ZYGODACTYLI.

Fam. Cuculidae.

370. *Crotophaga sulcirostris*, *Sw.*
San José (J. Carmiol).
371. *Dromococcyx phasianellus* (*Spix*).
"Dr. Frantzius." Cab. J. f. O., Vol. x. p. 171.
372. *Diplopterus nævius* (*Linn.*).
Guiatil (J. Carmiol); San Mateo (J. Cooper).
373. *Piaya mehleri*, *Bonap.*
San José (J. Carmiol); Angostura (F. Carmiol).
374. *Morococcyx erythropygia* (*Less.*).
Pacaca (J. Zeledon).
375. *Coccyzus americanus* (*Linn.*).
"Dr. Frantzius." Cab. J. f. O., Vol. x. p. 167.
376. *Coccyzus erythrophthalmus* (*Wils.*).
Barranca (F. Carmiol).

Fam. Ramphastidae.

377. *Ramphastos tocard*, *Vieill.*
Angostura, San Carlos and Turrialba (J. Carmiol).
378. *Ramphastos approximans*, *Cab.*

San José (Dr. Frantzius); Angostura, Dota and Grecia (J. Carmiol).

I have no specimens at hand of the Costa Rica bird, but as Mr. Cassin states (*Proc. Phil. Acad.*, 1867, *p.* 103) that those from Panama are the same, I am able to compare with *R. carinatus* from Mexico; as noticed by Mr. Cassin they differ in the southern bird having the red band below the yellow of the throat much wider, yet with a large number of specimens before him, Mr. Cassin says: "I acknowledge myself quite perplexed to distinguish satisfactorily between them."

Mr. Salvin (*P. Z. S.*, 1867, *p.* 156) puts *approximans* as a synonym of *carinatus* and remarks: "This race is so very closely allied to the more northern bird that I am unwilling to separate them."

I have two specimens from Panama, male and female, and but one from Mexico; this last has only a mere edging of red on the lower border of the yellow of the throat, and has the black coloring of the plumage tinged with purple, most apparent on the wings and tail, whereas the Panama specimens are of a greenish hue on those parts; the Mexican example is larger in all its proportions than either of the others.

Mr. Cassin in his "*Study of the Ramphastidæ*" keeps it separate from *carinatus*; I have also given it under Mr. Cabanis' name. It seems certainly to be a well marked race, if not distinct.

379. *Pteroglossus torquatus* (*Gm.*).

Angostura and Turrialba (J. Carmiol).

380. *Pteroglossus frantzii*, *Cab.*

San José and Angostura (J. Carmiol).

381. *Selnidera spectabilis*, *Cassin.*

Julian Carmiol.

382. *Aulacorhamphus cœruleigularis*, *Gould.*

Barranca, Dota and Turrialba (J. Carmiol).

Fam. CAPITONIDAE.

383. *Capito bourcieri* (*Lafr.*).

Barranca (J. Carmiol); Turrialba (J. Cooper).

384. *Capito Hartlaubi* (*Lafr.*).

Barranca (J. Carmiol).

385. *Tetragonops frantzii*, *Scl. Ibis, Vol. vi. p.* 371.

San José (Dr. Frantzius); Cervantes (J. Carmiol); Navarro (J. Cooper); Birris and La Palma (J. Zeledon).

The specimen described by Mr. Sclater from the Smithsonian collection was at the time unique and the sex unknown. it was suggested that possibly it was "a female of a more gaudily colored male," and the hope expressed that other examples might be obtained, to determine whether the sexes differ in plumage.

It would appear to be rather an abundant species and widely distributed, as there are now before me fourteen specimens, since received at the Smithsonian. These are from several collectors and of both sexes; in general coloration there is no difference between them, but the tuft of peculiar elongated black lustrous feathers on the hind neck, seems to be a characteristic of the male, and is entirely wanting in the female.

Fam. PICIDAE.

386. *Campephilus guatemalensis* (*Hartl.*).

San José (Dr. Frantzius); Angostura (J. Carmiol); Grecia (F. Carmiol).

387. *Dryocopus scapularis* (*Vigors*).

"Dr. Frantzius." Cab. J. f. O., Vol. x. p. 176.

388. *Picus jardinii*, *Malh.*

San José and Cervantes (J. Carmiol); Birris (J. Zeledon).

389. *Picus harrisii*, *Aud.*

"Dr. Hoffmann." Cab. J. f. O., Vol. x. p. 175.

390. *Celeus castaneus* (*Wagl.*).

Angostura (F. Carmiol); Turrialba (J. Cooper).

391. *Chloronerpes oleagineus* (*Licht.*).

Barranca and Turrialba (J. Carmiol).

392. *Chloronerpes yucatanensis* (*Cabot*). (*uropygialis*, *Cab.*).

Turrialba (J. Cooper); Barranca (J. Carmiol).

393. *Melanerpes formicivorus* (*Sw.*).

San José and Barranca (J. Carmiol); Dota and Birris (J. Zeledon).

394. *Centurus hoffmanni*, *Cab.*

San José (J. Carmiol); Grecia (F. Carmiol).

395. *Centurus gerini* (*Temm.*). (*pucherani*, *Malh.*).

San José (J. Carmiol).

Fam. Psittacidae.

396. *Sittace macao* (*Linn.*).

Los Anonos (J. Zeledon).

397. *Sittace militaris* (*Linn.*).

Barba (J. Carmiol.)

398. *Brotogeris tovi* (*Gm.*).

"Gulf of Nicoya." Collection of Mr. O. Salvin.

399. *Conurus petzii* (*Seibl.*).

San José (J. Carmiol); Sachi (F. Carmiol); Juan (J. Zeledon).

400. *Conurus hoffmanni*, *Cab.*

Angostura (J. Carmiol); Frailes (F. Carmiol); Naranjo (J. Cooper).

401. *Chrysotis pulverulenta* (*Gm.*).

Cervantes (J. Carmiol).

402. *Chrysotis viridigenalis*, *Cassin.*

San José (Dr. Frantzius and J. Carmiol).

403. *Chrysotis albifrons*, *Sparrm.*

Desmonte (Dr. Frantzius); Nicoya (J. Zeledon).

404. *Pionius senilis* (*Spix*).

San José (Dr. Frantzius); Barranca (J.Carmiol).

405. *Pionius hæmatotis*, *Scl.*

Pacuare (J. Carmiol).

Order ACCIPITRES.

Fam. Strigidae.

406. *Glaucidium gnoma*, *Wagl.*
"San José (Dr. Hoffmann)." Cab. J. f. O., Vol. x. p. 336.
407. *Syrnium perspicillatum* (*Lath.*).
Los Anonos (J. Zeledon).
408. *Syrnium virgatum*, *Cassin.*
Dota (J. Zeledon).
409. *Ciccaba nigrolineata*, *Scl.*
San José (Dr. A. v. Frantzius).
410. *Bubo virginianus* (*Gm.*).
San José (Dr. A. v. Frantzius).
411. *Scops brasilianus* (*Gm.*) (*choliba Vieill.*).
San José (Dr. A. v. Frantzius).
412. *Scops nudipes* (*Vieill.*).
"Enrique Arcé." Collection of Mr. O. Salvin.
413. *Lophostrix stricklandi*, *Scl. & Salv.*
San José (Dr. A. v. Frantzius).
414. *Strix perlata*, *Licht.*
San José (Dr. A. v. Frantzius).

Fam. Falconidae.

415. *Polyborus auduboni*, *Cassin.*
San José (J. Carmiol).
416. *Ibycter americanus* (*Bodd.*).
San José (J. Carmiol).
417. *Herpetotheres cachinnans* (*Linn.*).
Dr. A. von Frantzius.
418. *Spizaetus ornatus* (*Daud.*).
San José (J. Carmiol); La Palma and Juan (J. Zeledon).
419. *Spizaetus tyrannus* (*Max.*).
"Enrique Arcé." Collection of Mr. O. Salvin.
420. *Spizaetus melanoleucus* (*Vieill.*).

La Palma (J. Zeledon).

421. *Urubitinga zonura* (*Shaw*).

San José (J. Carmiol).

422. *Urubitinga anthracina* (*Nitzsch*).

San José (Dr. Frantzius); Angostura (F. Carmiol).

423. *Buteo borealis var. montanus, Nutt.*

San José (J. Carmiol); Los Tabacales (J. Zeledon).

424. *Buteo pennsylvanicus* (*Wils.*).

San José (J. Carmiol); Angostura (F. Carmiol).

425. *Buteo erythronotus* (*King*).

San José (J. Carmiol); San Antonio (J. Zeledon).

426. *Buteo albonotatus, Kaup.?*

San José (J. Carmiol).

The specimen before me is a young bird, and I think may be of the species to which I refer it. I have not met with any description of *B. albonotatus* in its immature plumage. it resembles my specimen of the adult in its general proportions, though smaller, the feet and bill are especially so; it has the front part of the tarsus feathered below the knee as in *B. albonotatus.* The feathers above are dark brown, showing much white on their edges, particularly on the head and hind neck, the upper tail coverts are white with wavy brown bars; tail bluish ash, crossed with narrow dusky bars; under plumage white, with large oval brown spots on the breast and a few sagittate ones on the sides; under wing coverts pale salmon color, the under plumage more or less tinged with the same.

Length 18 in.; wing $15\frac{1}{2}$; tail $8\frac{3}{4}$; tarsi $2\frac{5}{8}$.

427. *Buteo fuliginosus, Scl.*

La Palma (J. Zeledon).

428. *Leucopternis semiplumbeus, Lawr.*

"Val." (J. Carmiol).

429. *Leucopternis princeps, Scl. P. Z. S.,* 1865, *p.* 429.

"Tucurriqui (Enrique Arcé)." Collection of Mr. O. Salvin.

430. *Asturina nitida* (*Lath.*).

"Gulf of Nicoya." Collection of Mr. O. Salvin.

431. *Asturina magnirostris* (*Gm.*).

Juan (Dr. Frantzius): San José and Turrialba (J. Carmiol).

432. *Micrastur semitorquatus* (*Vieill.*).

Las Cruces de Candelaria and Rancho Redondo (J. Zeledon).

433. *Accipiter fuscus* (*Gm.*).

El Mojon (J. Zeledon).

434. *Accipiter pileatus* (*Max.*).

San José (J. Carmiol); Dota (F. Carmiol); Turrialba (J. Cooper).

435. *Accipiter cooperi*, *Bonap.*

El Mojon (J. Cooper).

436. *Tinnunculus sparverius* (*Linn.*).

San José (J. Carmiol).

437. *Hypotriorchis columbarius* (*Linn.*).

San José (J. Carmiol).

438. *Hypotriorchis deiroleucus* (*Temm.*).

La Palma (J. Zeledon).

439. *Cymindis cayennensis* (*Gm.*).

"Gulf of Nicoya." Collection of Mr. O. Salvin.

440. *Cymindis uncinatus* (*Temm.*).

San José (Dr. Frantzius).

441. *Rosthramus sociabilis* (*Vieill.*).

"Gulf of Nicoya." Collection of Mr. O. Salvin.

442. *Elanoides furcatus* (*Vieill.*).

Birris (J. Zeledon).

443. *Circus hudsonius* (*Linn.*).

San José (J. Carmiol).

Family Vulturidae.

444. *Gyparchus papa* (*Linn.*).

"Gulf of Nicoya." Collection of Mr. O. Salvin.

Order PULLASTRAE.

Fam. Columbidae.

445. *Chlorœnas flavirostris* (*Wagl.*).

Barranca (J. Carmiol); Dota (J. Zeledon).

446. *Chloroenas albilinea* (*Gray*).

Rancho Redondo (F. Carmiol); Juan (J. Zeledon).

447. *Chloroenas nigrirostris, Scl.*

"Enrique Arcé." Collection of O. Salvin.

448. Chloroenas subvinacea. sp. nov.

Male. Head, neck, and under plumage light purplish vinaceous, darker on the abdomen and sides, the throat paler and of a fulvous tinge; back, wing coverts and rump brownish cinnamon; tail of a fine dark brown slightly purplish, except the two central feathers, which are rather lighter in color and incline to olivaceous brown, the upper tail coverts are of the same color as the central tail feathers; the quills are dark brown, the primaries blackish on the outer webs, which are narrowly margined with pale cinnamon, the inner webs of the quill feathers are broadly marked with dull pale cinnamon to near their ends; the under wing coverts are vinaceous varied with cinnamon; bill black; feet yellow.

Length (fresh) $13\frac{1}{2}$ in.; wing $6\frac{1}{2}$; tail $5\frac{1}{2}$; tarsi $\frac{3}{4}$.

Habitat. Dota, collected by F. Carmiol 26th Feb., 1867.

Type in Mus. Smith. Institution No., 47575.

The female is a little smaller, $12\frac{1}{2}$ inches in length, and differs in plumage only in being less vinaceous on the lower part of the hind neck and abdomen, where it is brownish cinnamon.

Remarks. There are four specimens of this species in the collection, all agreeing in plumage. It differs from *C. vinacea* in being generally lighter in color, the back and rump being cinnamon brown, instead of dull dark vinous; the wings of *C. vinacea* are of an olivaceous cast, and the inner webs of the quills are not of a cinnamon color as in the present species.

C. nigrirostris, Scl., is smaller than either this or *C. vinacea*, and has the back and wings dark olive brown.

449. *Geotrygon montana* (*Linn.*).

Angostura (J. and F. Carmiol).

450. *Geotrygon albiventer, Lawr.*

Angostura (J. Carmiol).

151. Geotrygon costaricensis. sp. nov.

Forehead and the forward part of the cheeks next the bill of a brownish salmon color; cheeks and throat white; there is a bar of deep black on each side from the eye to the bill, and a stripe of the same color extends from the upper part of the throat along each side of the neck and borders the white cheeks, these black lines approach each other quite closely on the throat; across the middle of the crown and adjoining the salmon-colored front is a narrow band of grayish blue which gradually merges into the dark green of the occiput and hind neck; the lower part and sides of the hind neck and the upper part of the back, are of a lighter or yellowish green, more lustrous and quite distinct from the deep green of the occiput; scapulars and upper part of back rich purplish violet; lower part of back, rump and wing coverts of a cinnamon brown, the upper tail coverts are darker, more of a vinous brown; two central tail feathers dull purplish brown, the two next of a duller brown, the outer three purplish black, terminating with ashy gray; primaries and secondaries blackish brown; the tertiaries have their inner webs blackish brown, the outer brownish cinnamon; under wing coverts of a dusky brown; neck and breast dark grayish plumbeous; middle of abdomen testaceous white with a slight tinge of pale rose color, sides chocolate brown, feathers of the flanks and under tail coverts brownish ash, ending in whitish; thighs ashy brown; bill hazel brown, the under mandible yellowish at the end; tarsi and toes yellowish flesh color.

Length about $10\frac{1}{2}$ in.; wing $5\frac{3}{4}$; tail $3\frac{7}{8}$; bill $\frac{5}{8}$; tarsi $\frac{9}{16}$.

Received from Dr. A. v. Frantzius, precise locality unknown.

Type in Mus. Smith. Institution, No. 30431.

Remarks. This beautiful pigeon bears but little resemblance to any species of which I can find an account, it is allied to the group represented by *G. caniceps* from Cuba, the color of the breast in each is nearly the same, but they are not alike otherwise; it has much longer and stouter tarsi and toes than *G. caniceps.*

152. Geotrygon cœruleiceps. sp. nov.

Female. The entire head above and on the sides as far as just below the eyes, and the hind neck, are of a grayish blue, darker on occiput and on the middle of the hind neck, where there is a tinge of dull dark green; upper plumage of a fine brownish cinnamon, rather brighter on the wings, the interscapular region is purplish violet; tail cinnamon brown, all except the two central feathers have a subterminal dusky band and the ends of the feathers pale; primaries and secondaries brownish black; under wing coverts cinnamon brown; the sides of the head below the eyes, and the sides of the neck, are pale rufous, with a line of black across the cheek; throat white; lower part of neck and upper part of breast reddish cinnamon; sides of the breast brownish cinnamon; lower part of breast, abdomen and under tail coverts pale ashy cinnamon; bill black; feet reddish yellow.

Length about 12 in.; wing 6; tail 4; bill $\frac{5}{8}$; tarsi $1\frac{5}{8}$.

Habitat. Cervantes. Collected by J. Zeledon, April, 1867. Type in Mus. Smith. Institution, No. 51266.

Remarks. This species does not require comparison with any other, the most distinguishing feature is the extent of blue on the head; it is of a stouter form than the preceding species, and has very strong legs.

453. *Leptoptila verreauxi*, *Bonap.*

San José and Barranca (J. Carmiol); Dota (F. Carmiol).

454. *Leptoptila cassinii*, *Lawr.* *Proc. Phil. Acad.*, 1867, *p.* 94.

San José (Julian Carmiol); Tucurriqui (J. Zeledon).

455. Leptoptila riottei. sp. nov.

Male. Front and part of crown pale roseate vinaceous, gradually becoming olivaceous brown on the occiput and hind neck, which with the upper part of the back have changeable reflections of light reddish violet and green of different shades; back and rump brownish olive; central tail feathers browner than the back, the lateral feathers black, ending in white; primaries and secondaries blackish brown, tertiaries and wing coverts of the same color as the back, the smaller coverts tinged with cinnamon brown; under wing coverts deep cinnamon red, inner webs of quills to near their ends of a paler cinnamon; chin and upper part of throat white; sides of the head, the breast and upper part of the abdomen of a rather light brownish vinaceous; sides of the breast and of the abdomen pale fulvous brown; middle of abdomen and under tail coverts white; bill black; the tarsi and toes appear to have been flesh color.

Length (skin) about 10½ in.; wing 5½; tail 4½; bill 1/16; tarsi 1⅛.

Habitat. Navarro. Collected by Juan Cooper.

Type in Mus. Smith. Institution, No. 43044.

Remarks. This species is a close ally of *L. rufaxilla*, *L. albifrons*, Gray, *L. verreauxi*, Bonap., and *L. brachyptera*, Gray; according to Mr. J. Verreaux, *L. albifrons*, Bonap., *Consp. Avium*, II. *p.* 74, is the same as the last named species.

The bird now described comes nearest to *L. brachyptera*, but that has the front more of a grayish cast, and the cheeks brownish without any tinge of vinaceous; the new species is a little darker on the breast and sides, the under wing coverts are of a brighter color, and the inner webs of the quills are cinnamon, whereas in *brachyptera* there is only a mere edging of pale salmon on the inner webs of the quill feathers; this last is a striking character of *L. brachyptera*, as exhibited in fourteen specimens before me.

L. albifrons has a bluish front and crown, is much browner above, and has the sides of the neck and the breast of a brownish cast.

L. verreauxi is much like *brachyptera* and *riottei* in the upper plumage, but is very much paler and more roseate below.

L. rufaxilla has the front and crown bluish, but differs from all others in having the neck in front and the sides of the head of a dull brownish rufous.

L. riottei has a larger and stronger bill than any of the allied species.

In all the species above alluded to, there is quite a close general resemblance, and it is rather difficult to point out intelligibly by description, the difference in shades of coloring which mainly separates some of the species, yet in an autoptical examination the differences are very appreciable.

456. *Peristera cinerea*, *Temm.*

"Gulf of Nicoya." Collection of Mr. O. Salvin.

457. *Peristera mondetura, Bonap.*

Birris (J. Zeledon).

A male of this beautiful species from Mexico is in the Smithsonian collection, of which the specimen before me appears to be the female; the quadrate purple markings on the wings are much the same, but the plumage otherwise is quite different, the front is brownish rufous, the upper plumage brownish olive, the rump deep reddish brown, the under plumage dusky olive brown with the middle of the abdomen white.

458. *Chamæpelia passerina* (*Linn.*).

San José (J. Carmiol); Catargo (J. Cooper).

459. *Chamæpelia rufipennis, Gray.*

San José (J. Carmiol).

460. *Melopelia leucoptera* (*Linn.*).

San José (J. Carmiol).

461. *Zenaidura carolinensis* (*Linn.*).

Volcan Yrazei (J. Cooper); San José (J. Carmiol).

Fam. Penelopidae.

462. *Penelope purpurascens, Wagl.*

Barranca and Angostura (J. Carmiol); La Palma (J. Zeledon).

463. *Chamæpetes unicolor, Salv. P. Z. S.*, 1867, *p.* 159.

La Palma (Dr. Frantzius); Rancho Redondo (J. Zeledon).

464. *Ortalida poliocephala, Wagl.*

San José (Dr. Frantzius); Turrialba (J. Carmiol); La Palma (J. Zeledon).

Fam. Cracidae.

465. *Crax globicera, Linn.*

San José (J.Carmiol).

Sub-class II. CURSORES.

Order GALLINAE.

Fam. Perdicidae.

466. *Ortyx leylandi, Moore.*

San José and Barranca (J. Carmiol).

467. *Dendrortyx leucophrys*, *Gould*.

Dota (J. Carmiol); Las Cruces de Candelaria (J. Zeledon).

468. *Odontophorus guttatus*, *Gould*.

Dota (J. Carmiol).

469. *Odontophorus veraguensis*, *Gould*.

Dota and Barranca (J. Carmiol); Las Cruces de Candelaria (J. Zeledon).

470. *Odontophorus leucolæmus*, *Salv*.

San José (Dr. Frantzius and J. Cooper).

471. *Odontophorus melanotis*, *Salv*.

"Tucurriqui (E. Arcé)." Collection of Mr. O. Salvin.

Fam. Crypturidae.

472. *Tinamus robustus*, *Scl*.

San José and San Carlos (J. Carmiol).

473. Tinamus frantzii. sp. nov.

Female. Head above and hind neck black, the front and the sides of the head are somewhat ashy; general color of the plumage deep rufous brown, darker above, where the feathers are finely vermiculated with black, and the wings, rump and upper tail coverts are marked with small whitish spots, most numerous on the wing coverts; quills blackish brown, the outer webs of the primaries mottled with light rufous, the secondaries and tertiaries mottled with dull rufous on the outer webs, where they are also crossed with wavy bars of bright rufous, the under surface of quills ashy gray, with wavy bars of very pale rufous; throat rufous, paler on the upper part where the color is clear, and darker on the lower where the feathers are pencilled with black; the under plumage is more rufous than the upper, and crossed with undulating black lines, the middle of the abdomen is lighter in color; the sides, lower part of the abdomen and under tail coverts are marked with pale rufous white spots; upper mandible black, the under dusky yellowish; tarsi and toes fleshy dark brown, claws blackish brown; hind part of tarsus exceedingly rough or corrugated.

Length about 15 in.; wing $8\frac{3}{4}$; tail 3; bill from rictus $1\frac{1}{4}$; from front $1\frac{1}{8}$; tarsi $2\frac{3}{4}$; mid. toe and claw $2\frac{1}{4}$; hind toe and claw $\frac{13}{16}$.

Habitat. Cervantes. Collected by J. Zeledon.

Type in Mus. Smith. Institution, No. 51285.

Remarks. This fine *Tinamou*, which I have named in compliment to Dr. A. von Frantzius, is the second large species found to inhabit Central America.

It is about the same size as *T. robustus*, Scl., but is much darker and quite different in coloring; it can also be readily distinguished from that species by its spotted appearance, rufous throat, mottled primaries (those of *robustus* being immaculate), and by its strikingly longer toes; the scutellae on the hind part of the tarsus are more projecting than those of *T. robustus.*

474. *Crypturus sallæi* (*Bonap.*).

San José (Dr. Frantzius).

Order GRALLAE.

Fam. CHARADRIIDAE.

475. *Charadrius virginicus*, *Borck.*

Julian Carmiol.

476. *Aegialitis vociferus* (*Linn.*).

Julian Carmiol.

Fam. HAEMATOPODIDAE.

477. *Haematopus palliatus*, *Temm.*

Capt. J. M. Dow.

Fam. SCOLOPACIDAE.

478. *Gallinago wilsoni* (*Temm.*).

Dr. A. von Frantzius.

479. *Macrorhamphus scolopaceus* (*Say*).

Dr. A. von Frantzius.

480. *Gambetta flavipes* (*Gm.*).

San José (Manuel L. Calleja); F. Carmiol.

481. *Gambetta melanoleuca* (*Gm.*).

San José (Manuel L. Calleja); J. Carmiol.

482. *Rhyacophilus solitarius* (*Wils.*).

San José (Manuel L. Calleja); J. Carmiol.

483. *Tringoides macularius* (*Linn.*).
Dr. A. von Frantzius.

484. *Actiturus bartramius* (*Wils.*).
Julian Carmiol.

Fam. TANTALIDAE.

485. *Ibis alba* (*Linn.*).
"Gulf of Nicoya." Collection of Mr. O. Salvin.

Fam. PLATALEIDAE.

486. *Platalea ajaja*, *Linn.*
Capt. J. M. Dow.

Fam. CANCROMIDAE.

487. *Cancroma cochlearia*, *Linn.*
Rio Grande. J. Cooper.

Fam. ARDEIDAE.

488. *Demiegretta ludoviciana* (*Wils.*).
Dr. A. von Frantzius.

489. *Garzetta candidissima* (*Jacquin*).
Capt. J. M. Dow.

490. *Herodias egretta* (*Gm.*).
Julian Carmiol; Dr. A. von Frantzius.

491. *Butorides virescens* (*Linn.*).
Dr. A. von Frantzius; Julian Carmiol.

492. *Ardea herodias*, *Linn.*
Dr. A. von Frantzius; Julian Carmiol.

493. *Florida cærulea* (*Linn.*).
Dr. A. von Frantzius.

494. *Tigrisoma cabanisi*, *Heine.*
San Carlos (J. Carmiol).

495. *Eurypyga major*, *Hartl.*
Angostura (Dr. A. von Frantzius.)

Fam. RALLIDAE.

496. *Porzana albigularis* (*Lawr.*).
"Gulf of Nicoya." Collection of Mr. O. Salvin.

497. *Aramides cayennensis* (*Gm.*).

Santa Ana (J. Zeledon).

In my Catalogue of Birds from Panama (*Ann. N. Y. Lyc.* V. VII., p. 479), I referred this species erroneously to *A. ruficollis*, Gm.; it is, however, *A. ruficollis* of Swainson. For some time I have known that the Panama bird was not *ruficollis*, Gm.; it differed, in its much deeper color below, from specimens of *A. cayennensis* in the Phil. Acad., but in them the color has no doubt faded. The Costa Rica example before me, as well as others from Nicaragua, are identical with those from Panama, and comparing them with specimens from the Upper Amazon and Bogota (which I take to be *cayennensis*), I can see no essential points of difference.

This species seems to be widely distributed, but in Honduras and Guatemala it is replaced by my *A. albiventris*.

498. *Fulica Americana*, Gm.

San Antonio (Dr. A. von Frantzius); J. Carmiol.

Sub class III. NATATORES.

(*Section Lamellirostres.*)

Order LAMELLIROSTRES.

Fam. ANATIDAE.

499. *Dendrocygna autumnalis* (*Linn.*).

"Gulf of Nicoya." Collection of Mr. O. Salvin.

500. *Dafila acuta* (*Linn.*).

San José (Manuel L. Calleja).

501. *Querquedula discors* (*Linn.*).

San José (Manuel L. Calleja).

502. *Fulix affinis* (*Forster*).

San Antonio (Dr. A. von Frantzius).

(*Section Simplicirostres.*)

Order STEGANOPODES.

Fam. PLOTIDAE.

503. *Plotus anhinga*, *Linn.*

"Gulf of Nicoya" (E. Arcé).

Order PYGOPODES.

Fam. PODICIPIDAE.

504. *Podilymbus dominicus* (*Linn.*).

Dota (F. Carmiol).

APPENDIX.

A few recent additions to the land birds of the Costa Rican fauna are enumerated below:

Fam. TYRANNIDAE.

505. Pogonotriccus? zeledoni. sp. nov.

Male. Head above and hind neck dark plumbeous, back, rump, and smaller wing-coverts yellowish-green; tail light brown, with edges the color of the back; quills, middle and larger wing-coverts brownish-black, the primaries just edged with yellow; the other quills and the coverts more broadly bordered with light yellow; under-wing coverts and inner margins of quills light yellow; throat and a spot reaching from the eye to the bill, grayish-white; breast, abdomen, and under tail-coverts of a clear light yellow, the feathers of the breast and sides have their centres pale olive; upper mandible black, the under whitish; tarsi and toes black.

The second quill is longest, the first shorter than the fifth; the bill is small and depressed.

Length (fresh) $4\frac{1}{2}$ in.; wing, $2\frac{1}{2}$; tail, 2; bill, $\frac{3}{8}$; tarsi, 9-16.

The female does not differ in plumage from the male; the length is marked as being five inches.

Habitat.—Dota and Barranca. Collected by F. Carmiol. Types in Smithsonian collection. No. of ♂, 47513.

Remarks.—From its style of coloring, I have included this species in the genus *Pogonotriccus*, but the bill is wider and flatter; it may be of the same genus as a species recently described by Messrs. Sclater and Salvin (*P. Z. S*, 1868, p. 389), from Veraguas, and referred by them to *Leptotriccus* (a form I am not acquainted with), though with a larger and wider bill. It is possible that the present species and the one from Veraguas may be the same generically, and perhaps separable from both *Pogonotriccus* and *Leptotriccus*.

I have named this species in compliment to Mr. J. Zeledon, an intelligent and promising young naturalist and collector.

506. *Lophornis helenæ* (*Delatt.*).

A. R. Endrès.

507. *Klais guimeti* (*Bourc. et Muls.*).

A. R. Endrès.

Fam. Psittacidae.

508. *Chrysotis auripalliata*, *Less.*

San José (Dr. A. von Frantzius).

509. *Chrysotis guatemalæ*, *Hartl.*

Cervantes (J. Carmiol).

Fam. Falconidae.

510. *Harpyia destructor* (*Linn.*).

San José (Manuel L. Calleja).

511. *Leucopternis semiplumbea*, *Lawr.*

"Valza (J. Carmiol)." Collection of Salvin and Godman. *Exotic Ornithology*, 1868, Part viii., p. 121, pl. 61.

In the following notes are some observations on birds previously recorded, and changes of nomenclature made or ascertained since the publication of the former part.

12. *Turdus obsoletus.*

A specimen of this species lately received at the Smithsonian Institution from M. L. Calleja, marked as a female, does not differ in plumage from the two specimens previously spoken of as males.

152. *Pyrgisoma kieneri.*

Messrs. Sclater and Salvin (*P. Z. S.*, 1868, p. 324) have described the Costa Rica species under the name of *P. cabanisi*, considering it not to be the *kieneri* of Bonap., the typical example of which they lately had the opportunity of inspecting in the Paris Museum.

181. *Oxyrhynchus flammiceps.*

The Costa Rican bird is separated from the Brazilian by Messrs. Sclater and Salvin (*P. Z. S.*, 1868, p. 326), and is called

O. frater, based mainly for its separation on the longer bill and shorter wings and tail.

187. *Dendrocolaptes multistrigatus.*

The Central American bird has heretofore been considered the same as Eyton's species by Messrs. Sclater and Salvin (*Ibis*, 1860, p. 275); but recently having had the opportunity of comparing it with the type, they determined it to be distinct and have described it under the name of *D. puncticollis* (*P. Z. S.*, 1868, p. 54). The specimen above referred to in the *Ibis*, came from Guatemala; the example from Costa Rica is evidently the same, and must therefore bear the name of *puncticollis.*

248. *Rhynchocyclus sulphurescens.*

Having occasion lately to examine the species of *Rhynchocyclus*, I found the single specimen in the collection, which I referred to *sulphurescens*, Spix, to be *cinereiceps*, Scl.

306. *Monasa peruana.*

I noticed (anteà p. 118) the large dimensions of the bird from Costa Rica, on which character Messrs. Sclater and Salvin (*P. Z. S.*, 1868, p. 327) have described it as a new species, with the name of *M. grandior.*

321. *Eutoxeres aquila.*

In (*Ann. and Mag. of N. H.*, June, 1868, p. 455) Mr. Gould describes the bird from Veraguas and Costa Rica as distinct from *E. aquila*, though previously he thought them identical, and has conferred upon it the name of *E. salvini.* No specimen of this species has yet been received at the Smithsonian.

360. *Eupherusa eximia.*

Messrs. Sclater and Salvin (*P. Z. S.*, 1868, p. 389) have separated the Costa Rica bird as distinct, calling it *E. egregia*, differing from *eximia* in the white mark on the outer two tail feathers extending partly on the outer webs; in *eximia*, it is restricted to the inner webs, though the part of the shaft adjoining is white.

They describe the female as having the outer two tail feathers wholly white.

With two specimens under examination, they say, "The male is not quite adult, and would probably eventually lose all traces of the irregular dark margins of the outer tail feathers, as in the female no traces of these spots appear."

When I referred this species to *eximia*, there was but one specimen in the collection, a male, and if I noticed the extension of the white on the outer webs of the tail feathers, no doubt attributed it to immaturity; it appears, however, to be fully adult; the white mark occupies about two-thirds the width of the outer web of the outer tail feather, and the dark outer margin is uninterrupted to the dark end of the feather.

Two other males have been received since; in one the white extends on the outer web of the first lateral tail feather, as in the specimen described above, but the end of the feather is white—the inner web is white, with a dark blotch near the end; in the other the outer web is without white, except at the tip, and the white on the inner web extends to the end of the feather; these two I consider to be not quite mature, though the plumage is perfect in other respects.

In *E. eximia* the white is confined to the inner webs, is more clearly defined, extending evenly across the feather, and does not reach so near the end as in *egregia*; in the latter the wings and tail are somewhat longer.

I examined twenty or more specimens of *eximia* from Guatemala, and found none with white on the outer webs of the tail feathers.

At first sight the two species would be supposed the same, yet on examination they differ in the white markings on the tail as above pointed out; the specific name of *egregia* must apply consequently to the Costa Rican bird.

430. *Asturina nitida.* The Mexican and South American birds of this form have generally been considered identical. In recording it from Costa Rica, I overlooked the fact that Mr. Schlegel (*Mus. d'Hist. Nat. des Pays Bas*, 1862) gives the Mexican bird as distinct from the South American under the

name of *A. plagiata*, Licht. (*Nomencl. Mus. Berol.*, p. 3). Distinguished by its stouter form, larger dimensions, and the greater number of its tail bands.

I have no Costa Rica specimens at hand, but examples in my collection from Panama, as well as from Mexico, agree quite well with the measurements given by Mr. Schlegel.

Two adult specimens from Panama have their wings 9½ and 10 inches, and their tails 7 and 7¼; an adult from Jalapa, Mexico, had the wing 10 inches, the tail 6½; another specimen in young plumage, also from Mexico, has the wing 9½ inches, the tail 7¼; the tail of the last is light brownish-gray, crossed with seven dark brown narrow bars on the central feathers, increasing to twelve bars on the outer feather; this specimen agrees closely with Mr. Schlegel's description of *A. plagiata*, which was taken from specimens in the Berlin Museum. These are in immature plumage, and were obtained near Vera Cruz, Mexico. Mr. Schlegel says, "Queue avec douze bandes brunes," &c. In my specimen, this number of bars exists only on the outer tail feather.

452. *Geotrygon cœruleiceps.*

When I described this bird as new, it apparently was so, with the knowledge then possessed of the individual species in the genus *Geotrygon*; in other words, it differed from all that were recorded as being members of that genus. At that time Mr. Sclater considered his *G. chiriquensis* (described *P. Z. S.*, 1856, p. 143) to be the same as the species well known to ornithologists as *G. albifacies*, although their supposed identity was only discovered about the time of its announcement. See *Exot. Ornith.*, Jan., 1868, Part v., p. 77, pl. xxxix.

Such being its position when my description of *cœruleiceps* was written, there was no reason why I should consult the original description of *chiriquensis*, for, of *albifacies*, which was stated to be identical with it, I had many specimens before me.

Messrs. Sclater and Salvin subsequently found, on examination of the type of *G. chiriquensis* in the gallery of the Jardin des Plantes, that they had committed an error in considering it the same as *G. albifacies*, and that it is really a distinct and valid species, of which they give a figure and make the correction (*Exot. Ornith.* Oct., 1868, Part viii., p. 123, pl. lxii.).

Judging from the last plate and description, my species seems to be *G. chiriquensis*, which name, of course, must have priority.

I was, in fact, misled in conferring a synonym on a species since found to have a claim to a prior name, but the information then available justified the course which I adopted.

In the *Proc. of the Phil. Acad. of Sci.*, 1865, p. 108, I described a *Geotrygon* from Panama, viz., *G. albiventer*.

A reviewer in the *Ibis*, 1866, p. 120, notices it as follows: "The close proximity of Panama to Chiriqui makes us suspect it may ultimately prove identical with *G. chiriquensis*, though there are discrepancies in the descriptions. Still, when such delicate bronze colors have to be spoken of, it is hardly likely that two writers should call the same tint by the same name. The Chiriqui bird is somewhat larger (wings 5.9 inches instead of 5.5 inches); but not having specimens of either before us, we cannot decide the point." With both species before me, I can now state explicitly that they have but few points of resemblance; *G. albiventer* is very much smaller (about the size of *G. montana*), has no grayish-blue on the head, and although the colors of the upper plumage are somewhat alike, yet they are of quite different shades; below they are totally unlike, instead of the breast being dark castaneous as in *chiriquensis*, in my species it is pale lilac, and in the latter the belly and under tail-coverts are pure white, which in the former are of a rather light dull cinnamon.

When I first saw the suggestion of the probable identity of the two species, it did not seem to me that the arguments advanced to sustain it had much force, as they were based entirely on conjecture.

IV.—*Note respecting the Eyes of* AMBLYOPSIS SPELÆUS.

BY THEO. A. TELLKAMPF, M.D.

Read February 1st, 1869.

I WISH to offer some remarks in regard to the following statements respecting the eyes of the *Amblyopsis spelæus*, contained in a Report in the Proceedings of the Boston Soc. of Nat. Hist. of 1851–54, p. 395, to which my attention was called but recently:

"Prof. Wyman exhibited under the microscope, specimens of the eyes of the *Amblyopsis spelæus*, the so-called blind fish, from the Mammoth Cave of Kentucky. In a dissection made several years since, he had failed to detect any organ of vision. Subsequently, Müller Telkamph, of Berlin,* discovered minute black points, visible, with the aid of a lens, through the skin, but found no nerve or transparent media; Müller compared them to the eye dots of invertebrate animals . . . . . . After careful examination, he found no trace of eye dots externally, but in a mass of areolar tissue, occupying the usual position of the orbit, and deeply buried in this tissue, so as to preclude contact with the skin, he detected two dark points, one on each side, symmetrically placed. He traced the optic nerve on both sides as far as the cranial walls, but its connection with the optic lobes was not ascertained."

According to the above statements it must appear singular that J. Müller and myself could see the minute black points—the eyes—through the skin, with the aid of a lens. Yet not only J. Müller and myself, but others to whom they were pointed out, did see them, indistinctly even without the aid of a lens, in a specimen which I had bought at the Cave House, near the Mammoth Cave. That we were not mistaken as to the significance of the minute black spots, symmetrically placed, that they

* An awkward contraction of the name of the late Johannes Müller of Berlin, the eminent physiologist, and of my own name, incorrectly spelt.

were really the eyes, was proved by a careful microscopical examination.

The specimen in which the eyes were visible externally had been preserved in a fluid called whiskey; it was much shrivelled and of a yellowish hue. In another specimen which I had brought from the Mammoth Cave, preserved in alcohol, the eye dots were not visible externally. This fact was not stated in my article on the blind fish (Müller's Archiv, 1844, p. 387. Berlin), because no artificial means had been used on my part to render the skin and the cellular tissue transparent, and also probably because at that time, when the *Ambl. sp.* was considered eyeless, and was called accordingly the eyeless fish, the questions which engaged my attention particularly, were, whether this fish had eyes or not, and after they were discovered, what was the degree of their development.

The question why the skin of one of the specimens examined by me at that time was transparent to a certain degree, was, for the reasons above stated, neither asked nor answered; but to this question there can be but one answer, viz., that the fluid in which one of the specimens had been preserved (the constituent parts of which are unknown) had rendered the skin sufficiently translucent to cause the eyes to be visible externally.

Having made this explanation, which I deem proper under the circumstances, I proceed to correct some of the statements above quoted, reported to have been made by Prof. Wyman, namely, "They (meaning Müller and myself) found no transparent media." That this statement is incorrect follows from the comparison made by J. Müller of the rudimentary eyes of the *Amblyopsis spelæus* with the eyes of the invertebrate animals which have transparent media; but as no histological examination was made, no details were given. The membranes were sufficiently examined, however, to warrant the comparison. A fact of special interest, that the eye had no lens, was stated. No lens has since been found by other observers. Another statement, that we found no nerve, is equally incorrect, for before the microscopical examination of the eye was made I had already traced within the cranium the optic nerves from the optic lobes to the orbits, and represented them on the plate accompanying my article (*l. c.*). I did not trace the optic nerve within the orbit, because its existence between the optic nerve within the cranium and the retina could not be doubtful.

V.—*Lepidopterological Miscellanies.*

By Coleman T. Robinson.

Read March 1st, 1869.

BOMBYCIDAE.

Subfamily LITHOSIINAE, Stephens.

Euphanessa, Packard.

Euphanessa mendica, Packard. (Plate 1, fig. 1.)

Nudaria mendica, Walker, B. M., Lists, Part II., p. 576, 1854.

Eudule biseriata, Herrich-Schaeffer, Lep. Exot., p. 19, fig. 441, 1855.

Euphanessa mendica, Packard, Proc. Ent. Soc., Phil., III., p. 102, 1864.

Euphanessa mendica, Grote and Robinson, List Lep. N. A., Part I., p. 7, 1868.

Antennæ, head, and thorax pale ochreous; anterior wings, pale testaceous subhyaline, shaded with ochreous along costa and external margin, with two irregular gray bands composed of spots more or less interrupted by the veins, and a single similar gray circular spot beyond, near the middle of external margin.

Posterior wings very pale testaceous, margined with pale ochreous. Abdomen, pale testaceous or whitish.

Under surface like the upper.

Expanse. 25–30 millimetres.

Habitat.—Northern United States. Common.

Euphanessa unicolor. sp. nov. (Plate 1, fig. 2.)

Antennæ black. Head and thorax, above and beneath, bright red. Legs, red externally, internally blackish.

Upper and under surfaces of both pairs of wings and fringes, bright red, unicolorous. Abdomen, above and beneath, red.

Expanse. 23–25 millimetres.

Habitat.—Texas. ("Waco County, June 24th," G. W. Belfrage.)

PYRALIDAE.

Subfamily HYDROCAMPIDAE.

Genus OLIGOSTIGMA. Guenée.

Oligostigma albalis. sp. nov. (Plate 1, fig. 3.)

Antennæ, palpi, head, thorax and appendages, and abdomen, pure white.

Anterior wings, white. A dark brown line, commencing at the base, runs along internal margin to before the middle, and curving upwardly to the cell runs thence straightly outwardly to beyond the middle, and curving upwardly joins the costa before apical third, enclosing a subcostal dark-brown dot. The space enclosed by this line is more or less finely dusted with scattered brown scales; beyond, a subterminal dark-brown transverse line and a terminal yellow band, bordered outwardly and inwardly by narrow dark-brown lines. Fringes white.

Posterior wings white, with a transverse discal line and a subterminal line dark-brown. A terminal yellow band, limited by dark-brown lines as in the anterior pair. Fringes white.

Under surface of both pairs pure white.

Expanse. 23 millimetres.

Habitat.—New York; Pennsylvania.

Genus CATACLYSTA. Hübner.

Cataclysta bifascialis. sp. nov. (Plate 1, fig. 4.)

Head, thorax, palpi, and antennæ white.

Anterior wings white, with two parallel, straight, pale ochreous bands across the middle, the margins of which are irregular. There is a v-like ochreous mark just before the apex, enclosed by a similar larger mark, the base of which rests on the internal angle, the outer limb running along the margin to the apex, the inner limb attaining the costa at apical third. The wings are dusted with blackish scales, except the spaces between the double markings, which are either pure white or intermixed with silvery.

Posterior wings white, with an ochreous patch on the disk, which appears like a broken continuation of the bands of the anterior pair, except that it is filled in centrally with blackish and metallic scales. Beyond, a short blackish streak above the middle runs parallel with the outer margin, but does not reach it. A small ochreous patch at anal angle, filled in with black scales. The outer margin, from the middle to the tip, broadly margined with black, filled in with five irregular aggregations of shining metallic scales. Fringes of both pairs of wings white.

Under surface of both pairs white, the anterior wings freely dusted with fuscous scales. The black terminal band of the upper surface of the posterior pair is reflected beneath in a terminal row of rounded black spots, separated by aggregations of metallic scales.

Expanse. 15-17 millimetres.

Habitat.—Texas, July 7th. (Belfrage.)

Closely allied to *C. opulentalis*, Lederer (Wiener Ent. Monatschrift, vii., p. 486; Plate 18, fig. 7), in which species the v-like mark on the anterior pair is *single*, and there is no subterminal short black streak on the posterior wings.

CRAMBIDAE.

Genus EROMENE. Hübner.

Eromene texana. sp nov. (Plate 1, fig. 5.)

Head, thorax, and palpi, testaceous.

Anterior wings dark testaceous, crossed beyond the middle by two straight parallel ochreous bands narrowly separated by a line of pale shining scales. Two narrow white bands separated by a line of dark testaceous scales, commencing on the costa at apical third, run obliquely outwardly to just before the external margin at one-third below the apex, thence obliquely inwardly parallel to external margin to before internal angle. Below the angle formed by these lines there is a subterminal row of black spots, eight in number, heavily margined outwardly by aggregations of brilliant metallic scales, which, counting from above, unite the first spot with the second; the third with the fourth; the fifth, sixth, and seventh, leaving the eighth at internal angle single. The space beyond the central bands is freely dusted with dark scales. Fringes white.

Posterior wings pure shining white, except a narrow terminal testaceous line. Fringes white.

Under surface of both pairs of wings white.

Expanse. 20 millimetres.

Habitat.—Texas. April 25th. (G. W. Belfrage.)

The hitherto described species of *Eromene* inhabit Italy and other countries on either side of the Mediterranean. *E. texana* is allied to *E. ramburiella* (Zeller), but the anterior wings of our North American species are more elongate, the apices acute, and the central transverse bands cross just before the outer third, while in the European species they cross the middle of the wing.

GELECHIDAE.

Genus DEPRESSARIA. Haworth.

Depressaria cinereocostella, Clemens. (Plate 1, fig. 6.)

Depressaria cinereocostella, Clemens. Proc. Ent. Soc. Phil., II., p. 422, 1864.

Head and thorax ashen gray. Palpi, whitish above, fuscous beneath.

Anterior wings broadly gray along costa, brown, with a reddish tinge below, the entire surface marked with numerous longitudinal blackish streaks and dots. Hind wings fuscous, paler at base.

Expanse. ♂ 17, ♀ 20 millimetres.

Habitat.—Massachusetts; New York.

Mr. Francis Walker has described in the British Museum List, Part XXIX., p. 564, an American species of *Depressaria*, under the name *D. clausella*, which agrees in many respects with *D. cinereocostella*; but the latter has not the subterminal row of blackish streaks mentioned by the English entomologist. *D. clausella* inhabits Georgia.

Depressaria atrodorsella, Clemens. (Plate 1, fig. 7.)

Depressaria atrodorsella, Clemens. Proc. Ent. Soc. Phil., II., p. 124, 1863.

Palpi, pale ochreous beneath; third joint ringed with black. Thorax and head black.

Anterior wings pale ochreous, with several blackish costal dots beyond the base, and an irregular subapical costal patch of the same hue. Beneath the costa the wings are streaked longitudinally with dark brown, and a suffused discal reddish brown shade contains a black dot before the middle, and a white dot in the darker portion of the shade beyond the middle.

Posterior wings pale fuscous below, beneath whitish.

Under surface of anterior pair fuscous, centrally margined with pale ochreous.

Expanse. ♂ and ♀ 23 millimetres.

Habitat.—Massachusetts (Sanborn); Putnam Co., New York.

Depressaria pulcipennella, Clemens. Proc. Ent. Soc. Phil., II., p. 421, 1864.

Second joint of palpi red beneath, internally pale ochreous; third joint ochreous, ringed with dark brown. Head, red above. Thorax, dark brown.

Anterior wings dark ochreous, much clouded and spotted with dark brown. A large dark brown shade in the disc contains a central pale ochreous or white dot.

Posterior wings and under surface of both pairs pale fuscous.

Expanse. 22 millimetres.

Habitat.—New York. (Coll. C. T. R.), Texas (Belfrage).

Depressaria lecontella, Clemens. (Plate 1, fig. 9.)

Depressaria lecontella, Clemens. Proc. Ac. N. S. Phila., p. 174, 1860.

Head and palpi ochreous, the third joint of the latter with two brown rings.

Anterior wings reddish ochreous, or ochreous much dotted and clouded with blackish brown. Two very prominent black dots on the disc, just before and beyond the middle, and a rounded dark spot above near the outer dot. A subterminal row of black dots between the veins.

Hind wings fuscous, fringes pale.

Expanse. 24 millimetres.

Habitat.—Pennsylvania (Theo. Bunte).

Depressaria grotella, sp. nov. (Plate 1, fig. 10.)

Palpi pale ochreous, second joint fuscous beneath. Head and thorax pale ochreous.

Anterior wings pale ochreous, longitudinally streaked with dark brown from the base to beyond the middle, with a similarly colored prominent dot on the outer margin of the disc, which is slightly tinged with reddish brown. A subterminal row of dark dots nine in number.

Posterior wings shining, very pale fuscous. Fringes concolorous.

Under surface of both pairs pale fuscous.

Expanse. 25–28 millimetres.

Habitat.—New York; Pennsylvania.

I take pleasure in dedicating this species to my friend and colaborer, Mr. A. R. Grote.

VI.—*Note on Bulimus ciliatus*, Gould:

By Mr. A. D. Brown, of Princeton, N. J.

Communicated by Mr. T. Bland, March 8th, 1869.

Gould, in his description of this species (Exped. Shells, p. 32), has the words "*labrum simplex*," and gives as habitat the "Organ Mountains, Brazil."

His description was evidently taken from an immature shell, as I have collected many specimens of it with a well developed reflected lip. I found it not rare at "San Domingo," a suburb of Rio de Janeiro, but have never met with it in the Organ Mountains, although I have collected extensively among them.

In San Domingo, it is found upon the trunks of trees accompanied by *B. auris-leporis*, Brug.

VII.—*On Tribasic Phosphoric Acid; its history, its modes of separation from sesquioxyds, principally from Sesquioxyd of Iron, and its estimation.*

By Paul Schweitzer.

Read March 29th, 1869.

One of the most important and interesting chapters of natural science is the history of phosphoric acid. Not only has the study of it given us a deeper insight into the secret laws of nature, but it has been a bearer of fruitful ideas, which have arisen from the reflections of the most penetrating and ingenious chemists of all countries, who for one hundred and fifty years have labored to remove the difficulties, to explain the anomalies, and to reduce to a fundamental law the enigmatic phenomena which surround the knowledge of this acid and of its salts. The spirit of the present century has not yet succeeded in finding this; and whenever the facts become too complicated, we have recourse to the assumption of modifications, which, however, leave the causes unexplained. The defectiveness of such interpretations we see all the more glaringly in the case of phosphoric acid, as in this acid we have to assume many modifications, and are obliged to express them with almost arbitrary constitutional signs in order to make them comparable with each other. I will, however, not dwell on the different phosphoric acids, which in part seem to bear a semi-organic character, but will give a brief historical review of the so-called tribasic modification, and then enter upon the criticism of the modes of separating it from bases.

Before doing this, however, I will tabulate the forty-two phosphatic minerals according to the year of their discovery, giving in the second number the time when the phosphoric acid in them was first determined quantitatively.

77–1834. *Turquois*, Pliny (xxxvii., 33; Callais, Callainum) Zellner (Isis 637).

M. John made, in 1811, the first analysis, in which he overlooked phosphoric acid ($Al_2\ O_3=73$ p. c.) Descotils about the same time mentioned the presence of a little PO^5 (Ann. d. M. II. iii. 231).

$$Al_2\ O_32,\ PO^5+5\ HO.$$

77–1864. *Callainite*, Pliny (XXXVII., 33; Callais, Calaina).

Damour (C. R. LIX. 936).

Damour made the first and only analysis according to the method with metallic tin (described by M. Aimé Girard, Bull. Soc. Ch. de Paris, I. p. 20) by which he found 42.58 p. c. PO^5.

$Al_2\ O_3, PO^5 + 5\ HO.$

1747–1831. *Pyromorphite*, Wallerius (Min. grön Blyspath).

Kersten (Schw. J. LXI. 1)

may have been known before the edition of Wall. Mineralogy. Klaproth discovered in the year 1784 that it contained phosphoric acid (Crell's Ann. I. 394), and Kersten, who analyzed nine different kinds, found 16.52 p. c. PO^5; one sample gave him 11.05 p. c. CaO 3, PO^5.

$3\ (PbO\ 3, PO^5) + PbCl.$

1758–1821. *Vivianite*, Cronstedt (Bloa Järnjord, 182 Naturligit Berlinerblätt).

Vogel, Laugier, Strohmeyer.

Klaproth, in the year 1784, found this mineral to contain phosphoric acid.

$FeO3, PO^5 + 8\ HO.$

1770–1788. *Apatite*, Cronstedt (Mineralogy).

Proust (J. d. Ph. p. XXXII. 241, phosphate calcaire).

The name Apatite, which Werner in the year 1786 gave to this mineral, was subsequently to Vauquelin's analysis (Ann. Chi. XXVI. 123), 1798, applied to the whole class.

$CaO\ 3, PO^5 + \frac{1}{3}\ Ca\ (Cl\ ;\ Fl).$

This is, by the way, the first phosphatic mineral in which phosphoric acid has been determined quantitatively; and it seems significant that the most important phosphate, in fact the most important mineral to agriculture, a science that touches so nearly the welfare of nations, should have been first selected for analysis. In these facts is visible the hidden instinct of mankind that feels the important, the necessary, in nature.

1772–1823. *Torbernite*, Born (Lytophycacium Born. I. 42).

M. Richard Phillips (Ann. Phil. II. 57).

M. Gregor made, in 1819, the first analysis of this mineral, in which he found 74.4 $U_2\ O_3$ (overlooking the PO^5). Berzelius, in 1819, (Système minéralogique) found 72.15 $U_2 O_3$. Phillips obtained $PO^5=16$, $U_2 O_3=60$, $CaO=9$, by boiling the nitric acid solution with excess of Potassa, neutralizing with $\overline{A}c$ and precipitating with PbO $\overline{A}c$. The two oxydes were separated by NH_3.

$$U_2 O_3 2, PO^5+CuO, HO+7 HO.$$

1779–1840. *Plumbogummite*, De Lisle (Demeste Lettres sur la minéralogie).

Damour (Ann. d. M. III. xvii. 191).

Phosphate of lead was known long ago. But Berzelius, who made the first analysis of this mineral in the year 1820, did not find phosphoric acid (Schw. J. XXVII. 65). Dufrenoy noticed a little in 1835 (An. Ch. Phys. LIX. 440). Damour fuses with KO, CO^2, and boils the filtrate with pure SiO^2. The filtrate from the residue is evaporated with hydrochloric acid (to separate SiO^2) and ignited with a known weight of sesquioxyd of iron.

$$3 (PbO3, PO^5)+6 (Al_2 O_3 3 HO.)$$

1791–1818. *Lazulite*, Widenmann (Bergm. J. 346, April).

Fuchs (Schw. J. XXIV. 373).

Minerals of this character were known before, but as their composition had not been previously investigated, a great difference of opinion prevailed among mineralogists as to placing them. Trommsdorff made the first analysis, in which he found 66 p. c. $Al_2 O_3$, Klaproth soon afterwards 71 p. c. $Al_2 O_3$, both overlooking the phosphoric acid. Fuchs boils the pulverized mineral with caustic potassa, evaporates and fuses it. He proceeds then as described under Plumbogummite, but weighs PO^5 as CaO3, PO^5.

$$Al_2 O_3, PO^5+(MgO, FeO) HO.$$

Up to the end of the eighteenth century eight phosphatic minerals only were known, and the composition of but one of them had been ascertained, that of Apatite. From that time, 1788, the analysis of phosphates rested for sixty years, until after Berzelius' investigations; we meet the next analysis of a phosphate in the year 1818. We have to except, however, the Triplite, a mineral that was analyzed in 1802, by Vauquelin.

1801-1846. *Pseudomalachite*, Karsten (Klaproth N. Schrift. Ber. Ges. Nat. Freunde iii. 304).

Hermann (J. pr. Ch. XXXVII.).

Many minerals existed of this constitution which had been analyzed before Hermann. He was, however, the first to analyze them all and classify them. He heats to red heat, and counting the loss as water, fuses with caustic soda. The residue after washing is oxyd of copper. After testing the wash-water for Al_2O_3 and MnO, in their absence he calls the difference phosphoric acid.

1. *Trombolithe*, CuO 3, PO^5 2+6 HO, was first analyzed by Plattner.

II. PO^5=41.00.
CuO=39.20.
HO=16.80.

2. *Libethenite*, CuO 4, PO^5+HO.
(CuO 4, PO^5+HO)+(CuO 4, PO^5+2 HO).
CuO 4, PO^5+2 HO

is mentioned 1812 by Leonhardt (Leonhardt and Selby's Mineral. Stud.). Kuhn analyzed it in 1844, also Berthier and Hermann.

K. PO^5=29.44
CuO=66.94
HO= 4.01

B. PO^5=28.70
CuO=63.90
HO= 7.40

H. PO^5=26.61
CuO=65.89
HO= 5.50

3. *Tagilithe*, CuO 4, PO^5+3 HO, analyzed first by Hermann.

$PO^5 = 26.44$
$CuO = 61.29$
$HO = 10.77$
$1.50\ Fe_2O_3$

4. *Dihydrite*, CuO 5, $PO^5 + 2$ HO, has been analyzed by Arfvedson under the name of Phosphor-Kupfererz. Hermann made the first analysis.

H. $PO^5 = 25.30$
$CuO = 68.21$
$HO = \ 6.49$

Afvs. $PO^5 = 24.70$
$CuO = 68.20$
$HO = \ 5.97$

5. *Phosphoro calcite* (CuO 5, $PO^5 + 2$ HO)+(CuO 5, $PO^5 + 3$ HO) occurs principally in Taigilsk, also (a) in Rheinbreitenbach; it has been analyzed by Klaproth, Kuhn, Lynn and Hermann.

			(a)
H. PO^5	= 23.75	— 23.47	— 24.55
CuO	= 68.75	— 67.73	— 67.25
HO	= 7.50	— 8.80	— 8.20

Klp. $PO^5 =$ —
$CuO = 68.13$
$HO =$ —

K. $PO^5 = 21.52$
$CuO = 68.74$
$HO = \ 8.62$

L. $PO^5 = 21.69$
$CuO = 62.85$
$HO = 15.45$

6. *Ehlite*, CuO 5, $PO^5 + 3$ HO, has been analyzed by Bergmann.

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$HO = 8.62$

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$HO = 15.45$

6. *Ehlite*, $CuO\ 5, PO^5 + 3\ HO$, has been analyzed by Bergmann.

B. PO^5=24.93—25.70—26.22
CuO=65.99—65.74—64.85
HO= 9.06— 8.56— 8.93

7. *Kupferdiaspor* (Lynn), CuO 5, PO^5 +5 HO, was first analyzed by Lynn.

L. PO^5=24.22—24.13
CuO=67.00—69.61
HO= 8.78—6.26

H. PO^5=23.14
CuO=66.86
HO=10.00

1802–1802. *Triplite,* Vauquelin (J. d. M. XI. 295).

Vauquelin (l. c.)

This mineral was discovered at Limoges by Alluaud, from whom Vauquelin obtained it; he fuses the substance for analysis with caustic potassa, neutralizes the filtrate with nitric acid, and precipitates the phosphoric acid with lime water. He obtained 27 p. c. PO^5. Berzelius, who analyzed it in 1819 by the Sulphide of Ammonium Method, found 32.8 p. c. PO^5, weighing it as CaO^3 PO^5.

($\frac{1}{3}$ FeO+$\frac{2}{3}$ MnO) 3, PO^5+RFl. R=1 Ca+2 Mg+3 Fe.

1803–1825. *Dufrenite,* Jordan (Min. Reisebemerk, 243).

Vauquelin (Ann. Chem. Pharm. XXX. 202).

Vauquelin analyzed twenty-five years previously a similar substance. He finds by loss 27.84 p. c. PO^5, while in a direct determination with PbO, $\overline{A}$c. he obtained 35.8 p. c., owing, no doubt, to the formation of a compound of phosphate of lead with some other lead salt.

Fe_2O_3 2, PO^5+3 HO.

1805–1816. *Wavellite,* Babbington (Davy's Mem. in Phil. Trans. 162).

Fuchs (Schw. J. XVIII. 288—XXIV. 121).

This mineral was discovered by Wavel, and has been often analyzed; among others by Berzelius, Davy, Klaproth, who all overlooked phosphoric acid. This mineral seems to be the first one in the analysis of which the method with water glass was used.

$$Al_2\ O_3\ PO^5 + \tfrac{1}{2}\ Al_2\ O_3,\ 3\ HO.$$

1817–1820. *Amblygonite*. Breithaupt (Hoffm. Min. IV. 6, 159).

Berzelius (Gilb. Ann. LXV. 321).

$$(\tfrac{1}{4}\ (LiO,\ NaO)\ 3 + \tfrac{3}{4}\ Al_2\ O_3)\ 4,\ PO^5.$$

1819–1819. *Autunite*, Berzelius (N. Syst. Min. 295).

Berzelius (l. c.)

It was known before as Uranite; Werner, who analyzed it, found it to contain 72.15 $U_2\ O_3$. Berzelius obtained 15.20 PO^5.

$$U_2\ O_3\ 2,\ PO^5 + CaO.\ HO + 7\ HO.$$

1821–1821. *Wagnerite*, Fuchs (Schw. J. xxxiii. 269).

Fuchs (l. c.)

$$MgO\ 3.\ PO^5.$$

1823–1852. *Childrenite*. Levy (Brande's J. XVI. 274).

Rammelsberg (Pogg. Ann. LXXXV. 435).

$$2\ (RO4,\ PO^5) + (Al_2\ O_3\ 2,\ PO^5) + 15\ HO.$$

1824–1824. *Xenotime*, Berzelius (Ak. H. Stockh. ii. 334).

Berzelius (l. c.)

$$YO\ 3,\ PO^5.$$

1825. *Hopeite*, Brewster (Trans. R. Soc. Edinb. X. 107).

Brewster, no analysis.

Is supposed to be an hydrous phosphate of zinc with a little Cadmium.

1825–1825. *Cacoxenite*, J. Steinmann (Leonh. Oryctogn. 750).

J. Steinmann (l. c.)

$$Fe_2\ O_3\ 2,\ PO^5 + 12\ HO.$$

1825–1825. *Hureaulite*, Allnaud (Vauq. Ann. Ch. Phy. XXX. 302).

Vauquelin (l. c.)

$$(MnO.\ Fe\ O,\ HO)\ 3,\ PO^5 + 2\ HO.$$

1826–1857. *Beudantite*, Levy (Ann. Phil. II. ii. 194).

Sandberger (Pogg. C. 611).

$$PbO, SO^3 + (PbO 3, \left\{ \begin{matrix} AsO^5 \\ PO^5 \end{matrix} \right. + 3 Fe_2 O_3 3 \left\{ \begin{matrix} AsO^5 \\ PO^5 \end{matrix} \right) + 24 HO.$$

1828. *Herderite*, Haidinger (Phil. Mag. IV. 1).

Turner and Plattner qualitative.

1829–1839. *Monazite*, Breithaupt (Schw. J. 55–301).

Kersten (Pogg. XLVII. 385).

$$(CeO, LaO, DiO, \tfrac{1}{2} ThO^2) 3, PO^5.$$

1830–1844. *Peganite*, Breithaupt (Schw. J. LX. 308).

Hermann (Erdm. XXXIII. 287).

$$Al_2 O_3 2, PO^5 + 6 HO.$$

1834–1834. *Triphylite*, Fuchs (Erdm. III. 98).

Fuchs (l. c.)

$$(Fe O ; MnO ; LiO) 3, PO^5.$$

1837. *Diadochite*, Breithaupt (Erdm. X. 503).

Plattner (Rambg. 1 Suppl. 45).

$$Fe_2 O_3 3, PO^5 2 + 2 (Fe_2 O_3, SO^3 2) + 32 HO.$$

1844–1844. *Fischerite*, Hermann (Erdm. 33–285).

Hermann (l. c.)

$$Al_2 O_3 2, PO^5 + 8 HO.$$

1845–1851. *Struvite*, Ulex (Oefv. Ak. Stockh. iii. 32).

Ulex (Jahrbuch Min. 1851–51).

$$NH_4 O, MgO 2, PO^5 + 12 HO.$$

1846–1846. *Kryptolite*, Woehler (Gel. Anz. Gött. 19).

Woehler (l. c.)

$$CeO 3, PO^5.$$

1849–1849. *Conichalcite*, Breithaupt and Fritzsche Pogg. LXXII. 139).

Fritzsche (l. c.)

$$(CuO, CaO) 3, (AsO^5, PO^5) + CuO HO + \tfrac{1}{2} HO.$$

1849–1849. *Stercorite*, Herapath (Q. J. Ph. Soc.).

Herapath (l. c.)

$$NaO, N H_4O, PO^5 + 9 HO.$$

1854–1854. *Borickite*, v. Hauer (Jahrl. G. Reichs. 68).

v. Hauer (l. c.)

$$(Fe_2 O_3, CaO) 3, PO^5 2 + 15 HO.$$

1854–1854. *Svanbergite*, Igelström (Oefv. Ak. Stockh. 156).

Igelström (l. c.)

$(\frac{1}{2}\ CaO3+\frac{1}{2}\ Al_2\ O_3)\ 2,\ PO^5+2\ (Al_2\ O_3\ SiO^3)+6\ HO.$

1864–1864. *Evansite*, D. Forbes (Phil. Mag. IV. 28–341).

D. Forbes (l. c.)

$Al_2\ O_3\ 2,\ PO^5+Al_2\ O_3\ 3\ HO+15\ HO.$

1864–1864. *Brushite*, G. E. Moore (Proc. Ac. Cal. iii. 176).

Moore (l. c.)

$(\frac{2}{3}\ CaO+\frac{1}{3}\ HO)\ 3,\ PO^5+4\ HO.$

1865–1865. *Metabrushite*, A. Julien (Am. J. Sc. II. 40,371).

A. Julien (l. c.)

$(\frac{2}{3}\ CaO+\frac{1}{3}\ HO)\ 3,\ PO^5+3\ HO.$

1865–1865. *Churchite*, A. H. Church (Ch. News XII. 121).

Church (l. c.)

$(\frac{5}{6}\ CeO+\frac{1}{6}\ CaO)\ 3,\ PO^5+4\ HO.$

1865–1865. *Tavistockite*, A. H. Church (J. Ch. Soc. II. 3–263).

Church (l. c.)

$(\frac{1}{2}\ CaO3+\frac{1}{2}\ Al_2\ O_3)\ 2,\ PO^5+3\ HO.$

1866–1866. *Amphithalite*, Igelström (Oefv. Ak. Stockh. 93).

Igelström (l. c.)

$RO,\ R_2\ O_3,\ PO^5+HO.$*

1867–1867. *Sphaerite*, v. Zepharovich (Ber. Ak. Wien. 56–1867).

Boricki (l. c.)

$Al_2\ O_3\ 5,\ PO^5\ 2+16\ HO.$

1867–1867. *Barrandite*, v. Zepharovich (l. c.)

Boricki (l. c.)

$(\frac{4}{7}\ Fe_2\ O_3+\frac{3}{7}\ Al_2\ O_3)\ PO^5+4\ HO.$

1867–1867. *Berlinite* (C. W. Bloomstrand, Priv. Contr. Lund).

Bloomstrand.

$Al_2\ O_3,\ PO^5+\frac{1}{2}\ HO.$

1867–1867. *Trolleite*, (C. W. Bl.)

* $RO=CaO,\ MgO\ ;\ R_2O_3=M_2A_3.$

$Al_2O_3PO^5 + \frac{1}{3} Al_2O_3, 3 HO.$

1867–1867. *Cirrolite*, (C. W. Bl.)

$Al_2O_3 2, PO^5 + 2 CaO 3, PO^5 + 3 HO.$

1867–1867. *Attacolite*, (C. W. Bl.)

Phosphoric acid seems to have been known as a peculiar acid before the discovery of phosphorus. Angelus Sala, an Italian, who came to Germany and settled there, prepared it in 1602 from horns, which he treated with oil of vitriol, using the product as a remedy against the plague of the middle ages. This fact, however, remained unnoticed for over one hundred and fifty years, which is all the more to be wondered at, as the tendency of the age was to discover new substances, and to design new modes of preparation. Even after phosphorus had been discovered in 1669 or 1670 by Brandt, and, independently of him, perhaps by Boyle and Kunkel, this wonderful substance, surrounded as it was with mystery and to which the imagination attributed miraculous properties, attracted the attention of the learned to such a degree as to divert them for a time entirely from the study of its compounds. It was only at the end of the next century, when the ideas concerning chemical composition became clearer, that a number of chemists interested themselves in the study of phosphoric acid and of its salts.

Markgraf (born 1709, died 1780) published in the year 1740 a treatise "*on the bearing of phosphorus on metals and half-metals*," showing the preparation of phosphoric acid from phosphorus by burning it in atmospheric air, and also by treating it with nitric acid, and he described also many crystallized phosphates. In weighing the produced phosphoric acid he found it in the former case to be 3 to 3½ times heavier than the phosphorus employed for its production, and, inquiring into the cause of this phenomenon, he was very near becoming the discoverer of oxygen. As it is, we assign to him the honor of the discovery of phosphoric acid in the year 1740.

I must mention here the names of several chemists, who about this time rendered important services to their science, without, however, coming to any definite and important results as to phosphoric acid. They were:

H. Davy (born 1778, died 1829).

Cronstedt (born 1722, died 1765).

Bergmann (born 1735, died 1784), who in 1780, in a paper "on the analysis of minerals in the wet way," made known certain laws of combination, which, together with Proust's publications on the same subject, must be considered the forerunners of the great essay of Berzelius (born 1779, died 1848) which was published in 1810, "*Essay to find the fixed and simple proportions, according to which the constituents of inorganic nature are supposed to enter into combination.*"

Before speaking, however, of this great man and his works, I have to mention—

Scheele (born 1742, died 1786), who, with a rare talent for observation and acuteness of reasoning, an ornament of his country and of his times, was remarkable in the highest degree for the many and important discoveries which he made with comparatively very few expedients. Scheele and Priestley (born 1733, died 1801) must, together with Lavoisier (born 1743, died 1794), be considered the discoverers of oxygen, and the founders of modern chemistry.

The discovery of oxygen, in 1771, introduced the balance into the laboratory, and a new field was opened to the inquiring student of nature. The importance of this step was, however, not immediately recognized, and the century passed away before the chemists of that time understood the laws that govern the combination of atoms. And although the tendency of any age to some great result is felt by all, there may be only one man living who understands it, and is gifted with the power to achieve it and give it expression. I was actuated with feelings of the sort in reading the journals published in those days, and which contained in the year 1810 (Gilbert's Ann. vol. 37) the above-mentioned essay of Berzelius, in which, after a careful study and comparison of many analyses, he found: that when two oxydized substances combine, the oxygen of the electro-negative complex is always a multiple in a whole number of the oxygen of the electro-positive complex. To arrive at this conclusion a great number of reliable and good analyses were required, and, in order to make them, difficulties were encountered that can only be appreciated when one considers the imperfect methods of separation and the few expedients then at hand. Berzelius undertook this task, and analyzed in the course of his researches many compounds of phosphoric acid, especially with oxyd of lead and baryta, in which phosphoric acid was determined by loss. He found the proportion of the oxygen in the acid to that in the base to be as 2 : 1, taking the constitution of phosphoric acid as it was taken at that time.

Phosphorus had been the first combustible body the capacity of which for oxygen was determined by chemists, a thing that in this case appeared very easy, but in fact offered considerable difficulties.

Lampadius (in his hand-book of chemical analysis of mineral substances, 1798) had found the proportions of phosphorus to oxygen in phosphoric acid to be as

100 : 150.

Lavoisier had found it to be as

100 : 154.

Davy (in his miscellaneous researches concerning the compounds of phosphorus, 1810) had found it to be as

100 : 153.

(and taking in phosphoric acid twice as much oxygen as in phosphorous acid).

Thénard (in his remarks on phosphorus, 1811) had found it to be as

100 : 110.39.

Thomson had found it to be as

100 : 163.4

while H. Rose had determined it as

100 : 114

These figures, being used by different chemists of the time, deviated far enough to make a new investigation desirable. Dulong published in the year 1816 (Ann. Ch. et Phy. vol. 2) an essay in which he stated that the proportion of phosphorus to oxygen in phosphoric acid was as 100 : 124.8, and that the oxygen in the phosphoric acid was to the oxygen in the phosphorous acid as 5 : 3 ; also that the atomic weight of phosphorus, reduced to our present figure of oxygen, was 32.048.

I will here give the figures, which since the discovery of phosphorus have been used at different times by different chemists to represent its atomic weight:

So H=1=9 32 16 31.436 3.699
15.777 15.7 31.4 (8 fig.)
So O=1.100.1000=167.512 4 3.9308
39.30 1.50 19.65 196.155
46.155 196.143 19.62 196.153
392 196.0285 (13 fig.)

They are in all 23, varying from 1.5 to 392.3, and offering a variety, out of which almost any one might have selected a number that would suit his particular views and tastes.

Up to this year, 1816, only twelve phosphatic minerals were known, two of which only were analyzed as to their amount of phosphoric acid. In the same year occurs the publication of Berzelius' great and masterly essay (Ann. Ch. Phy. vol. 2) "*On the composition of phosphoric and phosphorous acids, and their combination with salifiable bases.*" This essay finishes the first epoch in the knowledge of phosphoric acid, the second reaching to Graham's investigations, 1834, and the third not having been yet concluded. Berzelius, to whom Dulong's investigations were not unknown, judged, from the results of certain analyses of phosphates of baryta and lead, that 100 phosphorus combined with 122.2 oxygen in phosphoric acid, and that 100 phosphoric acid, containing 55 parts of oxygen, saturated exactly $\frac{55}{2}$ parts of oxygen in a base, that therefore the composition of phosphoric acid was PO^2. After many experiments and a great deal of reflection, however, he came to the conclusion that the proportion was a different one. About this time he was notified by Thomson (Ann. of Phil. 40–306) that in contradiction to Dulong he had found 163.4 of O to 100 of P in phosphoric acid, and that he had prepared six different phosphates of lime containing to 5 eq. of phosphoric acid, 1, 2, 3, 4, 5 and 6 eq. of lime. As, however, certain of his salts were prepared by evaporation and ignition of weighed quantities of phosphoric acid and lime salt, and others cannot be prepared according to his prescription, we will not go further into the details he gives. He mentions, however, the fact, that phosphate of lime ignited with chloride of calcium drives off chlorine, which Berzelius found to be true. Berzelius divides his essay into six parts, and it being of a very important nature, I may be allowed to enter at some length into its results:

1. On the composition of phosphates.
2. On the composition of phosphoric acid.
3. On the composition of phosphorous acid.
4. On the composition of phosphites.
5. On the condition in which phosphorus is contained in metallic phosphides.
6. On the weight of a volume or molecule of phosphorus, and other kindred subjects.

1. For those investigations the precipitates were produced by phosphate of ammonia, which was prepared by supersaturating pure phosphoric acid with pure ammonia, and evaporating until litmus paper was only very slightly reddened. It was found here, that salts of lead and baryta enter readily into the composition of the precipitated phosphates, and only after a great deal of inquiry Berzelius devised means to avoid this.

Herntz, in working on the same subject (1847), found that under ordinary conditions, phosphate of lead will always take down a fixed part of the lead salt, and (in case chlorides are present in the solution), chloride of lead. The lead salt thus taken down seems to be always ⅓ of the phosphate of lead. This tendency of the phosphate will also hold good with other oxyds than oxyd of lead.

And in the formation of minerals of this order, as Apatite, Pyromorphite and others, conditions must have prevailed that were favorable to their formation and separation from the surrounding rock. It is also apparent that the composition of these minerals in connection with this tendency of the phosphate proper, will throw light on the probable state in which their constituents existed in the moment of, and on the chemical and physical forces that were active in, their formation.

Berzelius then analyzed phosphates of baryta, lead, silver, soda and ammonia, which, independently of the water contained in them, represent to 100 of phosphoric acid, the following amounts of oxygen in the base:

$BaO =$	22.518	16.327	11.246
$PbO = 33.75$	22.440	16.480	
$AgO = 33.75$			
$NaO =$	22.320		
$NH_4O = 33.81$	22.540		11.27

In all these experiments, which were made with the greatest care, as might be expected from Berzelius, phosphoric acid was determined by loss. He gave special attention to the compounds of phosphoric acid with lime, and prepared and analyzed a great number of them.

2. In comparing now the different conditions of saturation of phosphoric acid, the oxygen of the acid was 2, 3 and 6 times as much as the oxygen of the base. Phosphoric acid would therefore contain 67.5 p. c. of oxygen, or more than 200 of oxygen to 100 phosphorus, an amount which deviates so far from that actually found by experiment, that the law as to the saturation

of acids by bases was either to be regarded as false, or the composition of phosphoric acid was a different one.

Berzelius therefore again determined the oxygen in phosphoric acid, but in a way that had never as yet been tried, namely, by the reduction of certain oxyds in solution with phosphorus. After many and wonderfully invented experiments, he found an excellent substance for this purpose in chloride of gold, which gave him to 100 phosphorus 126.99, and 127.04 of oxygen, the silver salt having given him the number 128.17. These determinations and the above-mentioned analysis proved therefore the oxygen of the phosphoric acid to be 5, $\frac{5}{2}$, $\frac{5}{3}$ parts of the oxygen of the base, that therefore phosphoric acid had a composition similar to that of nitric acid, and that phosphoric acid probably contained $\frac{5}{3}$ of the oxygen in phosphorous acid. In order to decide this point, he had to ascertain the amount of oxygen in phosphoric acid, but before doing this he determined once more the oxygen in phosphoric acid by decomposing the highest chloride of phosphorus, and obtained as a result 127.74, which then sustained him in this opinion.

3. As the highest chloride of phosphorus had given him so good results, he used for this determination the lower chloride, and obtained in two analyses 76.92 and 77.28. Davy had formerly found 76.5. The proportion of the oxygen of phosphoric acid to the oxygen of phosphorous acid was also not as 2 : 1 (as found by Davy) nor as 3 : 2 (as found by Gay Lussac), but as 5 : 3 (128.16 : 76.9).

4. As the proportion of oxygen of phosphoric acid to that of phosphorous acid is as 5 : 3, phosphorous acid will have a composition analogous to sulphuric acid, and neutral phosphites ought to contain $\frac{1}{3}$ of oxygen in the base, compared with that of the acid. Berzelius found, however, in analyzing the salts of lead and baryta, the oxygen in the base equal to $\frac{2}{3}$ of that of the acid.

5. As the behavior of these two acids presents anomalies and exceptions to the rule, which may easily be explained in case of the phosphorus containing oxygen, an investigation was

made to decide this point. In such a case the oxygen surely would be liberated by the phosphorus combining with metals, and in oxydizing a phosphide more phosphoric acid would be obtained from the same weight of combined phosphorus than from phosphorus in its free state. Among all metals iron is principally remarkable for the facility with which a constant compound of it with phosphorus may be obtained. After obtaining such a compound, and analyzing it in a very ingenious way, Berzelius obtained as a result 122.8 for oxygen, which is so near the one found with free phosphorus, as to decide this point completely; namely, that phosphorus does not contain oxygen, and secondly, that PO^5 presents an exception to the rule. After saying this Berzelius tries to show that phosphorus may still be a compound body, as is very probably the case with nitrogen; to decide these difficult points, however, the utmost care and criticism have to be used, and one must not be prejudiced in favor of the one idea or the other. Chemists, who are not much accustomed to accurate working, have commenced enriching our knowledge concerning proportions by analyses undertaken to prove speculative views, and have correspondingly corrected their results. This is an easy but a dangerous course.

6. Berzelius determined the equivalent of phosphorus to be 31.21.

In the year 1819, Berzelius published an answer to a communication of Davy's, in which the latter tried to show that the oxygen of the three acids of phosphorus is as 1 : 2 : 4; stating that his analyses are not accurate enough, and that by a great number of analyses of this kind he has found that the best analytical methods are those by which the unavoidable errors are not more than thousandths. He never passed that limit, unless accidentally. An analysis which varies less than $\frac{1}{100}$ is still good; if, however, in spite of the usual care, the results vary more than $\frac{1}{100}$, we can regard it only as an approximation. These views are even now fundamental with regard to the estimation of an analysis. After the year 1819 we find the composition of phosphoric and phosphorous acids, of phosphates and phosphites, established, as we consider them at the present day. As the history of phosphoric acid subsequent to 1819 is simply that of analytical methods of separating and determining it, I will now present some figures which will answer as a criticism of the different methods of separating it from bases.

The investigation of the methods for separating tribasic phosphoric acid from sesquioxides, principally from sesquioxide of iron, was undertaken with a view of finding a more perfect way of analyzing iron ores, and has taken me nearly two years for its completion. The analyses were not all commenced in the order in which I give them, yet the object for which they were undertaken was never lost sight of. In spite of much work, and that very tedious, I must confess that I have not succeeded in pointing out a course of analysis which will hold good with all iron ores, the varied and manifold constituents of which require very often a deviation from the rules laid down. I hope, however, that the comparative analyses made may serve as an addition to analytical chemistry.

In the course of this investigation, the necessity was felt of comparing the different ways of determining iron. To this end, pure crystals of twice crystallized green vitriol or sulphate of iron were dissolved in water, and 50 cubic centimetres of this solution were used each time for analysis. The particulars of the manipulations I may well leave unmentioned, and only give the results. In two instances 50 c. c. were oxydized with pure nitric acid, and while hot, precipitated with ammonia; after washing out with boiling water, until no sulphuric acid could be detected in the filtrate, the precipitates were dried and weighed. I may mention here, that to wash out a gramme of hydrated sesquioxide of iron, one gallon at least of hot water is required. When the latter is washed out, it assumes a more sandy appearance, it runs very easily through the filter, and when suspended in water will settle only after the expiration of weeks. It is a hydrate still, and probably contains two equivalents of water, and by heating it with an alkaline salt it can easily be brought back to the flocculent, gelatinous condition of the terhydrate. I will say more of this peculiarity of the sesquioxide of iron hereafter.

One of the two determinations of iron just mentioned was then taken as representing the normal amount, and all the rest were compared with it. Six other experiments were made in the same way, differing only in this point, that before precipitating with ammonia, to 3 and 4 was added one gramme of chloride of sodium, to 5 and 6 one gramme of chloride of potassium, and to 7 and 8 one gramme of sulphate of potassa. Again 50 cubic centimetres (No. 9) were oxydized with hydrochloric acid and chlorate of potassa—the solution precipitated by ammonia, the precipitate washed out and weighed. In four experiments, 50 c. c. were reduced by zinc and sulphuric acid, and after adding to 12 and 13 a large amount of phosphate of soda, treated with a standard solution of permanganate of potassa. In the two last experiments, 50 c. c. were reduced by means of zinc and hydrochloric acid, and after adding a considerable amount of phosphate of soda, treated with the same solution of permanganate of potassa.

As I have said heretofore, I will omit particulars and give the results, as follows:

	No. 1.	0.8938	gr. Fe_2O_3		=100 p. c.
	" 2.	0.8940	"	"	=100.02 p. c.
Na Cl.	" 3.	0.8961	"	"	=100.26 p. c.
	" 4.	0.9006	"	"	=100.76 p. c.
K Cl.	" 5.	0.9006	"	"	=100.76 p. c.
	" 6.	0.9020	"	"	=100.92 p. c.
$KO'SO^3$	" 7.	0.8951	"	"	=100.14 p. c.
	" 8.	0.8954	"	"	=100.18 p. c.
$HCl+KO,ClO^5$	" 9.	0.8935	"	"	= 99.97 p. c.
$SO^3+Zn.$	" 10.	0.8932	"	"	= 99.93 p. c.
	" 11.	0.8932	"	"	= 99.93 p. c.
	" 12.	0.8932	"	"	= 99.93 p. c.
	" 13.	0.8932	"	"	= 99.93 p. c.
$HCl+Zn.$	" 14.	0.9060	"	"	=101.36 p. c.
	" 15.	0.9060	"	"	=101.36 p. c.

It will be seen by these figures that in the ordinary course of analysis, very satisfactory results may be obtained by reducing the iron solution with zinc and sulphuric acid. Hydrochloric acid, however, which is ordinarily used in the reduction of iron in iron ores, will lead to errors, on account of its decomposing some of the permanganate of potassa, and this will take place even in very dilute solutions, when the odor of chlorine is not perceptible. In precipitating by ammonia, and weighing the precipitate of sesquioxide of iron, traces at least of alkalies are always retained, and these it does not seem possible to separate from the hydrated sesquioxide by washing. The same is the case in regard to phosphoric acid, the absolute separation of which is connected with the greatest difficulties—so much so, that I feel justified in saying that, so far, no iron has ever been prepared by metallurgical process, or by the most minute and careful work of the accomplished chemist, which was perfectly free from phosphorus. The same has been proved with regard to sulphur, and is also very probably true with regard to carbon. We do not know as yet the properties of absolutely pure iron.

This tenacity of the sesquioxide of iron to retain alkaline salts, especially salts of potassa and ammonia, in connection with the same degree of affinity that it has for phosphoric acid, seems to me a matter of great moment in the process of nourishment of plants. The hydrated sesquioxide of iron, which, to a greater or less extent, is never wanting in any soil, is, like the humus, a holder of those mineral constituents on the presence of which in the soil is dependent the existence of vegetable life. I may say that when you consider the powers of the sesquioxide of iron (as well as alumina) of condensing in its pores gases, such as carbonic acid and ammonia, which gases are the daily food of plants, it is perhaps possible to demonstrate that the fertility of a soil depends upon the presence of a certain amount of sesquioxide of iron. It is certain that the latter substance, changing continually as it does, converts by its own oxydation and reduction, the complicated carboniferous compounds with which nature and human foresight supply the soil, into more simple forms that alone are adapted to the maintenance of vegetable life; and after having converted them into those compounds, retains them and disposes of them to the plants under the influence of the stronger living power of assimilation by means perhaps of the water of hydration, which is always, even after the long-continued heat of a hot summer, to be found in sesquioxide of iron, and which, if I may say so, serves as a channel of transportation of the inflexible, motionless, dead mineral into the living plant and animal.

This tendency of the sesquioxide of iron to retain alkalies seemed to me as bearing a part in the formation of compounds like $RO, Fe_2 O_3$. I therefore tried to produce a compound in which the protoxide would be an alkali. To this end, I heated a certain quantity of iron alum with carbonate of potassa for over six hours in a porcelain crucible, which was inserted into an ordinary Hessian crucible, at the strongest white heat I could produce. After washing with water, I separated, as far as I could, the black, heavy crystalline part from the red deposit which after awhile was forming. Giving my experience, I must say that the black undecomposed substance was $KO, Fe_2 O_3$, which, by boiling with water, was decomposed, the potassa becoming eliminated, and the iron converted into a sandy red hydrate. The black powder, as I obtained it, was after drying at 100° C. a little magnetic, dissolved to a beautiful red color in hydrochloric acid, was free from sulphuric and carbonic acids, and was composed of

70.80 $Fe_2 O_3$
14.00 KO
15.20 HO

Part of it was here already decomposed, which may perhaps be illustrated in the following way:

$Fe_2 O_3, KO$ has the composition

62.99 $Fe_2 O_3$
37.01 KO;

$Fe_2 O_3, KO + Fe_2 O_3, 3 HO$ has the composition

68.38 $Fe_2 O_3$
20.17 KO
11.45 HO; while

$Fe_2 O_3, KO + 2 (Fe_2 O_3, 3 HO)$ has the composition

70.39 $Fe_2 O_3$
13.78 KO
15.83 HO,

approaching very nearly the composition of the substance I analyzed.

After these deviations, I return to my subject proper. For the following experiments a preparation was used which was produced by pouring a solution of sesquichloride of iron into a solution of phosphate of soda. After washing out completely, the precipitate was dried in the air, pulverized, and then put through a fine sieve to secure more perfect mixture. In testing it as to its purity, it proved to be free from sulphuric and hydrochloric acids, and no traces of alkaline earths could be detected by the spectroscope. The latter apparatus, however, showed a trace of soda.

I. *Determination of Water.*

For the determination of water in (a), the powder was dried at 100° C. and weighed at different times, afterwards heated to red heat, and weighed again. The mass looked white after ignition. In (b) and (c) the substance was simply heated to red-heat and weighed. It looked blue. The results are as follows:

(a)—29.99 p. c. ignited.
(b)—29.99 p. c. "
(c)—29.93 p. c. "
mean—29.97 p. c. "

In heating (a), at 100° C.

For 2 hours=15.18 p. c.
" 3 " =15.31 p. c.
" 16 " =26.85 p. c.

Part of the water, therefore, seems to be retained by a stronger affinity than the rest.

II. *Determination of the iron with permanganate of potassa.*

The reduction of the iron was effected in a wide-mouthed 8 oz. bottle, which was covered with a glass plate. The hydrogen acted on the sesquioxide from a piece of platinum, that was in the acidulated fluid, touching a piece of amalgamated zinc. The reduction was finished in about twelve hours, without the slightest trouble or inconvenience.

Hydrochloric acid, in these experiments, giving me always differing results, I dissolved the aforesaid powder in sulphuric acid and then titered. Those differences, by the way, were the cause of my trying the various methods of determining iron by weight and measure. The permanganate solution indicated in the cubic centimetre 0.0065 gr. metallic iron.

The results are as follows:

(a) 0.3886 gr.=13.90 c. c.=33.21 p. c. Fe_2O_3
(b) 0.3168 " =11.40 c. c.=33.41 p. c. "
(c) 1.0852 " =38.80 c. c.=33.20 p. c. "
mean=33.27 p. c.

The salt was therefore composed of

36.76 PO_5 (by loss).
33.27 Fe_2O_3
29.97 HO.

Corresponding to the formula:

$$Fe_2O_3\ 4,\ PO_5\ 5+HO\ 32,$$

or perhaps, as a part of the water is driven off more easily than the rest, of

$$5\ (Fe_2O_3\ 2,\ PO_5\ 3+8\ HO)+2\ (Fe_2O_3,\ 3\ HO)+59\ HO.$$

Corresponding to a composition of

$$\begin{array}{l} 36.86\ PO_5 \\ 33.23\ Fe_2\ O_3 \\ 29.91\ HO = 15.58 = 50 \text{ eq.} \\ \qquad\qquad\quad 14.33 \\ \qquad\qquad\quad \overline{29.91} \end{array}$$

B.

I will, in the following experiments, describe the methods with the same accuracy with which they were executed, though I am well aware that I am giving nothing new. I will here remark, that in precipitating phosphoric acid as ammonio-phosphate of magnesia, the fluid was always evaporated to about 150 c. c., and the dissolved part never taken into consideration. Of the magnesia mixture which was prepared in a most careful manner, 50 c. c. sufficed to precipitate 1 gr. of phosphoric acid. The three analyses by the same method were always commenced at the same time, continued under the same circumstances, and finished with an accuracy and patience necessary in researches of this kind. I will give the methods in the order of their exactness.

I. *Method with* MO_3.

The substance was dissolved in nitric acid, diluted with water, and heated with a sufficient amount of molybdic acid solution (Vide Fresenius, Qualitative Analysis). After cooling, the yellow precipitate was filtered off, washed from the filter and dissolved in ammonia. This solution was again precipitated by dilute nitric acid, with the addition of a little molybdic acid solution, and after washing out completely the second precipitate, and dissolving it in ammonia, the solution was filtered when necessary, evaporated, and then precipitated with magnesia mixture. This precipitate of ammonio-phosphate of magnesia was carefully washed, and, without dissolving a second time, dried and weighed.

The ignited mass in (b) was snow white, in (a) and (c) slightly tinged with yellow.

The fluid which was filtered off from the yellow precipitate containing the phosphoric acid, was heated a second time with more molybdic acid solution without coloring it in the least. Ammonia was then added in excess and the precipitates washed —(a) not quite as long as (b), and (b) not quite as long as (c). After drying and weighing, the residue was dissolved in hydrochloric acid, and the Fe_2O_3 separated from the molybdic acid, by a twofold treatment with poly-sulphide of ammonium. After washing the sulphide of iron, dissolving it in HCl, oxidizing with NO_5, filtering from separated sulphur, and precipitating with NH_3, this precipitate was, after careful washing, dried and weighed. The results are as follows:

	(a) 0.438 gr.	(b) 0.2750 gr.	(c) 0.3195 gr.
PO_5	36.74	36.73	36.74
Fe_2O_3	33.58 ($10.44 MO_3$)	33.40 ($9.51 MO_3$)	33.40 ($8.35 MO_3$)
HO	29.68	29.87	29.86

mean $PO_5 = 36.74$
$Fe_2O_3 = 33.46$
$HO = 29.80$

II. *Method with* SiO_2 (Berzelius' by fusing).

I prepared for this method a mixture which I also think useful in the analysis of iron ores, and which consisted of

1 gr.—KO, NO_5
5 gr.—SiO_2
20 gr.—KO, CO_2
10 gr.—NaO, CO_2

15 to 25 parts of this mixture are sufficient for 3 gr. of iron ore.

The substance was fused with five parts of this mixture, and after cooling dissolved in water. The residue, after washing out, was dark-green and crystalline like hornblende.

It was dissolved in hydrochloric acid, and after separating silicic acid by evaporating to dryness three times, precipitated by ammonia. The fluid containing the phosphoric acid was also separated from silicic acid and then boiled for several hours with concentrated sulphuric acid, in order to convert the pyro-phosphoric acid into the tribasic modification. After dilution to 150 c. c. phosphoric acid was precipitated by magnesia mixture. This method is very clean, accurate, and, under some conditions, preferable to the MO_3 method.

The results are as follows:

	(a)—1.3567	(b)—1.5683	(c)—1.577
PO_5	36.63	36.71	36.59
Fe_2O_3	33.41	33.51	33.48
HO	29.96	29.78	29.93

mean = 36.64—PO_5
33.47—Fe_2O_3
29.89—HO.

III. *Method with* SiO_2 (Fuchs' by boiling with water-glass).

As this method was and still is often used in the analysis of alumina compounds, I tried to introduce it here and compare its results. It is an exceedingly troublesome and disagreeable method, especially when taking much silicic acid. The results are good. I am, however, able to report only two analyses, the only ones that out of nine I could safely bring to an end. The substance was dissolved in hydrochloric acid, precipitated with caustic potassa, and then boiled for a considerable time with a solution of water-glass, which in this case was prepared from pure silica and pure potassa, the silica having been prepared from soluble glass. The greatest care has to be taken not to add too much of the silicic acid solution, as, with an excess of it, the mechanical difficulties of the analysis will become very great. After long-continued boiling, the fluid must be allowed to settle and become cold. It is then separated from the residue by filtration and washing. After dissolving the residue in hydrochloric acid, it, as well as the solution, is freed from silica in the ordinary way. When silica is contained in the fluid in large quantities, it may be preferable to separate it by a current of HS in an ammoniacal solution. The process of evaporation, in cases like these, has always to be repeated at least twice, in order to get rid of all traces of silica; the iron precipitate yielded on a second evaporation 1.9 p. c. SiO_2, on a third evaporation, 1.6 p. c. SiO_2, and would, no doubt, have yielded some SiO_2 a fourth time. The solution containing phosphoric acid was then evaporated and precipitated with magnesia mixture. The loss of phosphoric acid here was owing to the formation of the β-modification, which was disregarded, and therefore lost. The results are as follows:

	(a) 1.2399	(b) 1.4159
PO_5	32.49	32.32
Fe_2O_3	33.70	33.97
HO	33.81	33.71

The 4 p. c. which is in excess of the amount of water actually contained in the substance, belongs to PO_5, and would have been precipitated here under precautions. Taking this case into account, we have the mean

$$PO_5 = 36.40$$
$$Fe_2O_3 = 33.83$$
$$HO = 29.77$$

IV. *Method with* NH_4S_x.

The substance was dissolved in hydrochloric acid, then ammonia and poly-sulphide of ammonium added, and the whole digested for about a day until the supernatant liquid was perfectly clear and of a yellow color.

After filtering and washing out with water containing some sulphide of ammonium, the operation was repeated in the same manner, the sulphide of iron having been previously dissolved in hydrochloric acid. The second filtrate contained no trace of phosphoric acid, the sulphide of iron was then dissolved in HCl, oxydized with HO, NO_5, filtered from the separated S, precipitated by NH_3, and carefully washed out. It was weighed after drying and igniting. The filtrate containing the phosphoric acid was evaporated to a suitable volume, slightly acidulated, filtered from separated sulphur, and precipitated by magnesia mixture, in the usual way. This method will yield better results than the ordinary method of fusing with carbonate and nitrate of soda. Yet all phosphoric acid cannot even here be separated from the iron, and while in the method by fusion about 1.3 p. c. (respectively 1 p. c.) of phosphoric acid will remain with the iron, not to mention that part of the phosphoric acid, which, in the latter case, is dissolved as ammonio-phosphate of magnesia in the alkaline salts, here 0.7 p. c. will be found to be missing. This deficiency of phosphoric acid we ought to find in an increase of the weight of the iron, but instead of this, we have still less, owing, in my opinion, to the sulphide of iron being soluble in poly-sulphide of ammonium, under the influence perhaps of the remaining phosphoric acid.

It is a well-known fact, that sulphide of iron will dissolve in poly-sulphide of potassium and sodium to a larger extent in hot than in cold solutions. And now we cannot but consider this to be also the case with sulphide of ammonium. It is lost to the analysis probably in this way.

In evaporating the alkaline solution of sulphide of ammonium containing the phosphoric acid, it separates in such a form, and is covered with the separated sulphur in such a way as to be not easily attacked by dilute hydrochloric acid. As a method it is nice and clean, the results being as follows:

	(a)—1.1468	(b)—1.7613	(c)—0.8639
PO_5	36.00	35.91	35.92
Fe_2O_3	33.00	33.09	33.04
HO	31.00	31.00	31.04

mean	PO_5	35.95
	Fe_2O_3	33.04
	HO	31.01

V. *Method by Mercury.* (To be used when it is desirable to separate alkalies from alkaline earths.)

This method is exceedingly valuable in cases where alkalies and alkaline earths have to be separated from iron in phosphatic minerals. It might have been, therefore, superfluous to include it here, as this case will probably never occur in iron ores; for the sake of completeness, however, I undertook to experiment with it in regard to its facility and value as a method. The compound has to be dissolved to this end, in a very little HO, NO_5, as a large amount renders it difficult to drive off the excess of nitric acid, to wash out the alkalies and alkaline earths, and to prevent the mass from coming over, in the subsequent fusion. A large amount of nitric acid, besides all this, will cause a turbulent reaction, which may easily give rise to losses by spattering. I will state, in this connection, that I did not succeed in any case in driving off all the nitric acid from the sesquioxide of iron, as I found each time a little of it in solution, and in two cases, also, traces of phosphoric acid. After heating the mass with mercury on a water bath, (a wide dish being the more suitable,) until no smell of nitric acid can be detected, the insoluble part was completely separated by washing, the filtrate (which will contain the alkalies, &c.), gave a slight precipitate with ammonia and sulphide of ammonium. After freeing it from the mercury, this was filtered off, dissolved in HCl, oxydized with NO_5, and precipitated with NH_3.

In the filtrate from the sulphide of iron, after proper treatment, no indication of phosphoric acid was produced by molybdic acid solution. The residue was carefully dried, mixed with carbonate of soda and potassa, and then fused.

The washing out of this latter residue of sesquioxide of iron had to be repeated several times, as it ran very easily through the filter. The residue and filter were then ignited, dissolved in HCl, filtered and precipitated by NH_3. I find that in cases where it is difficult to separate the residue completely from the filter paper it is better to ignite the paper than to treat it directly with acid. The residue of sesquioxide of iron obtained by fusion, as every one knows who has ever made an analysis of iron ores, will not very easily dissolve in acid; by digesting the filter with warm hydrochloric acid, some organic substances will be introduced into the solution which will prevent the complete precipitation of iron by ammonia. Sulphide of ammonium will not effect a more complete separation. The method itself is very difficult and troublesome, and requires much care and circumspection.

The results are as follows:

	(a)—1.1825	(b)—1.2911	(c)—1.5425	(d)—1.0429
PO_5	35.98	35.85	35.88	
Fe_2O_3	34.53 $\begin{matrix}33.01+\\1.52\end{matrix}$	34.37 (32.67)	34.51 (32.50)	
HO	29.49	29.78	29.61	

mean PO_5 35.90

Fe_2O_3 34.47

HO 29.63

VI. *Fusing Method.*

The substance was heated with three parts of a mixture of

$$6—NaO, CO_2$$
$$1—KO, NO_5$$

for not longer than fifteen minutes over the flame of a single Bunsen burner. The agglutinated mass was triturated with water and washed out. The residue was dried, and together with the filter-ash fused again with three parts of the above-named mixture for one half-hour over the blast lamp. The filtrate from the second fusion contained no phosphoric acid, showing that the separation, or rather decomposition, as far as it goes, will take place at a comparatively low temperature, and in a short time. In this case and in the other analyses of iron ores, of which I made a great number, it was almost impossible to wash out the sesquioxide of iron so that it should not run through the filter. The cause of this is the above-mentioned sandy hydrate (probably very pure). In evaporating the filtrate however, the concentration of the solution will predispose either the alkali or the water to combine with the sesquioxide again, whereby it is rendered voluminous, and may be washed out without trouble. I have already mentioned that it is very difficult to separate the iron from the filter; the latter has to be treated therefore with HCl, and sometimes even with a little KO, ClO_5. Filtering off the solution and boiling it for hours with renewed addition of KO, ClO_5, will not completely destroy the organic matter, which will hold iron in solution, as may be seen from the results of the analyses. The sesquioxide of iron, precipitated from solutions containing organic matter, looks black after ignition, and becomes heavier and of a lighter color after long-continued heating in the air. The filtrate containing PO_5 was evaporated and acidulated; ammonia was added, and by these means it remained clear and was precipitated in the usual way.

The water in these cases was determined directly. The results are as follows:

	(a)—1.7692	(b)—1.3066	(c)—1.5358
PO_5	35.41	35.81	35.19
Fe_2O_3	$35.34 = \frac{35.03+}{0.31}$	$35.24 = \frac{35.20+}{0.04}$	$35.10 = \frac{34.90+}{0.20}$
HO	29.24	29.19	29.93
	99.99	100.24	100.22

mean PO_5	35.47
Fe_2O_3	35.23
HO	29.45
	100.15

We see that it is impossible by this method to separate all the phosphoric acid from the iron, as I will hereafter show by direct analysis.

VII. *Fusing Method.* (In connection with MO_3.)

The following analyses were made with a view of ascertaining the influence which alkaline salts exert on the ammonio-phosphate of magnesia. To this end, the analyses were conducted in exactly the same way as heretofore described, with the difference only that the PO_5 after having acidulated the filtrate with nitric acid, was first precipitated by molybdic acid solution. The residue of iron was dissolved in HCl. and precipitated by NH_3 and NH_4S. After washing out, the sulphide of iron was again dissolved, oxydized, and precipitated by ammonia. The results go to show that the alkaline salts dissolve more of the ammonio-phosphate of magnesia than ammoniacal water alone, and that sulphide of iron is soluble, to some extent, in poly-sulphide of ammonium.

The results are as follows:

	(a)—0.2951	(b)—0.271	(c)—0.4302
PO^5	35.63	35.49	35.81
Fe_2O_3	34.29	34.35	34.22
HO	30.08	30.16	29.97

mean PO_5	35.64
Fe_2O_3	34.29
HO	30.07.

It is needless for me to state, that all the analyses just cited were made with the greatest care. The results of each method agree so well, that we have to look for the differences to errors in the methods. And as I gave my views concerning those errors, in describing the way according to which I have conducted the analyses, I have now only to give some figures that will further illustrate the incorrectness of the figures that represent the phosphoric acid, determined by the fusing method, as generally conducted.

1.7715 gr. of substance was heated for one half-hour with 11 gr. of carbonate and nitrate of soda, over a Bunsen burner, and afterwards fused for one half-hour over a blast-lamp. After complete washing out, the residue was dissolved in hydrochloric acid, reduced by bisulphite of soda, and the fluid boiled till all sulphurous acid was driven off. Acetate of soda, and then chlorine water, were added. The small red precipitate was filtered out without washing, dissolved in HCl, and precipitated with NH_3. This latter precipitate was washed several times with hot water, then dissolved in nitric acid, and heated with molybdic acid solution. It gave 1.029 p. c. PO_5, as was to be expected from comparison of the analyses. In the same way were conducted many analyses of different sesquioxides of iron, which were obtained from iron ores by the ordinary fusing method (as basic acetates), and which invariably were found to contain phosphoric acid.

I will cite only two more instances, concerning the determination of phosphoric acid in sesquioxide of iron—which sesquioxide was procured from Dr. Endemann.

Dr. Endemann found in one case 0.04 p. c. PO_5 in the ore, while 0.31 p. c. was left in the sesquioxyd, as determined by myself.

In the other he found a trace only of PO_5, while 0.13 p. c. was left.

After deciding this point, I proposed to prove that, by the silica method, all the phosphoric acid can be separated from the iron. A quantity of the material was fused to this end, with the silicic acid mixture.

The residue was, after washing out, prepared for the treatment of molybdic acid solution, which, after heating, produced only a slight yellow coloration, without any precipitate whatever.

This, therefore, is, besides the molybdic acid method, the only one by which phosphoric acid can be separated from iron in such a way that no appreciable amount will remain with the latter. For better comparison, I give the averages of all the analyses again.

Normal composition,

	PO_5	36.86	
	Fe_2O_3	33.23	
	HO	29.91	
(1)	PO_5	36.76	Determination of iron
	Fe_2O_3	33.27	(by permanganate)
	HO	29.97	and water.
(2)	PO_5	36.74	MO_3 Method.
	Fe_2O_3	33.46	
	HO	29.80	
(3)	PO_5	36.64	SiO_2 " (Berzelius.)
	Fe_2O_3	33.47	
	HO	29.89	
(4)	PO_5	36.40	SiO_2 " (Fuchs')
	Fe_2O_3	33.83	
	HO	29.77	
(5)	PO_5	35.95	NH_4S_x. "
	Fe_2O_3	33.04	
	HO	31.01	
(6)	PO_5	35.90	Hg. "
	Fe_2O_3	34.47	
	HO	29.63	

(7)	PO_5	35.64	Fusing Method (MO_3)
	Fe_2O_3	34.29	
	HO	30.07	
(8)	PO_5	35.47	" "
	Fe_2O_3	35.23	
	HO	29.45	

As this finishes my actual work, as regards the separation of phosphoric acid from iron, I may be allowed to give my views as to the state in which this acid occurs in iron ores, and to call attention to some points which may finally lead us to succeed in preventing it from entering to a larger extent into the composition of metallic iron.

Phosphorus is always contained in iron ores as phosphoric acid. I believe this to be the case even in bog ores, the only ores in connection with which we might question this statement.

The oxides, and principally the sesquioxides of iron, have a great affinity for phosphoric acid, and will retain it with a strong force. The substances, however, accompanying iron ores, as alkalies, alkaline earths, and alumina, have a still greater affinity for phosphoric acid than even sesquioxide of iron, and will have taken up in the process of formation of iron ore beds, either by a dry or a wet process, most of the phosphoric acid, so that the iron ore proper, it being considered as a mixture of pure compound of iron with some gangue, or as the Germans term it, "*Begleiter*," will only contain a very small amount of it. This amount of phosphoric acid, which is necessarily contained in iron ores, is less in the magnetic than in the hematite varieties, inasmuch as the strong combining power of the sesquioxide in the former has been satisfied to some extent by the protoxide present, and we are therefore able to obtain, under similar conditions, a better iron from those than we can from hematites. This slight amount of phosphoric acid in the iron ore proper will enter into the mass of metallic iron by the process of reduction and smelting, and, in combination with other constituents, give it its distinctive character. This small percentage of phosphorus in metallic iron I hold to be necessary to make a good article, and I do not doubt that the absence of it, as in the case of iron made from some magnetic and titanic ores, will be supplied by some other substance, say sulphur or carbon.

A difference in the relative proportions of carbon, sulphur, and phosphorus, will change the properties of the metal in such a way as to render it more or less adapted to certain particular uses. As, however, very few exact analyses of metallic iron exist, we have first to ascertain those proportions of carbon, sulphur, and phosphorus, and their relations to the changes they effect in the properties of pure iron, before we are able to produce an iron of a certain character by the mixing of different ores, the composition of which we know.

We have also to make a distinction between the phosphoric acid in the ore proper, and the phosphoric acid in the gangue. This latter I believe to be comparatively easy to eliminate and bring completely into the slag. The proof of this, as also the results of an attempt to remove an excess of phosphoric acid, that by some peculiarity of composition or form may have entered into combination with the ore proper, will be the subject of another series of experiments.

For the investigation of some of these methods for the separation of phosphoric acid from alumina, a precipitate similarly prepared and similarly treated was used, which, however, was not as well washed out as the iron precipitate had been. It had the same composition as the iron compound, with the exception of the water, of which it contained a little more.

$$Al_2O_3\ 4, + PO_5\ 5, + HO\ 58\ (Al_2O_3 = 51.5).$$

$$PO_5 \quad = 32.78$$

$$Al_2O_3 = 19.02$$

$$HO \quad = 48.20$$

I. *Method with* MO_3.

The analyses, according to this method, were made in exactly the same way as previously described; the acid fluid, however, that was filtered off from the precipitate containing the phosphoric acid, was super-saturated with ammonia, and a current of sulphydric acid passed through it. The solution, of a dark-red color, was washed out from the residue; the latter dissolved in hydrochloric acid, and treated once more in the same way, before finally dissolving in HCl, precipitating by NH_3, washing, drying, and weighing.

The results in this case, were as follows:

	(a) (A) 0.698	(B) 0.7354	(C) 0.6375
PO_5	32.31	32.39	32.36
Al_2O_3	19.19	19.17	19.18
HO	48.50	48.44	48.46

mean PO_5	32.35
Al_2O_3	19.18
HO	48.47

II. *Method with* SiO_2 (Berzelius' by fusing).

I have to remark on this method and on the following one, that a small quantity of alumina will get into solution, depending probably on the amount of silica used, for more or less of it will change the character of the otherwise insoluble residue. About 1 gr. of the substance was fused over a single Bunsen burner, with 10 gr. of the above mentioned mixture containing the silica. The mass looked crystalline and separated easily from the platinum crucible; after digestion with hot water, the soluble part was washed out and separated from silica by twice evaporating to dryness. The filtrate was then supersaturated with carbonate of soda, evaporated to dryness, and heated for a few minutes to fusion. The fused mass dissolved clearly in water. After acidulating with HCl the solution was boiled, and ammonia was added to alkaline reaction. A slight precipitate was filtered off, washed out, dissolved in nitric acid, and precipitated by molybdic acid solution. The small yellow precipitate was dissolved in ammonia after washing. This solution was added to the main one, containing the phosphoric acid. After evaporation to the required volume, PO_5 was precipitated by magnesia mixture. The fluid filtered from the yellow precipitate was treated in a proper manner, and the slight amount of alumina weighed. The insoluble residue that had been freed from PO_5 by washing was separated from SiO_2 in the usual way, and the Al_2O_3 precipitated and weighed. Results are as follows:

	(a) 1.027	(b) 1.032	(c) 1.03
PO_5	32.31	32.28	32.35
Al_2O_3	$19.19 = \frac{19.04+}{0.15}$	$19.18 = \frac{19.04+}{0.14}$	$19.21 = \frac{19.07+}{0.14}$
HO	48.50	48.54	48.44

mean PO_5 32.31
Al_2O_3 19.19
HO 48.50

III. *Method with* SiO_2 (Fuchs' water-glass).

The analyses were made in the manner heretofore described, but the fluid containing the phosphoric acid, after having separated SiO_2, and boiled with a little concentrated HO, SO_3, was mixed with PbO, NO_5, and then precipitated by NH_3 and NH_4O, CO_2. The precipitate was filtered off and washed out; the filtrate contained no trace of PO_5. The precipitate was dissolved in a little HO, NO_5, diluted with HO, and the lead separated by HS. After completely washing out, evaporating and filtering from separated sulphur, ammonia and (disregarding a very slight precipitate) magnesia mixture was added.

The operation with lead was interpolated to get rid of the large amount of alkaline salts, that exert a dissolving influence upon the ammonio-phosphate of magnesia. The results are as follows:

	(a)—1.038	(b)—1.051	(c)—1.0201
PO_5	32.71	32.56	32.79
Al_2O_3	18.98	19.03	19.09
HO	48.31	48.42	48.12

mean PO_5	32.69
Al_2O_3	19.03
HO	48.28

The averages of the analyses are as follows:

1.	PO^5	=32.78	Normal composition.
	Al_3O_3	=19.02	
	HO	=48.20	
2.	PO^5	=32.35	Method with MO^3
	Al_2O_3	=19.18	
	HO	=48.47	
3.	PO^5	=32.31	Method with SiO^2 (Berz.)
	Al_2O_3	=19.19	
	HO	=48.50	
4.	PO^5	=32.69	Method with SiO^2 (Fuchs.)
	Al_2O_3	=19.03	
	HO	=48.28	

These analyses go to confirm what I have already expressed regarding the value of the methods. I have nothing further to add to this subject; and as the other sesquioxyds, that would have to be separated from iron and phosphoric acid, rarely occur as such in iron ores, I make no mention of them, and will only add a few words on the determination of phosphoric acid. The main point in the case at issue is always to have the phosphoric acid in the tribasic modification; its determination is then sufficiently easy, and is best effected in the form of ammonio-phosphate of magnesia.

The precipitation by iron is not reliable; nor by a salt of lead, dependent, as it is, on circumstances over which we have not always control. I should, therefore, in all ordinary cases, recommend the use of magnesia mixture as a precipitant of tribasic phosphoric acid, and it is hardly necessary to say that the results will be good, if the mixture has been properly prepared.

VIII.—*List of a Collection of Birds from Northern Yucatan.*

By Geo. N. Lawrence.

Read May 10th, 1869.

During the year 1865 Señor Jose Salazar Ylarregui, then governor of the province of Yucatan, began the important enterprise of a complete survey of the country, in regard both to its physical and natural history. As the Mexican Commissioner of the United States and Mexican Boundary Survey, Governor Salazar was well known in the United States as an accomplished astronomer and geographer, and his experience in the former work was an earnest of success in his new undertaking. Inviting Dr. Arthur Schott, of Washington, to connect himself with the survey as naturalist, an arrangement was made by Governor Salazar with Professor Henry, Secretary of the Smithsonian Institution, to send all the collections to his care for identification, and the ultimate preparation of a report.

The survey was fully organized, and commenced its operations with great success, and continued until 1866, when the change in the affairs of Mexico prevented all further proceedings, and the work was broken off without any prospect of speedy resumption. Many valuable collections were however made during the progress of the work, and transmitted to Washington; and having had those of the birds intrusted to me for examination by Professor Henry, I present herewith a list of the species.

All the specimens are from Merida, unless otherwise noted.

Fam. TURDIDAE.

1. *Turdus grayi, Bonap.*
2. *Mimus gracilis, Cab.*

Fam. TROGLODYTIDAE.

3. *Campylorhynchus guttatus, Lafr.*

Progress and Celestin.

There are several specimens of this species, but none were in the Smithsonian collection at the time Prof. Baird had this genus under examination to include in his "*Review of American Birds.*" In this he states (page 108) that it "belongs to the same section as *C. brunneicapillus*, etc., with reddish-brown head, and back striped longitudinally with white."

It differs from *C. brunneicapillus* in its smaller size, and longer bill, the under mandible whitish ; the feathers of the head are brownish-black, with light rusty-brown margins, the head of *brunneicapillus* is of a uniform dark reddish-brown ; the upper plumage of *guttatus* is less rufous, with the white shaft stripes broader and more conspicuous, the spots on the chin and throat are small and sparse, in the other species this part has a dense agglomeration of black spots ; the sides are barred, not spotted, and the abdomen is without the rufous coloring of *C. brunneicapillus.*

Length $7\frac{1}{2}$ in. ; wing 3 ; tail 3 ; bill 1 ; tarsi 1.

4. *Thryothorus albinucha* (*Cabot*).
5. *Troglodytes intermedius, Cab.*

Fam. SYLVIIDAE.

6. *Polioptila cœrulea* (*Linn.*).

Fam. Sylvicolidae.

7. *Parula americana* (*Linn.*).
8. *Protonotaria citrea* (*Bodd.*).
9. *Helmitherus vermivorus* (*Gm.*).
10. *Dendrœca pennsylvanica* (*Linn.*).
11. " *cœrulea* (*Wils.*).
12. " *æstiva* (*Gm.*).
13. " *vieilloti*, *Cassin.*

Sisal, Progress and Celestin.

14. *Dendrœca dominica* (*Linn.*).
15. *Seiurus auricapillus* (*Linn.*).
16. " *noveboracensis* (*Gm.*).
17. *Geothlypis trichas* (*Linn.*).
18. " *poliocephala*, *Baird.*
19. *Icteria virens* (*Linn.*).
20. *Myiodioctes mitratus* (*Gm.*).

Fam. Hirundinidae.

21. *Stelgidopteryx fulvipennis* (*Scl.*).

A specimen in young plumage, apparently of this species.

Fam. Vireonidae.

22. *Cychloris flaviventris*, *Lafr.*

Fam. Tanagridae.

23. *Euphonia affinis* (*Less.*).
24. *Saltator atriceps*, *Less.*
25. " *grandis*, *Licht.*

Fam. Fringillidae.

26. *Hedymeles ludovicianus* (*Linn.*).
27. *Guiraca cœrulea* (*Linn.*).

28. *Cardinalis virginianus* (*Linn.*).
29. *Volatinia jacarina* (*Linn.*).
30. *Phonipara pusilla* (*Sw.*).
31. *Cyanospiza cyanea* (*Linn.*).
32. " *ciris* (*Linn.*).
33. *Embernagra rufivirgata*, *Lawr.*

Fam. Corvidae.

34. *Cyanocitta crassirostris*, *Bonap.*
35. *Cyanocorax luctuosus* (*Less.*).

Fam. Dendrocolaptidae.

36. *Dendrornis eburneirostris* (*Less.*).

Fam. Formicaridae.

37. *Thamnophilus affinis*, *Cab. & Hein.*

Fam. Tyrannidae.

38. *Camptosoma imberbe*, *Scl.*

This agrees well with Mr. Sclater's description, except, in dimensions, it measures, length $4\frac{1}{4}$ in.; wing $2\frac{1}{8}$; tail $1\frac{7}{8}$; he gives, length 3.5 in.; wing 2.8; tail 1.3.

39. *Elainea placens*, *Scl.*
40. *Myiozetetes texensis* (*Giraud*).
41. *Rhynchocyclus cinereiceps*, *Scl.*
42. *Pitangus derbianus* (*Kaup*).
43. *Megarhynchus mexicanus* (*Lafr.*).
44. *Muscivora mexicana*, *Scl.*
45. *Pyrocephalus mexicanus*, *Scl.*
46. *Empidonax traillii* (*Aud.*).

47. Contopus schottii, sp. nov.

Plumage above of a light olivaceous-brown with a wash of dull rufous, rather darker on the head; tail liver-brown with reddish-brown shafts; wing coverts and quills dark liver-brown; the middle and larger coverts, the secondaries and tertiaries margined with dull grayish-white; under wing coverts dull pale ochreous; chin and upper part of throat dull yellowish-gray; neck, breast and sides of a brownish ochreous, the middle of the abdomen and under tail coverts light ochreous yellow; upper mandible black, the lower yellowish white; feet black.

Second and third quills equal and longest, fifth a little longer than the first.

Length (skin) $5\frac{5}{8}$ in.; wing $2\frac{13}{16}$; tail $2\frac{5}{8}$; bill $\frac{7}{16}$; tarsi $\frac{1}{2}$.

Habitat.—Merida, collected by Dr. A. Schott, Feb. 21st, 1865.

Type in Museum Smithsonian Inst., No. 37,965.

This resembles my *C. lugubris* from Costa Rica, in its dull dark coloring, but it is much smaller; the color above is quite different, being reddish brown in place of dark olive-brown, and the throat and breast are dull ochreous instead of olive-brown; the bill is much smaller than that of *lugubris.*

I have conferred upon this species the name of Dr. Arthur Schott, the energetic naturalist of the Commission.

48. *Myiarchus cooperi* (*Kaup*).
49. " *mexicanus* (*Kaup*).

The two specimens before me are quite distinct from my *M. cinerascens* (*Ann. Lyc., N. Y., vol. v., p.* 121), which is referred by Prof. Baird (*Pacif. R. R. Rep., vol. ix., p.* 179) *to M. mexicanus*, Kaup. Kaup's description (*Proc. Zool. Soc., London*, 1851, *p.* 51) is short and unsatisfactory. He says: "With short wings; all the wing-feathers, except the first, with rufous margins; breast light ash-gray; above lighter."

Kaup's character of short wings, applies to the Yucatan species better than to *M. cinerascens*, which has rather longer wings than any of its allies. I have examples of all the species enumerated by Kaup, and subjoin a table of measurements of the wings and tails, in the order given by him, adding those of my *M. cinerascens*:

	Wing.	Tail.
M. cooperi	4 in.	$3\frac{7}{8}$
" *crinitus*	4	$3\frac{1}{2}$
" *validus* (*gossii*, Bp.)	$3\frac{7}{8}$a4	$3\frac{3}{4}$
" *mexicanus*	$3\frac{3}{8}$	$3\frac{3}{8}$
" *stolidus*	$3\frac{1}{4}$	$3\frac{1}{8}$
" *cinerascens*	4a$4\frac{1}{8}$	$4\frac{1}{16}$

It will thus be seen the wing measurements differ in the order given by Kaup. *M. mexicanus* having the wings shorter than any except *M. stolidus*, whereas in *M. cinerascens* the wings and tail exceed all of them in length. This, I think, clearly establishes the integrity of my species, and also the probability of the name of *mexicanus* being applicable to the Yucatan bird, which is further strengthened by locality.

The two species differ materially in other respects: the rufous outer edgings to the quills in mexicanus are much darker; the abdomen and under tail coverts duller in color, more of a tawny-yellow; the rufous on the inner webs of the tail feathers occupies but half the width of the web on the innermost feather, becoming less on the outer ones, and existing only on the margin of the outermost; in *M. cinerascens* this color covers the whole inner webs of the tail feathers, except at their ends, the outer one only having a narrow dark line next the shaft; in my species the under coloring is paler and more ashy on the neck and breast, the outer tail feather edged with white, and the wings more conspicuously margined with whitish.

In the species under examination the head is of a darker brown, with a cast of rufous, and the bill broader than in *cinerascens*.

50. *Myiarchus lawrencii* (*Giraud*).
51. *Galeoscoptes carolinensis* (*Linn.*).
52. *Tyrannus satrapa* (*Licht.*).

Fam. Cotingidae.

53. *Tityra personata* (*Jard. & Selb.*).
54. *Hadrostomus aglaiæ* (*Lafr.*).

Fam. Momotidae.

55. *Momotus lessoni*, *Less.*
56. *Eumomota superciliaris* (*Jard. & Selb.*).

Fam. Alcedinidae.

57. *Ceryle superciliosa* (*Linn.*).
Sisal.

Fam. Caprimulgidae.

58. *Chordeiles texensis*, *Lawr.*
59. *Nyctidromus albicollis* (*Gm.*).

Fam. Cypselidae.

60. *Chætura vauxii* (*Townsend*).
One specimen, which agrees quite well with an example from Puget Sound and others from Guatemala, but is a little smaller.

Fam. Trochilidae.

61. *Pyrrhophæna cinnamomea* (*Less.*).
There is but one example of this species, which agrees in every respect with specimens from Honduras.

There are no specimens of *P. yucatanensis* (*Cabot*), which is rare in collections, though stated by Dr. Cabot to be abundant in Yucatan. Mr. Gould was no doubt correct in referring the bird sent him by Dr. Cabot as the female of this species, to *P. cinnamomea*.

Fam. Cuculidae.

62. *Crotophaga sulcirostris*, *Sw.*
63. *Piaya mehleri*, *Bonap.*.
64. *Geococcyx mexicanus* (*Gm.*).

Fam. Picidae.

65. *Dryocopus scapularis* (*Vigors*).
66. *Picus scalaris*, *Wagl.*; (*parvus*, *Cabot.*)
67. *Sphyropicus varius* (*Linn.*).
68. *Centurus albifrons* (*Sw.*); (*dubius*, *Cabot.*)

In the collection are eight specimens which have the nasal feathers and middle of abdomen bright scarlet, without an exception; and in all, the two central rectrices are of an immaculate black. Prof. Sundeval (*Cons. Av. Picinarum*, 1866, p. 52) places *C. santacruzi*, *Bp.* under *albifrons* as a variety; Dr. Cabanis (*J. f. o.* 1862, *p.* 324) is of the same opinion; the yellow of the belly being more or less tinged with red is thought due to age. Malherbe, however, considers them distinct. I have seven specimens labelled *C. santacruzi*, from Mexico and Guatemala; four Mexican examples from Jalapa are in fine plumage, and have the nasal feathers and spot on abdomen orange, some with a tinge of red; another, a female from Orizaba, has these parts more red, but not so bright as in the birds from Yucatan; of the two from Guatemala, one, a male, has these parts the nearest in color to Yucatan specimens, the other, a female, has them pale orange; this last has the central tail feathers without spots or bars, whereas in all the others called *C. santacruzi*, these feathers are more or less barred with white on the inner webs.

In addition to the birds from Yucatan showing no orange colors, they are whiter about the face and throat, and have the white transverse striae of the upper plumage perceptibly finer than the birds from Mexico.

Here are some very decided points of difference apparently, but I do not decide that they are distinct; yet if the different colors are due to age, why should not some with orange colors be among such a number of specimens from Yucatan?

Another marked difference, is the uniformly black middle rectrices of the birds from Yucatan.

C. radiolatus from Jamaica is very distinct, a fine adult male, has the front to the bill, the sides of the head and throat nearly pure white; the upper plumage blacker, with the narrow transverse white lines further apart than in *C. albifrons;* the rump is black, conspicuously barred with broad white lines; the central tail feathers are black, crossed with widely separated fine white lines on the inner webs; the under plumage is dark brownish-olive, middle of abdomen orange-red.

69. *Centurus rubriventris, Sw.*

A single male specimen agrees closely with Swainson's description; its validity, as a species, has been doubted by many writers, and generally referred to *C. tricolor*, though admitted to be distinct by Malherbe, and accurately figured and described in his splendid Mon. of the *Picidæ.* It seems to be very rare, as Malherbe states that besides Swainson's example, he only knows of the male in his own collection. With specimens before me of *C. tricolor* from Bogota, St. Martha and Panama, the distinctness of the two species does not admit of a question. As stated by Malherbe, the bands on the upper plumage of tricolor are twice the width of those of rubriventris; in the last species the transverse white lines on the back are similar to those of *C. albifrons*, while in tricolor they are much as in *C. aurifrons;* another marked difference is in the central tail feathers; those of tricolor are deeply and broadly indented with white on both webs, whereas in the example of rubriventris, these feathers are black, except for a small space at the base on the outer web, where it is white, this color extending higher up next the shaft. In size and general coloring the two species are much alike.

The acquisition of this specimen is of much interest, as it helps to set at rest any doubt of its claim as a distinct species, and determines its locality, heretofore unknown, though supposed to be some part of Mexico.

Fam. Psittacidae.

70. *Conurus aztec, Souan.*
71. *Chrysotis albifrons, Sparrm.*

Fam. Strigidae.

72. *Glaucidium infuscatum* (*Temm.*).
73. *Bubo virginianus* (*Gm.*). *A nestling.*

Fam. Falconidae.

74. *Polyborus auduboni, Cass.*
75. *Urubitinga zonura* (*Shaw*).
76. *Buteo borealis var. montanus, Nutt.*

A specimen in young plumage, apparently of this species; it is, however, more generally rufous than California examples, and the tail much lighter in color (pale fulvous white) with narrower bars.

77. *Buteo erythronotus* (*King*).
78. *Asturina magnirostris* (*Gm.*).
79. *Tinnunculus sparverius* (*Linn.*).
80. *Hypotriorchis aurantius* (*Gm.*).

Fam. Columbidae.

81. *Leptoptila albifrons, Bonap.*; (*brachyptera, Gray.*)
82. *Chamæpelia passerina* (*Linn.*).
83. " *rufipennis, Gray.*
84. *Melopelia leucoptera* (*Linn.*).
85. *Zenaidura yucatanensis. sp. nov.*

Male. Front, sides of the head and throat of a brownish fawn-color; chin whitish; crown tinged with blue; neck, breast, abdomen and under tail coverts of a fine brownish cinnamon, a slight purplish tinge on the breast, the abdomen a little redder, and the under tail coverts rather lighter in color; sides and under coloring of the wings clear grayish-blue; upper plumage brownish-olive, with an ochreous tinge, brighter on the smaller wing coverts and rump; the metallic color on the sides of the neck is reddish-violet; the auricular spot is deep prussian-blue; the central tail feathers are the same color as the back, with an interrupted blackish bar about an inch from the end; the other feathers are bluish cinereous at base, each with a black subterminal bar; the three pairs next the central have their ends bluish cinerous; in the three outer pairs, the ends are white with a slight cinereous tinge; the primaries are blackish-brown, narrowly margined with white; the secondaries and larger wing coverts blackish cinereous of a bluish cast, the former have their outer webs more or less black next the margins, and their ends conspicuously white; the tertiaries and scapulars are blotched with black; bill black; tarsi and toes yellowish flesh-color in the dried state.

Length (skin) $11\frac{1}{4}$ in.; wing, 6; tail, $4\frac{3}{4}$; bill, $\frac{5}{8}$; tarsi, $\frac{3}{4}$.

Habitat. Merida. Collected by Dr. A. Schott, April 3d, 1865.

Type in Mus. Smithsonian Institution, No. 39,325.

The distinctness of this species from *Z. carolinensis* is apparent at first sight; in their upper coloring they are much alike, but entirely different in the coloring of the under plumage, which is uniform in the new species, with none of the pale ochreous prevailing on the abdomen and under tail coverts of *carolinensis*; the auricular spot is dark blue instead of black, and the metallic color on the neck without any tinge of golden; the central tail feathers are not pointed, retaining their width nearly to the end, and their coloring is similar to the back, not darker as in *carolinensis*; it also differs in the ends of the secondaries being conspicuously white.

The tail consists of fourteen feathers as in the allied species.

Fam. Penelopidae.

86. *Ortalida maccalli* (*Baird*).

Four specimens in the collection agree so well with Texan examples, that I consider them the same; they differ from Wagler's description of *O. vetula*, in the same manner as pointed out by Prof. Baird. The skins measure from 19 to 20 in. in length (in a fresh state would be larger); wings from 7½ to 8; tails, 6½ to 7 inches; these exceed the dimensions given by Wagler. I have never seen an authentic specimen of *O. vetula*, or one answering accurately to Wagler's description, yet it is not improbable that it may be the species under consideration.

My specimen from Texas is in very fine order, and somewhat larger than those from Yucatan.

Fam. Perdicidae.

87. *Ortyx nigrogularis*, *Gould*.

Fam. Charadriidae.

88. *Aegialites vociferus* (*Linn.*).

Sisal.

89. *Aegialites nivosus*, *Cassin*?

Celestin.

One specimen marked as a male; it differs from two specimens (in spring and winter plumage) from California, in having the back of a much lighter color, and the head of a paler ochreous; the upper coloring is paler even than in *A. melodus*, whereas in both my examples of *nivosus* that part is darker; the wings are shorter, and the quills and tail feathers of a lighter brown than in those from California, but as they agree in distribution of colors, size, and shape of the bill, I have placed it provisionally as that species.

90. *Squatarola helvetica* (*Linn.*).

Fam. Haematopodidae.

91. *Haematopus palliatus*, *Temm.*

Fam. Scolopacidae.

92. *Gambetta flavipes* (*Gm.*).

Progress.

93. *Calidris arenaria* (*Linn.*).
94. *Limosa fedoa* (*Linn.*).
95. *Symphemia semipalmata* (*Gm.*).

Fam. Ardeidae.

96. *Demiegretta rufa* (*Bodd.*).

Progress.

97. *Demiegretta ludoviciana* (*Wils.*).

Progress.

98. *Garzetta candidissima* (*Gm.*).

Progress.

99. *Ardea herodias* (*Linn.*).
100. *Florida cœrulea* (*Linn.*).

Fam. Anatidae.

101. *Fulix affinis* (*Forster*).

Progress.

Fam. Laridae.

102. *Sterna regia*, *Gambel.*
103. " *acuflavida*, *Cabot.*

Celestin.

IX.—*On the Earth contained in the Zircons of North Carolina.*

By H. Endemann and O. Loew.

Read March 29, 1869.

The Zircons that were analyzed by O. Loew came from Henderson county, N. C. Zircons of the same and other American localities have been examined before by Chandler*, Gibbs†, and Wetherill‡, showing, when compared with analyses of European chemists who worked on Zircons of other localities, very nearly the same composition.

These authors found:

	Chandler.	Gibbs.	Wetherill.
ZrO	65.30	63.33	63.50
Fe_2O_3	0.67	0.79	2.02
SiO_2	33.70	35.26	34.07
HO	0.41	0.36	0.50
	100.08	99.74	100.09

We found:

ZrO.	66.08
SiO_2	33.92
	100.00

The iron and water are included with the Zirconia.

With regard to the physical properties, however, a marked difference was found to exist, as had been already mentioned by Chandler, inasmuch as the Zircons from the above-men-

* Jahresbericht, 1856.

† Pogg. Ann. LXXI. 559.

‡ Sill. Am. Jr. [2] xv. 443.

tioned locality did not emit the phosphorescent light, which the crystals from other localities do.

The reactions of Zirconia, as described by Berzelius, Hermann, Rose, Scheerer and others, differ in some points from the reactions of the earth contained in the Zircons of North Carolina and Miask in Siberia, as described by Troost and Saint Claire Deville, so as to suggest the idea of a difference between those two earths.

Berzelius and many other chemists state that the solution of Zirconia salts is precipitated by oxalic acid, and that this precipitate remains insoluble, when an excess of oxalic acid is added. This reaction was so sure that several chemists even founded on it a method of separating iron from Zirconia.*

The earth, however, contained in our Zircons was entirely and easily soluble in oxalic acid.

In order to obtain a larger quantity of the earth, or of a soluble compound to determine the properties of this earth, we mixed Zircons finely pulverized with carbon and heated this mixture in a current of chlorine gas. We obtained a mixture of the chloride of the earth and that of iron, which was dissolved in water and then precipitated with caustic potassa in excess. The thoroughly washed precipitate was redissolved with hydrochloric acid in excess, the solution mixed with alcohol and then with ether.

Small crystals were precipitated while the iron remained in solution, and was then removed by further washing with ether.

The air-dried salt was carefully analyzed, and yielded in the average of two analyses

21.62 Chlorine.

38.87 of the earth.

We were not able, with the equivalent of Zirconium, to abstract a simple formula from these results.

According to our observations it appears to be probable that Zircons of different localities may contain different earths.

* Those Zircons were probably from Ceylon.

which assertion is supported by the fact that Sorby in England has announced two new earths among the Zircons, and by the opinion of Svanberg, who is an authority with regard to this subject.

Svanberg announced, two years ago, that the so-called Zirconia is a mixture of two different earths.

Our investigation is merely in its beginning, and therefore we can for the present only publish this short notice, but we hope at a future occasion to present more definite results.

X.—*On the Surface Geology of the Basin of the Great Lakes, and the Valley of the Mississippi.*

By J. S. Newberry.

Read May 25th, 1869.

The area bounded on the north by the Eozoic highlands of Canada, on the east by the Adirondacks and Alleghanies, and on the west by the Rocky Mountains, though now, and apparently always, drained by two systems of watercourses, may be properly considered as one topographical district; since much of the water-shed which separates its two river systems is of insignificant height, is composed of unconsolidated "Drift" materials, has shifted its position hundreds of miles, as the water level in the great lakes has varied, and was for a long interval submerged beneath a water connection uniting both drainage systems in one.

In this great hydrographic basin the surface geology presents a series of phenomena of which the details, carefully studied in but few localities, still offer an interesting and almost inexhaustible subject of investigation, but which, as it seems to me, are already sufficiently well known to enable us to write at least the generalities of the history which they record.

The most important facts which the study of the "Drift phenomena" of this region have brought to light are briefly as follows:

1st. In the northern half of this area, down to the parallels of 38°—40°, we find, not everywhere, but in most localities where the nature of the underlying rocks is such as to retain inscriptions made upon them, the upper surface of these rocks planed, furrowed or excavated in a peculiar and striking manner, evidently by the action of one great denuding agent. No one who has seen glaciers and noticed the effect they produce on the rocks over which they move, upon examining good exposures of the markings to which I have referred, will fail to pronounce them the tracks of glaciers.*

Though having a general north-south direction, locally the glacial furrows have very different bearings, conforming in a rude way to the present topography, and following the directions of the great lines of drainage.

On certain uplands, like those of the Wisconsin lead region, no glacial furrows have been observed (Whitney), but on most of the highlands, and in all the lowlands and great valleys, they are distinctly discernible if the underlying rock has retained them.

2d. Some of the valleys and channels which bear the marks of glacial action—evidently formed or modified by ice, and dating from the ice period or an earlier epoch—are excavated far below the present lakes and water-courses which occupy them.

These valleys form a connected system of drainage, at a lower level than the present river system, and lower than could be produced without a continental elevation of several hun-

* From my own observation on the action of glaciers on rock surfaces in the Alps and in Oregon and Washington Territory, I do not hesitate to assert that no other agent *could* have produced such effects. A different view is taken of this subject, it is true, but only by those who either have never seen a glacier or have never seen the markings in question. The track of a glacier is as unmistakable as that of a man or a bear.

dred feet. A few examples will suffice to show on what evidence this assertion is based.

Lake Michigan, Lake Huron, Lake Erie, and Lake Ontario are basins excavated in undisturbed sedimentary rocks. Of these, Lake Michigan is 600 feet deep, with a surface level of 578 feet above tides; Lake Huron is 500 feet deep, with a surface level of 574 feet; Lake Erie is 204 feet deep, with a surface level of 565 feet; Lake Ontario is 450 feet deep, with a surface level of 234 feet above the sea.

An old, excavated, now-filled channel connects Lake Erie and Lake Huron. At Detroit the rock surface is 130 feet below the city. In the oil region of Bothwell, &c., from 50 to 200 feet of clay overlie the rock. What the greatest depth of this channel is, is not known.

An excavated trough runs south from Lake Michigan—filled with clay, sand, tree trunks, &c.—penetrated at Bloomington, Ill., to the depth of 230 feet.

The rock bottoms of the troughs of the Mississippi and Missouri, near their junction or below, have never been reached, but they are many feet, perhaps some hundreds, beneath the present stream-beds.

The borings for oil in the valleys of the Western rivers have enabled me not only to demonstrate the existence of deeply buried channels of excavation, but in many cases to map them out. Oil Creek flows from 75 to 100 feet above its old channel, and that channel had sometimes vertical and even overhanging cliffs. The Beaver, at the junction of the Mahoning and Shenango, runs 150 feet above the bottom of its old trough.

The Ohio throughout its entire course runs in a valley which has been cut nowhere less than 150 feet below the present river.

The Cuyahoga enters Lake Erie at Cleveland, more than 100 feet above the rock bottom of its excavated trough. The Chagrin, Vermilion, and other streams running into Lake Erie exhibit the same phenomena, and prove that the surface level of the lake must have once been at least 100 feet lower than now.

The bottom of the excavated channel in which Onondaga Lake is situated, and the Salina salt-wells bored, is at least 414 feet below the surface level of the lake and 50 feet below the sea level. (Geddes. Trans. New York State Agricultural Society, 1859.)

The old channel of the Genesee River at Portage, described by Prof. Hall in the Geology of the 4th District of New York; the trough of the Hudson, traceable on the sea bottom nearly 100 miles from the present river mouth; the deeply buried bed of the Lower Mississippi, are additional examples of the same kind; while the depth to which the Golden Gate, the Straits of Carquinez, the channel of the lower Columbia, the Canal de Haro, Hood's Canal, Puget Sound, &c., have been excavated, indicates a similar (perhaps simultaneous) elevation and erosion of the Western coast of America.

The falls of the Ohio—formed by a rocky barrier across the stream—though at first sight seeming to disprove the theory of a deep continuous channel in our Western rivers, really afford no argument against it, for here, as in many other instances, the present river does not follow accurately the line of the old channel below, but runs along one or the other side of it. In the case of the Louisville falls the Ohio runs across a rocky point which projects into the old valley from the north side, while the deep channel passes under the lowland on the south side, on part of which the city of Louisville is built.

The importance of a knowledge of these old channels in the improvement of the navigation of our larger rivers is obvious, and it is possible it would have led to the adoption of other means than a rock canal for passing the Louisville falls, had it been possessed by those concerned in this enterprise.

I ventured to predict to Gen. Warren that an old filled-up channel would be found passing around the Mississippi rapids, and his examinations have confirmed the prophecy. I will venture still further, and predict the discovery of buried channels of communication between Lake Superior and Lake Michigan—probably somewhere near and east of the Grand Sable—at least, between the Pictured Rocks and the St. Mary's River—between Lake Erie and Lake Ontario through Canada,—between Lake Ontario * and the Hudson by the valley of the Mohawk,—between Lake Michigan and the Mississippi, somewhere along the line I have before indicated. I also regard it probable that a channel may be found connecting the upper and lower portions of the Tennessee River, passing around the Mussel Shoals. This locality lies outside of the area where the Northern Drift deposits were laid down to fill and conceal ancient channels, but the excavation and the filling up of the channel of the Tennessee—like that of the Ohio—were determined by the relative altitude of the waters of the Gulf. The channel of the Lower Tennessee must have been excavated when the southern portion of the Mississippi valley was higher above the Gulf level than now, and Prof. Hilgard has shown that at a subsequent period, probably during the Champlain epoch, the Gulf coast was depressed 500 feet below its present relative level. This depression must have made the Lower Mississippi an arm of the sea, by which the flow of the Ohio and Tennessee was arrested, their channels filled, terraces formed, &c. If the Upper Tennessee has, as appears, a channel

* When the water in the lake basin had subsided to near its present level, its old avenues of escape being all silted up by the Drift clays and sands, the surplus made its exit by the line of lowest levels wherever that chanced to run. As that happened to lie over the rocky point that projected from the northern extremity of the Alleghanies into the lake basin, there the line of drainage was established in what is now known as Niagara river.

Though among the most recent of the events recorded in our surface geology, this choice of the Niagara outlet by the lake waters was made so long ago that all the erosion of the gorge below the falls has been accomplished since. The excavation of the basin into which the Niagara flows—the basin of Lake Ontario, of which Queenstown Heights form part of the margin—belongs to an epoch long anterior.

lower than the Mussel Shoals, it must be somewhere connected with the deep channel of the lower river.

It should be said, however, that it by no means follows that where an old earth-filled channel passes around the rocky barrier by which the navigation of our rivers is impeded, it will be most convenient and economical to follow it in making a canal to pass the obstacle, as the course of the old channel may be so long and circuitous that a short rock cutting is cheaper and better. The question is, however, of sufficient importance to deserve investigation, before millions of dollars are expended in rock excavation.

If it is true that our great lakes can be connected with each other and with the ocean, both by the Hudson and Mississippi, by ship canals,—in making which no elevated summits nor rock barriers need be cut through,—the future commerce created by the great population and immense resources of the basin of the great lakes may require their construction.

3d. Upon the glacial surface we find a series of unconsolidated materials generally stratified, called the "Drift deposits."

Of these, the first and lowest are blue and red clays (the Erie clays of Sir Wm. Logan), generally regularly stratified in thin layers, and containing no fossils, but drifted coniferous wood and leaves. Over the southern and eastern part of the lake basin, these clays contain no boulders, but towards the North and West they include scattered stones, often of large size; while in places beds of boulders and gravel are found resting directly on the glacial surface.

In Ohio, the Erie clays are blue, nearly 200 feet in thickness, and reach up the hill-sides more than 200 feet above the present surface of Lake Erie. On the shores of Lake Michigan these clays are in part of a red color, showing that they have been derived from different rocks, and they there include great numbers of stones.

On the peninsula between Lake Erie and Lake Huron the Erie clays fill the old channel which formerly connected these lakes, having a thickness of over 200 feet, and containing a few scattered stones.

4th. Above the Erie clays are sands of variable thickness and less widely spread than the underlying clays. These sands contain beds of gravel, and, near the surface, teeth of elephant have been found, water-worn and rounded.

5th. Upon the stratified clays, sands, and gravel of the Drift deposits are scattered boulders and blocks of all sizes, of granite, greenstone (diorite and dolerite), silicious and mica slates, and various other metamorphic and eruptive rocks, generally traceable to some locality in the Eozoic area north of the lakes. Among these boulders many balls of native copper have been found, which could have come from nowhere else than the copper district of Lake Superior.

Most of these masses are rounded by attrition, but the large blocks of Corniferous limestone which are scattered over the southern margin of the lake basin in Ohio show little marks of wear. These masses, which are often 10 to 20 feet in diameter, have been transported from 100 to 200 miles south-eastward from their places of origin, and deposited sometimes 300 feet above the position they once occupied.

6th. Above all these Drift deposits, and more recent than any of them, are the "lake ridges,"—embankments of sand, gravel, sticks, leaves, &c., which run imperfectly parallel with the present outlines of the lake margins, where highlands lie in the rear of such margins. Of these, the lowest on the South shore of Lake Erie is a little less than 100 feet above the present lake level; the highest, some 250 feet. In New York, Canada, Michigan, and on Lake Superior, a similar series of ridges has been discovered, and they have everywhere been accepted as evidence that the waters of the lakes once reached the points which they mark. That they are nothing else than ancient lake beaches we shall hope to prove farther on.

In the southern half of the Mississippi valley the evidences of glacial action are entirely wanting, and there is nothing corresponding to the wide-spread Drift deposits of the north. We there find, however, proofs of erosion on a stupendous scale, such as the valley of East Tennessee, which has been formed by the washing out of all the broken strata between the ridges of the Alleghanies and the massive tables of the Cumberland Mountains,—the cañons of the Tennessee, 1,600 feet deep, &c. Here also, as in the lake basin, the channels of excavation pass far below the deep and quiet waters of the lower rivers; proving by their depth that they must have been cut when the fall of these rivers was much greater than now.

The history which I derive from the facts cited above is briefly this:

1st.—That in a period probably synchronous with the glacial epoch of Europe,—at least corresponding to it in the sequence of events,—the northern half of the continent of North America had a climate comparable with that of Greenland; so cold, that wherever there was a copious precipitation of moisture from oceanic evaporation, that moisture was congealed and formed glaciers which flowed by various routes toward the sea.

2nd.—That the courses of these ancient glaciers corresponded in a general way with the present channels of drainage. The direction of the glacial furrows proves that one of these ice rivers flowed from Lake Huron, along a channel now filled with drift, and known to be at least 150 feet deep, into Lake Erie, which was then not a lake, but an excavated valley into which the streams of Northern Ohio flowed, 100 feet or more below the present lake level. Following the line of the major axis of Lake Erie to near its eastern extremity, here turning north-east, this glacier passed through some channel on the Canadian side, now filled up, into Lake Ontario, and thence found its way to the sea either by the St. Lawrence or by the Mohawk and Hudson. Another glacier occupied the bed of Lake Michigan, having an outlet southward through a channel—now concealed by the heavy beds of drift which occupy the surface about the south end of the lake—

passing near Bloomington, Ill., and by some route yet unknown reaching the trough of the Mississippi, which was then much deeper than at present.

3D.—At this period the continent must have been several hundred feet higher than now, as is proved by the deeply excavated channels of the Columbia, Golden Gate, Mississippi, Hudson, &c., which could never have been cut by the streams that now occupy them, unless flowing with greater rapidity and at a lower level than they now do.

The depth of the trough of the Hudson is not known, but it is plainly a channel of erosion, now submerged and become an arm of the sea. As has been before stated, this channel is marked on the sea-bottom for a long distance from the coast and far beyond a point where the present river could exert any erosive action, and hence it is a record of a period when the Atlantic coast was several hundred feet higher than now.

The lower Mississippi bears unmistakable evidence of being —if one may be permitted the paradox—a half-drowned river; that is, its old channel is deeply submerged and silted up, so that the "father of waters," lifted above the walls that formerly restrained him, now wanders, lawless and ungovernable, whither he will in the broad valley.

The thickness of the delta deposits at New Orleans is variously reported from 1500 feet upwards, the discrepancies being due to the difficulty of distinguishing the alluvial clays from those of the underlying Cretaceous and Tertiary formations. It is certain, however, that the bottom of the ancient channel of the Mississippi has never been reached between New Orleans and Cairo; the instances cited by Humphreys and Abbot in their splendid study of this river being but repetitions of the phenomena exhibited at the falls of the Ohio—the river running over *one side* of its ancient bed.

The trough of the Mississippi is not due to synclinal structure in the underlying rocks, but is a valley of erosion simply. Ever since the elevation of the Alleghanies—*i.e.*, the close of the Carboniferous period—it has been traversed by a river which drained the area from which flow the upper Mississippi, the Ohio, the Tennessee, &c. Since the Miocene period, the Missouri, Arkansas, and Red rivers have made their contributions to the flood that flowed through it. The depth to which this channel is cut in the rock proves that at times the river must have flowed at a lower level and with a more rapid current than now; while the Tertiary beds formed as high as Iowa and Indiana in this trough, and the more modern Drift clays and boulders which partially fill the old rock cuttings, show that the mouth and delta of the river have, in the alternations of continental elevation, travelled up and down the trough at least a thousand miles; and that not only is it true, as asserted by Ellet, that every mile between Cairo and New Orleans once held the river's mouth, but that in the several advances and recessions of the waters of the Gulf the mouth has been more than twice at each point. The change of place of the delta has been caused, however, for the most part, by oscillations of the sea level, and not, as Ellet supposed, by the filling of the channel by the materials transported by the river itself.

Drift Deposits.

The Drift deposits which cover the glacial surface, consisting of fine clays below, sands and gravel above, large transported boulders on the surface, and the series of lake ridges (beaches) over all, form a sequence of phenomena of which the history is easily read.

Erie Clays.

The lower series of blue or red clays—the "Erie clays" of Sir William Logan—over a very large area, rest directly on the planed and polished rock-surfaces. These clays are often accurately stratified, were apparently deposited in deep and generally quiet water, and mark a period when the glacial ice-masses, melted by a change of climate, retreated northward, leaving large bodies of cold fresh water * about their southern margins, in which the mud produced by their grinding action on the paleozoic rocks of the Lake District was first suspended and then deposited.

On the shores of Lake Erie these clays contain no boulders, and very few pebbles, while farther North and West boulders are more abundant. This is precisely what might be expected from the known action of glacial masses on the surfaces over which they pass. Their legitimate work is to grind to powder the rock on which they rest; an effect largely due to the sand which gathers under them, acting as emery on a lead wheel. The water flowing from beneath glaciers is always milky and turbid from this cause. Rocks and boulders are sometimes frozen into glaciers, and thus transported by them, but nearly all the boulders carried along by a glacier are such as have fallen from above; and a moraine can hardly be formed by a glacier except when there are cliffs and pinnacles along its course.

In a nearly level country, composed of sedimentary rocks passed over by a glacier, we should have very little débris produced by it, except the mud flour which it grinds.

The Erie clays would necessarily receive any gravel or stones which had been frozen into the ice, either as scattered pebbles or stones, distributed to some distance from the glacial mass by floating fragments of ice, or as masses of frozen gravel, or larger and more numerous boulders near the glacier. In some localities torrents would pour from the sides and from beneath the glacier, so that here coarse material would alone resist the rapid motion of the water, and the stratification of the sediments would be more or less confused.

In regard to the *cause* of the gradual amelioration of the climate of the glacial epoch, by which the great glaciers of the

* *Cold*, because coming from the melting glacier, and depositing with its sediments no evidences of life; *fresh*, because no marine shells are found in it—only drift-wood—while the equivalent "Champlain" clays on the coast are full of marine Arctic shells.

lake basin were driven northward and finally altogether dissolved, we are not left entirely to conjecture.

Cosmical causes possibly and probably had the chief agency in producing this result, but we have unmistakable evidence of at least the co-operation of another and perhaps no less potent cause, viz., continental depression.

If a cosmical cause had simply increased the annual temperature till the glaciers were all melted, without the action of any other agent, we should never have had the accumulation of drift deposits which now occupy all the glacial area; but the drainage streams, changed in all their courses from ice to water, would have flowed freely and rapidly away through their deeply cut channels to deposit their abundant sediments only where their transporting power was arrested, in the depths of the ocean.

Instead of this, we everywhere find evidence that this flow was checked, and a basin of quiet water formed by an advance of the ocean consequent upon a subsidence of the land. On the Atlantic and Gulf coasts this depression progressed until the sea-level was more than 500 feet higher than now. The effect of this depression was to deeply submerge the eastern margin of the continent, and cover it with the "Champlain" clays.

It is evident that at this period the drainage from the great water-shed of the continent must have been met by the quiet waters of the ocean almost at the sources of the present draining streams, and as the "dead water" gradually crept up the valleys, arresting the transporting power of their currents, their old channels would be silted up and obliterated, and their valleys partially filled with materials for their subsequent terraces. In the advance and subsequent recession of the line of "dead water" we have ample cause for all our terrace phenomena.

This continental depression accounts satisfactorily for the filling of the old channels of the Mississippi and the Ohio, as a depression of 500 feet would bring the ocean nearly to Pittsburgh on the Ohio, to St. Paul on the Mississippi.

But I think we have evidence that the continent did not sink uniformly in all its parts, but *most at the North*. Not to cite any other proof of this,—northern coast fiords, &c.—the altitude of the loess-like deposits of the upper Mississippi and Missouri (the lacustrine non-glacial sediments of this period of submergence), the upward reach of the Drift clays of the lake basin, the filling of the valleys of the streams flowing into the Ohio and Lake Erie, the old lake beaches marking the former water-level in the lake basin—all indicate that the continental subsidence was greatest towards the north. To this subsidence we must, as I think, attribute the accumulation of water in the lake basin and Mississippi valley to form the great inland sea of fresh water, of which traces everywhere abound. It seems to me scarcely necessary to suppose any other barriers by which this sea was enclosed than the highlands that encircle it—such as are roughly outlined by the light tint on Prof. Guyot's map of North America—and the sea-water which filled the mouths of the two* straits by which it communicated with the ocean.

Yellow Sands and Surface Boulders.

I have mentioned that on the Erie clays are beds of gravel, sand, and clay, and over these again great numbers of transported boulders, often of large size and of northern and remote origin.

These surface deposits have been frequently referred to as the direct and normal product of glacial action, the materials torn up and scraped off by the great ice ploughs in their long journeys from the North; in fact, as some sort of huge termi-

* If there *were* two. That there was one in the course of the Mississippi we know, and that so long that, though salt at one end, it must have been fresh at the other. The eastern outlet of the lake waters may not have been by the St. Lawrence, but as likely through the gap between the Adirondacks and the Alleghanies. The shallow channels between the Thousand Islands and the Lachine Rapids seem to indicate that the St. Lawrence is a comparatively *new* line of drainage for the lakes.

nal and lateral moraines. I have, however, disproved, as I think, this theory of their transportation in a paper published some years since (Notes on the Surface Geology of the Basin of the Great Lakes. Proc. Bost. Nat. Hist. Soc. 1863), in which it is urged that the continuous sheet of the Erie clays upon which they rest, and which forms an unbroken belt between them and their place of origin, precludes the idea that they have been transported by any ice-current or rush of water moving over the glacial surface; as either of these must have torn up and scattered the soft clays below.

There is, indeed, no other conclusion deducible from the facts than that these sands, gravels, granite and greenstone boulders—masses of native copper, &c., which compose the superficial Drift deposits—have been *floated* to their resting-places, and that the floating agent has been ice, in the form of *icebergs*; in short, that these materials have been transported and scattered over the bottom and along the south shore of our ancient inland sea, just as similar materials are now being scattered over the banks and shores of Newfoundland.

If we restore in imagination this inland sea, which we have proved once filled the basin of the lakes, gradually displacing the retreating glaciers, we are inevitably led to a time in the history of this region when the southern shore of this sea was formed by the highlands of Ohio, &c., the northern shore a wall of ice resting on the hills of crystalline and trappean rocks about Lake Superior and Lake Huron.

From this ice-wall masses must from time to time have been detached,—just as they are now detached from the Humboldt Glacier,—and floated off southward with the current, bearing in their grasp sand, gravel, and boulders—whatever composed the beach from which they sailed. Five hundred miles south they grounded upon the southern shore; the highlands of now Western New York, Pennsylvania, and Ohio, or the shallows of the prairie region of Indiana, Illinois, and Iowa; there melting away and depositing their entire loads,—as I have sometimes seen them, a thousand or more boulders on a few acres, resting on the Erie clays and looking in the distance like flocks of sheep,—or dropping here and there a stone and floating on east or west till wholly dissipated.

These boulders include representatives of nearly all the rocks of the Lake Superior country, conspicuous among which are granites with rose-colored orthoclase, gray gneiss, and diorites, all characteristic of the Laurentian series; hornblendic rocks, massive or schistose, and dark greenish or bluish silicious slates, probably from the Huronian; dolorites and masses of native copper, apparently from the Keweenaw Point copper region.

In the Drift gravels I have found pebbles and small boulders of nearly all the paleozoic rocks of the lake basin, containing their characteristic fossils, viz.: The Calciferous Sand-rock with *Maclurea*, Trenton and Hudson with *Ambonychia radiata*, *Cyrtolites ornatus*, Medina with *Pleurotomaria litorea*, Corniferous with *Conocardium trigonale*, *Atrypa reticularis*, *Favosites polymorpha*, Hamilton with *Spirifer mucronatus*, &c.

The granite boulders are often of large size, sometimes six feet and more in diameter, and generally rounded.

The largest transported blocks I have seen are the more or less angular masses of corniferous limestone mentioned on a preceding page.

Along the southern margin of the Drift area, especially on the slopes of the highlands of Northern Ohio, the Drift sands and gravels are of considerable thickness, forming hills of 100 feet or more in height, generally stratified, but often without any visible arrangement. These deposits are very unevenly distributed, with a rolling surface frequently forming local basins, which hold the little lakelets or sphagnous marshes so characteristic of the region referred to. These are the beds to which I have alluded as constituting, in the opinion of some geologists, a great glacial moraine, but from the fact that they are locally stratified, and overlie the older blue clays, I have regarded them as transported not by glaciers, but by icebergs.

Possibly some part of this Drift material may have accumulated along the margin of the great glacier, moved by its agency; but in that case we should expect to find in it abundant fragments of the rocks which outcrop in the region under consideration, whereas I have rarely, if ever, seen in these Drift gravels any representatives of the rocks underlying the south margin of the lake basin.

By whatever agency transported, the Drift gravels have, like the boulders, for the most part come from some remote point at the North, and were once spread broadcast along the southern shore of the inland iceberg-bearing sea.

In the retreat of the shore line during the contraction of the water surface down to its present area, every part of the slope of the southern shore between the present water surface and the highest lake level of former times, *i. e.*, all within a vertical height of 300 feet or more, must in turn have been submitted to the action of the shore waves, rain, and rivers, by which if, as is probable, the retrograde movement of the water line was slow, these loose materials would be rolled, ground, sorted, sifted, and shifted, so that comparatively little would be left in its original bedding; the fine materials, clay and sand, would be washed out and carried further and still further into the lake basin, and spread over the bottom, to form, in short, the upper sandy layers of the Drift.

At certain points in its descent the water level seems to have been for a time stationary, and such points are marked by terraces and the long lines of ancient beaches which have been referred to. A similar "lake ridge" now borders the south shore of Lake Michigan, where it may be observed in the process of formation; and this seems to be the legitimate effect of waves everywhere on a sloping shore composed of loose material; storms driving up sand and gravel to form a ridge which ultimately acts as a barrier to the waves that built it. Winds, also, often assist in building up, and sometimes alone form these ridges, by transporting inland the beach sand.

In other localities, where hard rock masses formed the shore of our inland sea, perpendicular wave-worn cliffs were produced; and many of these now stand as enduring and indisputable monuments of a sea whose waves, perhaps, for ages beat against them. Such cliffs may be observed on Little Mountain, in Lake county, in the valley of the Cuyahoga, in Medina and Lorain county, Ohio, along the outcrops of the Carboniferous conglomerate and Waverley sandstone.

In all the changes through which the valley of the Mississippi passed during the "Drift Period," its general structure and main topographical features remained the same. Yet the character of its surface suffered very important modifications, and such as deeply affected its fitness for human occupation.

As we have seen, the glacial epoch was marked by erosion on a grand scale.

Then, our river valleys and some of our lakes—though mapped out long before—were excavated to a much greater depth than they now have.

During their subsequent submergence, these valleys and lakes were partially or perfectly filled with the drift deposits which covered all the surface like a deep fall of snow, rounded its outlines and softened all its asperities.

When the waters were withdrawn, the rivers again began clearing their obstructed channels; a work not yet accomplished, and in many instances not half done. Numbers of the old channels were wholly filled and obliterated, and the streams that once traversed them were compelled to find quarters elsewhere. Examples of this kind have been already cited, and they could be multiplied indefinitely.

ORIGIN OF THE GREAT LAKES.

The question of the origin of our lakes is one that requires more observation and study than have yet been given to it before we can be said to have solved all the problems it involves. There are, however, certain facts connected with the structure of the lake basins, and some deductions from these facts, which may be regarded as steps already taken toward the full understanding of the subject. These facts and deductions are briefly as follows:—

1st. Lake Superior lies in a synclinal trough, and its mode of formation therefore hardly admits of question, though its sides are deeply scored with ice-marks, and its form and area may have been somewhat modified by this agent.

2d. Lake Huron, Lake Michigan, Lake Erie, and Lake Ontario are excavated basins, wrought out of once continuous sheets of sedimentary strata by a mechanical agent, and that ice or water, or both.

That they have been filled with ice, and that this ice formed great moving glaciers, we may consider proved. The west end of Lake Erie may be said to be carved out of the Corniferous limestone by ice action; as its bottom and sides and islands—horizontal, vertical, and even overhanging surfaces—are all furrowed by glacial grooves, which are parallel with the major axis of the lake.

All our great lakes are probably very ancient, as since the close of the Devonian period the area they occupy has never been submerged beneath the ocean, and their formation may have begun during the Coal Measure epoch.

The Laurentian belt, which stretches from Labrador to the Lake of the Woods, and thence northward to the Arctic Sea, forms the oldest known portion of the earth's surface. The shores of this ancient continent, then high and mountainous, were washed by the Silurian sea, where the débris of the land was deposited in strata that subsequently rose to the surface, and formed a broad low margin to the central mountain belt, just as the Cretaceous and Tertiary strata flank the Alleghanies in the Southern States.

In the lapse of countless ages, all the mountain peaks and chains of the Laurentian continent have been removed and carried into the sea, and this has been done by rivers of water and rivers of ice. That these mountains once existed there can be no reasonable doubt, for their truncated bases remain as witnesses, and it is scarcely less certain that glaciers have flowed down their slopes of sufficient magnitude and reach to deeply score the plain which encircled them.

It will be noticed that all the great lakes of the continent hold certain relations to the curving belt of Laurentian highlands.

Some of them are embraced in the foldings of the Eozoic rocks, and fill synclinal troughs; but most of the series, from Great Bear Lake to Lake Ontario, exhibit the same geological and physical structure, are basins of excavation in the paleozoic plain that flanks in a parallel belt the Laurentian area. Few of us have any conception of the enormous general and local erosion which that plain has suffered. Those who will take the trouble to examine the section across Lake Ontario, from the Alleghanies to the Laurentian hills of Canada, and compare it with the other sections in the Lake Winnepeg district, radial to the Laurentian arch, given by Mr. Hind in his report on the Assiniboin country, will be sure to find the comparison interesting and suggestive; suggestive especially of a community of structure and history, and of an inseparable connection between the lake phenomena and the topographical features of the Laurentian highlands, flanked by the paleozoic plain.

In estimating the influences that might have affected the number and magnitude of glaciers on the sides of the Laurentian mountains, it should not be forgotten that the Cretaceous sea swept the western shore of the Paleozoic and Laurentian continent, from the Gulf of Mexico to the Arctic Ocean; and whether we consider this sea as a broad expanse of water simply dotted with islands, or a strait traversed by a tropical current, we have in either case conditions peculiarly favorable to the formation of great glacial masses of ice, *i. e.*, a broad evaporating surface of warm water swept by westerly winds that carried all suspended moisture immediately on to a mountain belt, which served as a sufficient condenser.

This, at least, may be positively asserted in regard to the agency of ice in the excavation of the lake basins, that their bottoms and sides, wherever exposed to observation, if composed of resistant materials, bear indisputable evidence of ice action, proving that these basins were filled by moving glaciers in the last ice period if never before, and that part, at least, of the erosion by which they were formed is due to these glaciers.

No other agent than glacial ice, as it seems to me, is capable of excavating broad, deep, boat-shaped basins, like those which hold our lakes.

If the elevation of temperature and retreat northward of the glaciers of the lake basins were not uniform and continuous, but alternated with periods of repose, we should find these periods marked by excavated basins, each of which would serve to measure the reach of the glacier at the time of its formation, the lowest basin being the oldest, the others formed in succession afterwards. Such a cause would be sufficient to account for any local expansions of the troughs of the old ice rivers.

Where glaciers flow down from highlands on to a plain or into the sea, the excavating action of the ice mass must terminate somewhat abruptly in the formation of a basin-like cavity, beyond which would be a rim of rock, with whatever of débris the glacier has brought down to form a terminal moraine.

When glaciers reach the sea, the great weight of the ice mass must plough up the sea bottom out to the point where the greater gravity of water lifts the ice from its bed, and bears it away as an iceberg.

If it is true, as the facts I have cited indicate, that our lakes are but portions of great excavated channels locally filled with drift material, the fiords of the northern Atlantic and Pacific coast present remarkable parallels to them; and I would suggest Puget's Sound, Hood's Canal, and other portions of that wonderful system of navigable channels about Vancouver's Island, as affording interesting and instructive subjects for comparison. Like our lakes, their channels are for the most part excavated from sedimentary strata which form a low and comparatively level margin to the bases of mountain chains and peaks. They too have their depths and shallows, their basins and bars, and probably all who have seen them will assent to Prof. Dana's view, that they are the "result of subaërial excavation," in which glaciers performed an important part.

THE "LOESS" OF THE MISSISSIPPI VALLEY.

The "Bluff formation" of the West, sometimes called "Loess," from its resemblance to the Loess of the Rhine, I have on a preceding page designated as a lacustrine, non-glacial Drift deposit. It seems to be the sediment precipitated from the waters of our great inland sea in its shallow and more quiet portions, to which icebergs, with their gravel and boulders, had no access, and where the glacial mud was represented only by an impalpable powder, which mingled with the wash of the adjacent land, land shells, &c.

It is evidently one of the most recent of the deposits which come into the series of Drift phenomena, and was apparently thrown down while the broad water surface which once stretched over the region where it is found was narrowing by drainage and evaporation, till, by its total disappearance, this sheet of calcareous mud was left.

It underlies much of the prairie region, and once filled, often to the brim, the troughs of the Mississippi and Missouri, so deeply excavated during the glacial epoch. When the system of drainage was re-established the new rivers began the excavation of their ancient valleys in the Loess. When they had cut into or through this stratum, so that it stood up in escarpments on either side, man came and called it the *Bluff* formation, because it composed or capped the bold bluffs of the river-banks. It is often, however, only a facing to the rocky cliffs, which are the true walls of these valleys, and which are monuments of an age long anterior to the date of its deposition.

XI.—*Catalogue of Birds from Puna Island, Gulf of Guayaquil, in the Museum of the Smithsonian Institution, collected by J. F. Reeve, Esq.*

By Geo. N. Lawrence.

Read May 10th, 1869.

Fam. Turdidae.

1. Turdus reevei. sp. nov.

The upper plumage and wing coverts are of a dark bluish plumbeous, with numerous darker narrow wavy lines, like water-marks, on the feathers of the upper parts except the head; the front and sides of the head are tinged with brownish; the central tail feathers and outer webs of the others are of a rather duller plumbeous than the back, the outer feather having only an edging of that color, all the inner webs are brownish-black; primaries brownish-black, with plumbeous outer margins, the other quills have their exposed portions the color of the back, the concealed parts brownish-black; throat and under tail coverts pale whitish-fulvous, the former streaked with blackish on the upper part; lower part of neck and upper part of breast light grayish fulvous; all the remaining under plumage and under wing coverts of a brownish-fulvous, paler on the middle and lower parts of the abdomen; bill yellow, clouded with brownish at the base; tarsi and toes pale yellowish.

Third quill feather the longest, the first and sixth equal.

Length (skin) 9½ inches; wing 4¾; tail 4; bill ¾; tarsi 1¼.

Type in Mus. Smithsonian Institution, No. 54,102.

Remarks. This does not require comparison with any other species; it comes under the section *Planesticus;* the sex of the specimen is not given.

I have conferred upon this species the name of J. F. Reeve, Esq., of Guayaquil, who (as I am informed by Prof. Jas. Orton) is a gentleman of great energy of character and courage, which latter quality is of importance in any explorations on Puna Island, where collections are made at great personal risk, from the ferocious nature of the wild animals with which it abounds.

Fam. TROGLODYTIDAE.

2. Thryothorus superciliaris. sp. nov.

Feathers of the fore part of the head blackish, margined with dull rufous, the entire upper plumage besides is of a light brownish rufous, brighter on the rump; tail of a rather light rufous, crossed with eight distinct bars of black; quills liver brown, the exposed portions barred with light rufous, except at their ends; the smaller quills entirely banded with light rufous and dark brown; a broad stripe running from the bill over the eye, sides of the head, the chin and throat pure white; there is a short postocular stripe of blackish brown, which does not extend to the eye, or prevent the superciliary stripe from connecting with the white of the side of the neck; on the breast is a mere suffusion of dilute rufous, which color gradually becomes darker on the abdomen and under tail coverts, but still is rather pale; under wing coverts white, tinged like the breast; upper mandible black, the under whitish with the end dusky; tarsi and toes dark hazel brown.

Length (skin) 6 inches; wing $2\frac{3}{4}$; tail 2; bill $\frac{7}{8}$; tarsi 1.

Type in Mus. Smithsonian Institution, No. 54,100. There are three specimens in the collection.

Remarks. This species most resembles *T. modestus*, but is larger and has a longer bill; the most marked difference in plumage is the broader superciliary stripe and the purer white of the sides of the head and throat; in *T. modestus* the head and hind neck are browner, the tail duller in color, with the dark bars less strongly defined, the white of the throat has a fulvous tinge, the lores are dusky, and the dark postocular stripe extends from the eye to the dark color of the hind neck.

Fam. SYLVICOLIDAE.

3. *Parula pitiayumi*, (*Vieill.*)

Fam. TANAGRIDAE.

4. *Tanagra cana*, *Sw.*

Fam. FORMICARIDAE.

5. *Thamnophilus albinuchalis*, *Scl.*

Fam. TYRANNIDAE.

6. *Eupsilostoma pusillum*, *Scl.*

There are two specimens which agree quite well with Mr. Sclater's description (P. Z. S. 1860, p. 68) except in the length given, viz.: 2.5 inches, which is without doubt a typographical error; the wing is also longer than as stated by him.

The dimensions are, length 4¼ inches; wing 2; tail 1⅝.

The bill is larger than that of *E. obsoletum*, but the wings and tail are shorter.

7. *Pyrocephalus nanus*, *Gould.*

Several specimens: they are of the same size as examples of *P. rubineus* from Bogota, and the apparent differences from that species are as follows:—upper plumage of a darker brown, more of a smoky cast; the quills and tail blacker, the red crest not extending so far behind, and the bill longer and narrower.

8. **Empidonax griseipectus.** sp. nov.

Plumage above of a dull greenish olive, brownish on the head; a grayish white line extends from the bill over the eye; tail light brown, the outer web of the lateral feather grayish-white; quills dark brown, the larger ones narrowly margined with dull pale brown, and the others with white; smaller wing coverts colored like the back, the middle and larger coverts dark brown ending with white, forming two distinct white bars across the wing; under wing coverts pale yellow, inner margins of quills light buff; throat grayish white, upper part and sides of the breast dark ashy gray; abdomen and under tail coverts clear pale yellow; upper mandible black, the under yellowish white; tarsi and toes blackish brown.

Length (skin) $5\frac{3}{8}$ inches; wing $2\frac{3}{8}$; tail $2\frac{3}{8}$; bill $\frac{7}{16}$; tarsi $\frac{9}{16}$.

Type in the Smithsonian Institution, No. 50,709.

9. **Contopus punensis.** sp. nov.

Front and top of head olivaceous brown; hind neck and back greenish olive; rump pale ochreous; upper tail coverts the color of the back tipped with pale ochreous; tail feathers hair brown with margins the color of the back, except the lateral feather, which has the entire outer web pale ochreous white; wing coverts and quills blackish brown, the coverts and the smaller quills bordered with pale ochreous white; under covering of wings light buff; lores gray, chin and throat grayish white, breast and abdomen pale yellow, duller on the former and clearer on the latter; under tail coverts pale yellowish white; sides dusky; upper mandible dark brown, the under yellow, with the edges orange; tarsi and toes black.

Third quill longest, first shorter than sixth; bill large and broad, comparatively.

Length (skin) $5\frac{3}{4}$ inches; wing $2\frac{5}{8}$; tail $2\frac{3}{8}$; bill $\frac{1}{2}$; tarsi $\frac{1}{2}$.

Type in Mus. Smithsonian Institution, No. 54,105.

Remarks. This differs from other members of the genus, in the breast being free from the clouded coloring which exists on that part, to a greater or less extent, in all of them.

The colors of the under plumage of this species are more like those of *Empidonax*, but its very large bill and short tarsi show its affinity to *Contopus;* the bill exceeds in size that of *C. richardsoni.*

10. *Myiarchus phæocephalus, Scl.*

11. *Tyrannus melancholicus, Vieill.*

Fam. TROCHILIDAE.

12. *Lesbia amaryllis* (*Bourc. et Muls.*).

13. *Metallura quitensis, Gould.*

14. *Petasophora anais* (*Less.*).

15. *Amazilia dumerili* (*Less.*).

Fam. Cuculidae.

16. *Crotophaga sulcirostris, Sw.*

Fam. Picidae.

17. *Chloronerpes callonotus* (*Waterh.*).

Fam. Falconidae.

18. *Urubitinga anthracina* (*Nitzsch.*).

19. " *unicincta* (*Temm.*).

Fam. Charadriidae.

20. *Aegialitis semipalmatus* (*Bonap.*).

Fam. Rallidae.

21. *Parra intermedia, Bonap.*

One specimen in immature plumage, with the back and wing coverts brownish olive, the sides, under wing coverts and shoulders, deep chestnut.

In a collection from Venezuela, made by W. B. Gilbert, Esq., sent me for examination by Prof. Henry, are three adult specimens. It is I think distinct from *P. jacana* from Brazil (which has been questioned by some writers), being smaller in all its dimensions; the chestnut coloring is much darker, more of a brownish maroon color, and the black coloring has a greenish lustre, which in *P. jacana* is of a deep purple cast.

XII.—*Additional Notes on the Geographical Distribution of Land Shells in the West Indies.*

By THOMAS BLAND.

Read May 10, 1869.

In various papers (Annals VII., 1861, with Catalogue of Species and Amer. Jour. of Conch, II., 1866, and IV., 1868) I have discussed the subject of the Geographical Distribution of the West Indian terrestrial Mollusca, and shown that the Islands, considering the facts of such distribution, may be divided into five sub-provinces, the whole group, in a general sense, being treated as one zoological province. For the sake of brevity, I may refer to the sub-provinces as those of Cuba, Jamaica, Haiti, Porto Rico, and Guadeloupe; with respect to several of which I now offer some additional information.

Cuba.—This sub-province includes the Isle of Pines, the Bahamas, Turk's Island and Bermudas. An amazing number of species have been discovered in Cuba since 1861, and also in the Bahamas. From the latter, including Turk's Island, 22 species only were enumerated in my Catalogue (1861), while between 70 and 80 are now known. The Bahamas species will be the subject of a separate paper, but I may mention that the islands on the Little and Great Bahama Banks are closely connected by their land shell faunas with Cuba, but those to windward of the latter Bank, Inagua especially, have evident relations with Haiti, to which geographically they are nearer.

Haiti.—The Island of Navassa, situate 33 miles S.W. from Haiti and 72 E. from Jamaica, belongs to this sub-province. We are indebted to Mr. Eugene Gaussoin for three species described by Tryon (Amer. Jour. Conch. II., 1866) viz.:—*Helix Gaussoini*, *Chrondropoma Navassense*, and *Helicina circumlineata*.

Porto Rico.—In this section Viéque and small islands adjacent are included, and also the Virgin Islands, with Anguilla, St. Martin, and St. Bartholomew. I am now enabled to enlarge and correct the lists of species from several of the islands. The Anegada and St. Bartholomew lists are from facts communicated by Mr. R. Swift, on the authority of Dr. P. T. Cleve of the University of Upsala, Sweden, who lately visited those islands.

Anegada.

Succinea. sp. indet.

Helix euclasta Shuttl.: also in Cuba.

—— notabilis Shuttl.: not found by Dr. Cleve.

Bulimus elongatus Bolt.

—— tenuissimus Fer. : also in Trinidad.

Pupa striatella Fer. : very abundant.

Macroceramus microdon Pfr.

—— signatus Guild. : var. in Haiti.

Chrondropoma Tortolense Pfr.

ANGUILLA.

Bulimus Anguillensis Pfr.

—— elongatus Bolt.

—— Lehmanni Pfr.

Pineria Schrammi Fisch. : also in Guadeloupe.

Macroceramus signatus Guild.

Cylindrella costata Guild. : also in Barbados.

Tudora pupæformis Sowb. : referred by Pfeiffer, I think erroneously, to Haiti.

Cistula lugubris Pfr. : attributed to Jamaica, from which it is not known, by Pfeiffer, who mentions the Anguilla shell, with doubt, as a variety.

ST. BARTHOLOMEW.

Succinea. sp. indet.

Helix subaquila Shuttl.

—— notabilis Shuttl. : not found by Dr. Cleve.

Bulimus elongatus Bolt.

—— exilis Gmel.

—— fraterculus Fer.

—— marginatus Say.

Stenogyra octona Chem.

Pineria Schrammi Fisch.

Choanopoma sulculosum Fer. : also sub-fossil.

The following, not in my Catalogue, belong to the different Islands named.

Helix castrensis Pfr. Porto Rico. (var.? of *H. lima.*)

Chrondropoma terebra Pfr. "

Macroceramus microdon Pfr. Viéque, Lillienskjold !
Helix marginella Gmel. Culabre, "
Bulimus elongatus Bolt. " " unusually fine specimens; color of interior of aperture and columella very dark.
Choanopoma senticosum ? Shuttl. " "
Oleacina subtilis Shuttl. in litt., St. Thomas; allied to *O. sulculosa* Pfr. of Porto Rico.
Bulimus marginatus Say, St. Croix.
Pupa pellucida Pfr., " also Cuba and Jamaica.
Bulimus elongatus Bolt. Tortola.
Megalomastoma Antillarum Sowb. "
Chrondopoma Julieni Pfr. Sombrero.

It may be remarked that the land shell fauna of the Porto Rico sub-province is distinct and its limits well defined, so much so, indeed, as to warrant the inference, that the islands comprised in it were, at a former period, more closely connected, if not united.

In connection with the Geology of Anguilla, the remarks of Professor Cope (Proc. Acad. Nat. Sci. Phila. 1868, p. 313), on the bones and teeth of a large Rodent from the cave deposits of that island, are very interesting. He thinks, "That its discovery on so small an island, with others of like character, indicated that the Caribbean continent had not been submerged prior to the close of the Post-pleiocene, and that its connection was with the other Antilles, while a wide strait separated it from the then comparatively remote shores of North America."

Mr. Julien (Annals VIII., 251, 1866) mentions the occurrence at Sombrero of the fossil remains of land-turtles, which were referred by Prof. Jeffries Wyman to three new extinct and gigantic species similar to those of the Gallapagos Islands. (See Cope in Proc. Acad. N. S. Phila., 1868, p. 180.)

XIII.—*Note on Lovén's Article on "Leskia mirabilis,* GRAY."

BY ALEXANDER AGASSIZ.

Read June 7th, 1869.

LOVEN has recently, in an article on *Leskia mirabilis*, GRAY, in the Proceedings of the Swedish Academy, taken the opportunity to suggest some views on the homologies of certain openings in Cystideans, tending to corroborate the explanation given by Billings, in the Decades of the Canada Geological Survey, of the functions of these apertures. Lütken has in the Geologist given the main points of Lovén's arguments, and at the same time, to a certain extent, criticized the explanations there given; his article has been reprinted in the Canadian Naturalist for December, 1868, to which Billings has added some notes and objections to the criticisms of Lütken.

I do not intend to pass in review the many theories which have been advanced at various times concerning the probable nature of the ovarian openings, and the openings called mouth or anus, or mouth-anus, by various paleontologists, but simply to point out a few features in the anatomy of recent Echinoderms which seem to have escaped paleontologists when discussing these questions.

In the first place there is nothing contrary to the homology of living Echinoderms in the fact that one and the same opening should perform at the same time the functions of mouth and anus. But the opening which performs this double function is always the mouth; it is the opening which in the embryo Echinoderms is the first formed; when there exists an anus in addition to the mouth, the anal opening is always formed later, and then the mouth performs only its proper functions. As to genital openings covered by plates, we find nowhere in recent Echinoderms any openings so constructed; the only structure to which we might homologize such genital openings is the genital slit of

Ophiurans, which is however usually but a single slit, never closed by a system of regularly arranged plates, as is the case with the opening to which the name of genital opening has frequently been given among Crinoids. In all other Echinoderms, the genital openings are mere pores in special plates; and in the Starfishes, for instance, it would puzzle any one to point out the position of the genital openings, or of the anus, even in a specimen prepared to show simply the calcareous parts, such parts as would be preserved in a fossil. We find in almost all sea-urchins a system of plates arranged, more or less regularly, upon the buccal membrane, but they are usually numerous and small, except in *Leskia*, where they are limited to five; so that it is the exception among living Echinoids to find the mouth protected by a system consisting of a small number of plates. If we examine the anal opening we find, on the contrary, as Dr. Lütken justly remarks, a number of genera in which the anal opening is covered by a small number of plates. This is the case in *Leskia* itself, in *Arbacia*, in *Echinocidaris*, in *Parasalenia*, in several species of *Echinometra*, and it is a feature which is common to all the young Echini which I have as yet had the opportunity of examining. In young *Toxopneustes*, *Lytechinus*, *Toreumatica*, *Temnotrema*, *Sphaerechinus*, *Opechinus*, we find the anal system covered at first in the early stages by a single plate, as in Salenia, afterwards by three, and then for a considerable period of their growth by five plates, one of which is slightly larger than the others, but presenting in all essential features the same arrangement as the plates covering what I would still consider, in the face of the arguments of Billings, reaffirmed by Lovén, the anal opening in *Cystideans*. If we were to take a fossil Comatula, of the type of our common *Antedon* and *Actinometra*, what proof would we have that in one case the ambulacra radiate pentagonally from a centre to each of the arms, the anal proboscis being eccentric, while in the other case the ambulacra form an open horseshoe-shaped curve, from which the five branches are sent into the arms, the anal proboscis being situated in the open space between the two extremities of the horseshoe-shaped ambulacral furrows, in the centre of the disc. In one case the mouth (a very minute opening in both instances) being central, while in the other the mouth is eccentric at the point of confluence of the ambulacral furrows, but in the middle of the horseshoe-shaped curve the anus being central.

It seems to me that Lovén's figures of the ambulacral furrows of *Sphæronites* show that, as far as we can trace the furrows, they formed, as in *Actinometra*, an open horseshoe-shaped curve, and that the mouth must have been placed in the middle of this curve, at a point corresponding with its position in *Actinometra*, opposite the base of the arm placed near the middle of this curve. That is, I suppose, that in this genus, as in *Comatula*, and as in all recent Crinoids known, there was a leathery actinal membrane extending along the arms, covering the central part of the disc, and in this were the ambulacral tubes, the soft parts forming a portion of the anal proboscis, and the minute mouth itself having a structure similar to that of our recent *Antedon* and *Actinometra*, while the opening covered by plates is nothing but the anal opening, we find in these Crinoids an embryonic feature of all young *Comatula* retained by the presence of one or more anal plates. This would give us an explanation of the structure of *Sphæronites* and of other Cystideans perfectly in accordance with the anatomical features of living Crinoids, and Prof. Lovén's figures of the curved horseshoe-shaped ambulacral furrows seem to me the strongest possible proof of the complete accordance with recent Crinoids of this apparently aberrant type.

It is certainly somewhere along the ambulacral furrows that we must look for the mouth, but we could hardly expect to find any trace of it, if, as I cannot help conjecturing from what we have in all our recent Crinoids, there was a leathery membrane which would form the mouth, covering these furrows, it has of course left no trace of its existence, any more than any of our recent Crinoids would show the presence of either a mouth or anus, if the calyx and arms alone were found fossil. This seems so natural an explanation, so entirely in accordance with all we know of the anatomy of Echinoderms, that the mouth should be somewhere along the ambulacral furrows, at their junction, where the annular ambulacral tube is placed, but that junction need not necessarily be a central point of the disc, that I give it for what it may be worth, loath as I am to assume the correctness of a theory which would place the mouth outside of all connection with the ambulacral furrows, a supposition totally unsupported by all homological inferences to be drawn from living Echinoderms. Nor can we suppose that this connection between the mouth and the ambulacra can have been separated in Crinoids, because we find one opening performing sometimes the functions of both mouth and anus. In the recent Echinoderms in which this is the case, we find that the opening performing this double function is invariably the mouth, which is placed at the point of confluence of the ambulacra.

The whole history of the embryological development of Crinoids, which is sufficiently well known for our purposes, shows us that such a separation between the mouth and ambulacra never exists in any of the earlier stages, and any theory which attempts to explain the homology of Crinoids on the assumption of the separation of the ambulacral system from the mouth, must explain away all we know of the anatomy of Echinoderms, and all we know of their development; it is contrary to everything we find in the living types, which after all must be our guides, and a theory against which such a sweeping assertion can be substantiated must be based upon an incorrect interpretation of the facts observed in their old fossil representatives, which certainly have not been built upon a type differing from that of their representatives of the present day.

XIV.—*Observations on a Collection of Chalchihuitls from Central America.*

BY E. G. SQUIER.

Read April 5th, 1869.

AMONG the articles of ornament used by the aboriginal inhabitants of Mexico and Central America, those worked from some variety of green stone resembling emerald, and called by the Nahuatl or Mexican name *chalchiuitl*, *chalchihuitl*, or *chalchiuite*,* were most highly esteemed, and are oftenest mentioned by the early explorers and chroniclers. The word *chalchiuitl* is defined by Molina, in his *Vocabulario Mexicano* (1571), to signify *esmeralda baja*, or an inferior kind of emerald. The precious emerald, or emerald proper, was called *quetzalitztli*, from the *quetzal*, the bird known to science as the *trogan resplendens* (the splendid plumes of which, of brilliant metallic green, were worn by the kings of Mexico and Central America as regal insignia), and *itzli*, stone; i. e. the stone of the *quetzal*.

The value attached to the *chalchihuitl* by the ancient Mexicans will appear from the testimony of the chronicler Bernal Diaz, which is supported by that of all the historians of the Discovery and Conquest. The first messengers that Montezuma sent to Cortez, on his landing at San Juan de Ulua, brought, among other presents, "four *chalchihuitls*, a species of green stone of uncommon value, which is held in higher estimation with them than the *smaragdus*." (Lockhart's *Translation of Bernal Diaz*, vol. i. p. 93.) Subsequently, after having firmly established himself in Mexico, Cortez required of the Emperor Montezuma that he should collect tribute from

* I have followed the orthography of the word throughout, as given by the various authors quoted.

all his vassals for the Spanish crown, which he proceeded at once to do; and, at the end of twenty days, handed over to Cortez all the treasures he had got together, amounting in value to 600,000 *pesos.* Bernal Diaz reports that Montezuma apologized for the smallness of the amount, on the score that his time for collecting the tribute had been too short; but that he would make it worthy of the acceptance of the Spanish king by adding to it the treasures of his father, and also "a few *chalchihuis* of such enormous value that I would not consent to give them to any one save such a powerful emperor as yours; each of these stones is worth two loads of gold." (*Ib.*, vol. i. p. 278.)

Sahagun mentions four of the Mexican gods who were the especial patrons of the lapidaries, and honored as the inventors of the art "of working stones and *chalchiuites*, and of drilling and polishing them." He does not, however, describe the process made use of by the Indians in cutting precious stones, "because," he says, "it is so common and well understood;" an omission which his editor, Bustamente, regrets, "since the art is now entirely lost."

Quetzalcoatl, the lawgiver, high-priest, and instructor of the Mexicans in the arts, is said to have taught not only the working of metals, but "particularly the art of cutting precious stones, such as *chalchiuites*, which are green stones, much esteemed, and of great value." (*Torquemada*, lib. vi. cap. xxiv.) Quetzalcoatl himself, according to certain traditions, was begotten by one of these stones, which the goddess *Chimalma* had placed in her bosom. Indeed, both among the Mexicans and the nations farther to the southward, the *chalchihuitl* seems to have represented everything that was excellent in its kind. Its name was used in compounding designations of distinction and honor, and was applied both to heroes and divinities. The goddess of water bore the name of *Chalchiuitlcuye*, the woman of the *chalchiuites;* and the name of *Chalchiuhapan* was often applied to the city of Tlaxcalla, from a beautiful fountain of water near it, the color of which, according to Torquemada, "was between blue and green." Cortez, according to the same authority, was often called "*Chalchiuitl*, which is the same as captain of great valor, because *chalchiuitl* is the color of emerald, and the emeralds are held in high estimation among the nations." (*Monarchia Indiana*, vol. i. p. 435.) When a great dignitary died, his corpse was richly decorated for burial with gold and plumes of feathers, and "they put in his mouth a fine stone resembling emerald, which they call *chalchihuitl*, and which, they say, they place as a heart." (*Ib.*, vol. ii. p. 521.)

Sahagun, in one place, describes the *chalchihuitl* as "a *jasper* of very green color, or a common emerald." Elsewhere he goes into a very full description of the various kinds of green stones which the Mexicans held in esteem, and as his account may materially aid in identifying the *chalchihuitl*, it is subjoined entire:

"The emerald which the Mexicans call *quetzalitztli* is precious, of great value, and is so called, because by the word *quetzalli* they mean to say a very green plume, and by *itztli*, flint. It is smooth, without spot; and these peculiarities belong to the good emerald; namely, it is deep green with a polished surface, without stain, transparent, and at the same time lustrous. There is another kind of stone which is called *quetzalchalchiuitl*, so called because it is very green and resembles the *chalchiuitl*; the best of these are of deep green, transparent, and without spot; those which are of inferior quality have veins and spots intermingled. The Mexicans work these stones into various shapes; some are round and pierced, others long, cylindrical, and pierced; others triangular, hexagonal, or square. There are still other stones called *chalchivites*, which are green (but not transparent), mixed with white; they are much used by the chiefs, who wear them fastened to their wrists by cords, as a sign of rank. The lower orders (*macequales*) are not allowed to wear them. . . . There is yet another stone called *tlilaiotic*, a kind of *chalchuite*, in color black and green mixed. . . . And among the jaspers is a variety in color white mixed with green, and for this reason called *iztacchalchiuitl.** Another variety has veins of clear green or blue, with other colors interspersed with the white. . . . And there is yet another kind of green stone which resembles the *chalchiuities*, and called *xoxouhquitecpatl.*† It is known to the lapidaries as *tecelic*, for the reason that it is very easy to work, and has spots of clear blue. The wrought and curious stones which the natives wear attached to their wrists, whether of crystal or other precious stones, they call *chopilotl*—a designation that is given to any stone curiously worked or very beautiful." (*Historia de Nueva España*, lib. xi. cap. viii.) The same author, describing the ornaments which the Mexican lords used in their festivals, speaks of a "head-dress called *quetzalalpitoai*, consisting of two tassels of rich plumes, set in gold, and worn suspended from the hair at the crown of the head, and hanging down on each side towards the shoulders. They also wear rings of gold around the arms and in their ears, and round their wrists a broad band of black leather, and suspended to this a large bead of *chalchiuitl* or other precious stone. They also wear a chin ornament (*barbote*) of *chalchiuitl* set in gold, fixed in the beard. Some of these *barbotes* are large crystals, with blue feathers put in them, which give them the appearance of sapphires. There are many other varieties of precious stones which they use for *barbotes*. They have their lower lips slit, and wear these ornaments in the openings, where they appear as if coming out of the flesh; and they wear in the same way semi-lunes of gold. The noses of the great lords are also pierced, and in the openings they wear fine turquoises or other precious stones, one on each side. They wear strings of precious

* *Iztac* signifies white; i. e. *white-chalchihuitl.*

† From *xoxouhqui*, *cosa verde*, something green, and *tecpatl*, stone; i. e. green-stone.

stones around their necks, sustaining a gold medal set round with pearls, and having in its centre a smooth precious stone." (*Ib.*, lib. viii. cap. ix.)

And here, as confirming the definition of *chalchihuitl* as given by Molina, I quote the exact words of Montolina, in his letter of 1555, to which Señor Icazbalceta has given the first place in his "Coleccion de Documentos para la Historia de Mexico." I quote from page 189, on which, enumerating the riches of Mexico, he says: "Hay mucho oro y plata, y todos los metales y piedras, en especial turquesos, y otras que acá se dicen chalchiuitl; *las finas de estas son esmeraldas*."

The chronicler Fuentes, in his unpublished history of the old kingdom of Guatemala, speaks of the Indians of Quiché as wearing "head-dresses of rich feathers and brilliant stones, *chalchiquites*, which were very large and of great weight, under which they danced without wearying." The Licenciado Palacio, in his account of the Pipil Indians of San Salvador, also makes mention of these stones, which were worn on the wrists and ankles, and also supposed, like the *bezoar* stone, to be a specific against certain diseases. (*Carta al Rey de España*, *Squier's "Coleccion de Documentos Originales, etc.,"* vol. 1, p. 72.)

In these descriptions, it will be seen that the *chalchihuitls* are spoken of as ornaments, round or oblong beads, which conforms with the representations in the paintings. But these or similar green stones were used for other purposes. The chronicler Villagutierre, in his account of the conquest of the Itzaes of Yucatan, speaks of idols in their temples "of precious jasper, green, red, and of other colors;" and, in describing the great temple of Tayasal, mentions particularly an idol which was found in it, "a span long, of rough emerald (*esmeralda bruta*), which the infidels called the god of Battles," and which the conquering general, Ursua, took as part of his share of the spoil.

It appears that when the Spaniards first landed in Tabasco, they mistook some of these *chalchihuitles* for true emeralds; at any rate the Indians were eager to obtain the glass beads of the Spaniards, not knowing them to be artificial. If, however, the Spaniards really fell into any mistake as to these stones, they were not long in finding it out, as appears from an anecdote related by Torquemada, describing how Don Pedro Alvarado often played with Montezuma at a game called *bodoque*, in which, while the latter paid his losses in gold, the former paid his in *chalchiuites*, "que son piedras entre los Indios estimada, y entre los Castellanos, no." (*Mon. Ind.*, vol. i. p. 462.)

The Mexicans nevertheless had true emeralds, of which we have left to us the most glowing descriptions. Gomara describes particularly five large ones which Cortez took with him from Mexico to Spain at the time of his first visit, and which were regarded as among the finest in the world. They were valued at 100,000 ducats, and for one of them the Genoese merchants offered 40,000 ducats, with the view of selling it to the Grand Turk. Cortez had also the emerald vases, which the padre Mariana assures us, in the supplement of his History of Spain, were worth 300,000 ducats. They are reported to have been lost at sea. All these emeralds were cut in Mexico by Indian lapidaries under the orders of Cortez, and were most elaborately worked. One was wrought in the form of a little bell, with a fine pearl for a clapper, and had on its lip this inscription in Spanish, *Bendito quien te crió!* Blessed he who made thee! The one valued most highly was in the shape of a cup, with a foot of gold. All of them were presented by Cortez to his second wife, who thus, says Gomara, became possessed of finer jewels than any other woman in Spain. Remarkable as were these emeralds, Peter Martyr mentions one, of which Cortez was robbed by the French pirates, that must have surpassed any of them in size and value. "But what shall wee speake of Iewelles and precious stones? Omitting the rest, there was an *Emerode* like a *Pyramis*, the lowest part or bottome whereof was almost as broad as the palme of a mans hande, such a one (as was reported to *Cæsar*, and to us in the Kinges Senate) as never any human Eye beheld. The French Admirall is said to have gotten it of the Pyrattes at an incredible price." (*Decade* viii. c. 4.)

Coming down to later times, we find Prof. P. Blake, in the American Journal of Science and Arts for March, 1858, in an interesting article on "The Chalchihuitl of the Mexicans," informing us that the Navajo Indians in the northern and western portions of New Mexico wear small ornaments and trinkets of a hard, green stone, which they call by the Mexican name, and which they regard as of great value; "a string of fragments large enough for an ear-ring being worth as much as a mule." Mr. Blake, suspecting this stone to be turquoise, and learning that it was yet procured in small quantity by the Indians among the mountains about twenty miles from Santa Fé, visited the spot, where he found an immense pit excavated in granular porphyry, "200 feet in depth and 300 or more in width," besides some smaller excavations. He obtained many fragments of the so-called *chalchihuitl* "of apple-green and peagreen, passing into bluish-green, capable of a fine polish, and of a hardness little less than that of feldspar." The fragments found were small, not exceeding three-quarters of an inch in length and one-quarter of an inch in thickness, and the material "appeared to have formed crusts upon the surfaces of cavities or fissures in the rock, or to have extended through it in veins."

Mr. Blake's description applies to the specimens exhibited to the Lyceum not long ago by Prof. Newberry, and there is no doubt that the material was, or rather is, a variety of the turquoise. But I doubt if it be the true *chalchihuitl* of the Mexicans and Central Americans. That they used the stone described by Mr. Blake for certain purposes, I know; for there exists in the museum of the late Mr. Henry Christy, in London, a human skull completely encrusted with a mosaic of precisely this stone, and a flint knife with its handle elaborately inlaid with it, in small fragments. Of the first of these relics I present a drawing made by Waldeck and published by the French Government. See Fig. 1.*

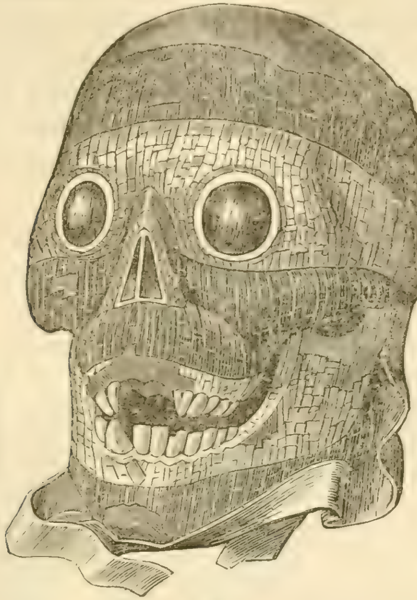


Fig. 1.
Human Skull, Ancient Mexican, inlaid with turquoise and obsidian.

The weight of evidence, in my opinion, goes to show that the stone properly called *chalchihuitl* is that which Molina defines to be "*baja esmeralda*," or possibly nephrite, "a jasper of very green color," as Sahagun, already quoted, avers. I should therefore object, on strictly critical and historical grounds, to the suggestion of Mr. Blake, that the variety of turquoise found by him should be "known among mineralogists as *chalchihuitl*."

* In Mr. Christy's museum is also a wooden mask encrusted in like manner, with turquoises, malachite, and white and red shells. The predominant stone in all is the turquoise. The back of the skull in the specimen engraved is cut away, so as to admit the face to be hung by leathern thongs (which still remain) over the face of an idol, as was the custom in Mexico. The transverse black bands in the cut are of obsidian in the original. The eyeballs are nodules of iron pyrites, cut hemispherically, and highly polished.

But apart from any speculations on the subject, I have to lay before the Lyceum a most interesting series of green stones, unrivalled, in their way, in the world, which were found among the ruins of Ocosingo, in the department of Quesaltenango, Guatemala, on the borders of Chiapas, and not remote from the more famous but hardly less imposing monuments of Palenque. I must not omit to say that, in common with similar stones, they were designated by the people of the region where they were found as *chalchichuites*.

Fig. 2.—The first and most interesting of these is precisely

Fig. 2.
Chalchihuitl, or engraved precious stone, from Ocosingo, Central America. Full size.

four inches long by two and three-tenths broad, and about half an inch in average thickness. The face is sculptured in low relief, with the figure of a divinity seated, cross-legged, on a kind of carved seat, with his left hand resting on his thigh, and his right raised to his breast, as if in the act of giving benediction. Around his loins is an ornamental girdle, and depending from his neck and resting on his breast is an oblong rectangular plate or charm, not unlike that said to have been worn by the Jewish high-priests. The face is in profile, showing the salient nose and

Fig. 3.
Basso-Relievo of the god Cuculcan, from Palenque.

conventional receding forehead that characterize most Central American sculptures. Ornaments are inserted in the lobes of the ears, and the head is surmounted with the characteristic and elaborate plumed head-dress that we observe on the Palenque monuments and in the paintings. The whole is almost an exact miniature copy of the large *bas-relief* found by Mr. Stephens in an inner chamber of one of the ruined structures of Palenque (Fig. 3). At about one-third of the length of the carved chalchihuitl, measuring from the top, it is drilled through from edge to edge, the hole being a little less than two-tenths of an inch in diameter; the drilling having been made from each side to the centre, where the two drillings run one into the other, with a slightly diminished bore. The purpose of this seems to have been to suspend the object from the neck or other part of the person; but the back edges of the plate are also pierced diagonally, as if to afford means of fastening it to cloth or other material, without those means showing in front.

Fig. 4.—The next relic in importance is of a similar but

Fig. 4.
Chalchihuitl from Ocosingo. Two-thirds actual size.

more opaque material, which, were it not for a strip of clear quartz on one edge, might be mistaken for enamel. It is a semi-disk in shape, four and a half inches in length by two and seven-tenths in greatest width. It shows a human face in full front, surmounted by a kind of heraldic shield, and surrounded by a profusion of feather ornaments, with huge ear-rings and other ornaments below the chin. It, too, is pierced near its upper edge, longitudinally from side to side. The back shows that it was sawn from a solid block of the same material, both from above and below, until the cuttings reached each other within half an inch, when the intermediate core, if I may so call it, was broken off. The *swerve* of the saw is distinctly visible from the top as well as the bottom, although the *striæ* are nearly polished out. This was clearly intended to be suspended, as there are no means by which to fasten it to robes of any kind. It must have served as a gorget or breast-plate.

Fig. 5.—This is a most interesting, although a very irregular,

Fig. 5.
Chalchihuitl from Ocosingo. Two-thirds actual size.

and comparatively rude specimen, four inches and two-tenths long by two and a half inches wide at its widest part. The back shows a compact greenish stone, with the same evidences of having been sawn from a solid block, to which I have alluded in describing Fig. 4. The front appears as if of a brilliant green enamel, exhibiting a full human face with a large and elaborate feather helmet or crown, huge ear and neck ornaments impossible to describe, and only to be understood by inspection of the original. This, too, is pierced, like that last described, from edge to edge, near its upper end.

Fig. 6.—This is a comparatively small fragment of identical material with Fig. 2, an irregular triangle in shape, somewhat concave on the face, where is carved in profile a human head, surmounted also with elaborate plumes, but with eyes closed

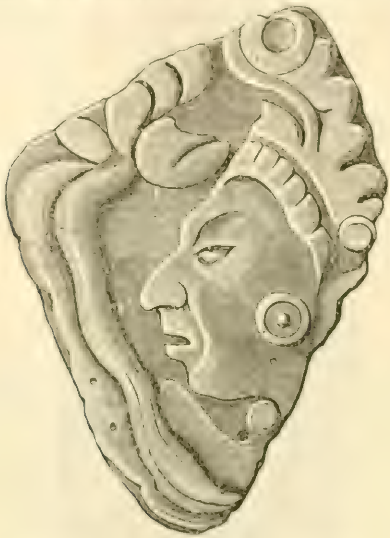


Fig. 6.
Chalchihuitl from Ocosingo. Full size.

as if in death. This is drilled through vertically and horizontally, and there are small diagonal holes, designed to afford means of attachment by threads to some portion of the dress of the wearer. It is polished back and face, and measures two and three-tenths inches by one and nine-tenths. It has its almost exact counterpart in the Christy, formerly Mayer Museum, of London.

Fig. 7.—This specimen is peculiar and very interesting. It is a slightly irregular globe, two and six-tenths inches in diameter, pierced from top to bottom by a perfectly circular hole one and three-tenths of an inch in diameter. On three sides, if I may use the expression in respect of a sphere, are as many engraved hieroglyphics, using that term in the popular sense, but which I conceive to be syllabo phonetic or phono-syllabic

signs, of which, of course, only engravings can give any adequate notion. (Figs. 8, 9, 10.) As I shall have something

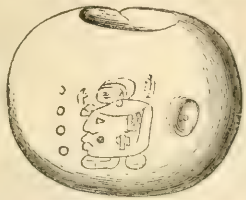
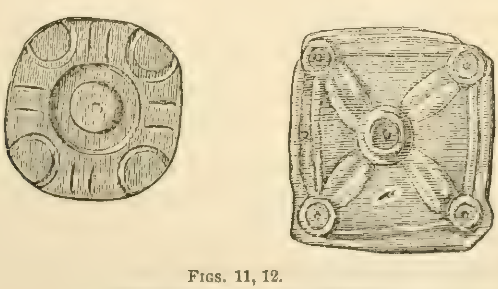


Fig. 7.
Chalchihuitl globe, pierced. One-fourt size.

to say about this specimen further on, I proceed to notice a simple polished perfect globe, of the same material with that

Figs. 8, 9, 10.
"Hieroglyphics" on Chalchihuitl globe. Full size.

last alluded to, and which may be sufficiently described as a large bead, an inch and a tenth in diameter, pierced through its exact centre by a hole sufficiently large to admit a stout thread.



Figs. 11, 12.
Chalchihuitl ornaments. Half size.

Figs. 11 and 12 are types of a large class of what may be called chalchihuitl ornaments, with no special significance.

Figs. 13 and 14, however, may have a hieroglyphical significance. The latter (Fig. 14) is a fragment of a thin plate, of the

Figs. 13, 14.
Chalchihuitl engraved plates.

same stone with the objects already described, two inches and eight-tenths in length by two inches and three-tenths broad and two-tenths of an inch thick, engraved on both surfaces and cut through with ornamental devices.

Fig. 15 is an engraving of one of a number of hat-shaped ob-

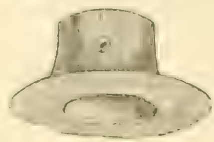


Fig. 15.

jects of the stone under notice, pierced through, so as to leave a very thin rim and walls, and obviously designed to hold those *penachos* or clusters of feathers which the Spanish conquerors so often describe, and which are so conspicuous in the head ornaments represented on the monuments and in the aboriginal paintings of Mexico, Central America, and Peru. They are each two inches and two-tenths in diameter over the rim, one inch and one-tenth high, with a bore of eight-tenths of an inch in diameter.

The relics above described are fair types of the chalchihuitls found at Ocosingo; but I possess some other worked and engraved green stones, worth mentioning, perhaps, in this connection. The first of these,

Fig. 16 has some resemblance to the engraved Assyrian seals, or, as they are sometimes called, "Chaldean" cylinders. It is a perforated cylindrical piece of heavy, opaque stone, of a dark sea-green color (nephrite?), two inches long by an inch and one-tenth in diameter. In a kind of oval, or what Egyptian scholars would call a *cartouche*, is presented the profile of some

Fig. 16.
Engraved stone cylinder from Yucatan.

divinity (the Maya god of Death?), with the eye closed and the tongue depending from the corner of the mouth. Something like claws, engraved on a projection of the cylinder, start out from the *cartouche* on the left side. The whole is boldly and sharply cut, and highly polished. This relic was obtained from the island of Flores, the ancient Tayasal, in the lake of Itza or Peten, in Yucatan. Among the things found by the conqueror of the Itzaes, Ursua, in the temples which he destroyed in the island in 1697, he mentions "an idol of emerald a span long, which," says the chronicler, "he appropriated to himself."

It may be observed of the figure engraved on this stone, that *to speak*, among American nations, was the verbal as well as symbolical expression of life or being, as is *to see* or *to breathe*, or *to eat*, among other nations in various parts of the world. The projecting tongue in the sculptured and painted American idols and figures denotes the living god or man; he who can talk, and therefore lives. In this instance, the lax and drooping tongue heightens the idea of death which the closed eye in part conveys.

Fig. 17 is an engraving of a stone hatchet or adze of hard green stone, resembling quartz, five inches long. It is highly polished on the face, but the reverse has marks which show that it too was sawn from a block of the same material.

Fig. 17.
Hatchet of green stone from Costa Rica.

Where the notches occur in the sides there are holes drilled entirely through the stone, parallel with its face. The lower or cutting edge is slightly curved outward, implying that, if intended for practical service, it was as an adze. But it is to be presumed that it was worn symbolically, in the way of distinction or ornament. It was found in an ancient grave in Costa Rica. The ruling Inca of Peru carried an axe instead of a sceptre as one of his insignia of dominion.*

* In Greece stone weapons of jade or nephrite are sometimes found, which the common people call "thunderbolts," and hold in high estimation. A correspondent of the *London Athenæum* found a similar object, called by the same name, in Nassau, New Providence, in the Bahamas. He describes it as polished and flattened, pointed at one end, with a broad cutting edge at the other, and regarded by the natives as a preventive against lightning. Another correspondent of the

FIG. 18 (full size of original) is the easily recognizable figure of a frog, in a kind of malachite, from the island of Omotepec, Lake Nicaragua.

FIG. 18.
Sculptured frog, Nicaragua.

FIG. 19 is of still another and harder variety of green stone, from a mound near Natchez, and appears to be a strange combination of the head of the siren of our western waters, or of

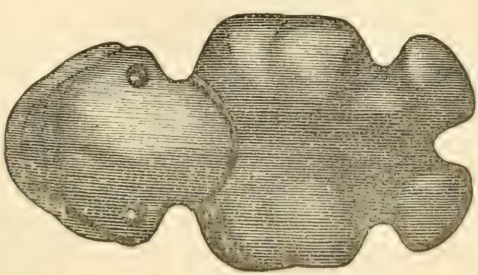


FIG. 19.
Carved green stone found near Natchez.

the frog, with the human body. It is also pierced laterally, like those already described, doubtless for suspension.

I do not present FIGS. 16, 17, 18, and 19 as specimens of the *chalchihuitl*, but as showing the regard paid to green stones generally. It is one that pervades both continents and many

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same publication states that he found a similar object in Jamaica forty years ago, also called a thunderbolt. It was kept in an earthen jar filled with water. and was supposed to keep the water cool.

nations, from the advanced Chinese, to whom the green jade is sacred, to the savage dwellers on the banks of the Orinoco, among whom Humboldt found cylinders of hard green stones, the most highly prized objects of the several tribes, and some of which it must have required a lifetime to work into shape.

Of the carved chalchihuitls, like those described from FIG. 1 to FIG. 15, I have seen but three specimens outside of my own collection: one already alluded to in the Christy Museum of London, another in the late Uhde Museum near Heidelberg, and a third in the Waldeck collection in Paris.

The question how these obdurate stones were engraved, drilled, and sawn apart, or from the blocks of which they once formed a portion, is one likely to arise in most minds. It is one that has puzzled many inquirers; nor do I pretend to give an answer, except that the drilling was probably performed by a vibratory drill, composed of a thin shaft of cane or bamboo, the silica of which was re-enforced by very fine sand, or the dust of the very article under treatment. The *striæ* shown in the orifices are proof of something of the kind, and the esteem attached to these stones by the aborigines proves that their value, like that of the main-spring of a watch, was due mainly to the amount of labor expended in their production.

As regards the sawing, of which the backs of FIGS. 4, 5, and 17 afford striking examples, we may find a clue in the accounts of the early chroniclers, who relate that they saw, in Santo Domingo and elsewhere, the natives use a thread of the *cabuya* (or agave), with a little sand, not only in cutting stone, but iron itself. The thread was held in both hands, and drawn right and left until worn out by attrition, and then changed for a new one, fine sand and water being constantly supplied.

Not a few inquirers entertain the hypothesis that most of the raised and sunken figures on various stones in Mexico, Central America, and the mounds of the United States, were produced by persistent rubbing or abrasion—a general hypothesis which I shall not dispute. But in objects from the mounds, as well as from other points on the continent, we have distinct evidence of the use of graving or incisive tools of some kind—as for instance in the hieroglyphics in Fig. 7, which are cut in a stone so hard that the blade of a knife produces scarcely any impression on its polished surface.

XV.—Characters of some New South American Birds, with Notes on other rare or little known Species.

By George N. Lawrence.

Read May 31st, 1869.

1. Turdus hauxwelli.

Male. The upper plumage is of quite an uniform deep cinnamon-brown, brightest on the rump; the coloring below is lighter and less cinnamomeous; the middle of the abdomen and under tail coverts are whitish, with the feathers more or less marked with the same color as the breast; the throat is without any white, and has a striated appearance, in consequence of the edges of the feathers being paler than their centres, where they are of the same color, and scarcely darker than the breast; the tail is of a dark liver-brown, the feathers edged the color of the back; the quill feathers have the inner webs dark liver-brown; the outer webs are colored like the rump; under wing coverts clear pale cinnamon; the inner margins of the quills have only a mere trace of this color; "iris brown"; bill blackish-brown, the under mandible lighter in color; tarsi and toes yellowish-brown.

First primary very short, fourth and fifth longest and equal, the second and eighth are of equal length.

Length (skin) 9 in.; wing $4\frac{5}{8}$; tail 4; bill $\frac{3}{4}$; tarsi $1\frac{1}{16}$.

Habitat. Pebas, Peru. Type in Vassar College Museum. It was obtained by Mr. J. Hauxwell, Oct. 3d, 1868, and sent in a collection to Prof. Jas. Orton.

I have named this species in compliment to Mr. John Hauxwell, the well-known collector on the Upper Amazon and its tributaries.

Remarks. The only thrush with which this species needs comparison is *T. leucomelas*, Vieill. This inhabits the same locality—a specimen being in the collection sent Prof. Orton; above they differ materially in color, that part of *leucomelas* is of a decided olive, whereas the new species is reddish-brown, with no olive shades, and is uniformly darker.

From the absence of white on the throat, it should perhaps be properly grouped with *T. grayii* and *T. obsoletus.*

2. Ochthoeca rufomarginatus.

Entire upper plumage of a dull rufous-brown, darker on the crown; a narrow line of grayish-white extends from the bill over the eye; tail blackish-brown, margined the color of the back; the ends of all the feathers and the outer web of the lateral feather paler; primaries and secondaries blackish-brown, narrowly edged with dull rufous; tertiaries and the middle and larger wing coverts black—the former with rufous margins, and the latter broadly ending with rather bright rufous; under wing coverts pale yellowish-white; inner edges of quills pale salmon color; throat grayish-white; a band across the upper part of the breast, and the sides under the wings light ashy brown; lower part of breast and abdomen pale yellowish-white; upper mandible black, the under dark brown; tarsi and toes black.

Length (skin) $5\frac{1}{8}$ in.; wing $2\frac{3}{8}$; tail $2\frac{1}{2}$; bill $\frac{7}{16}$; tarsi $\frac{13}{16}$.

Habitat. Quito Valley, Ecuador. Type in my collection.

Remarks. This is allied to *O. lessoni*, and much like it in the coloring above, but is without the rufous throat and breast, and the conspicuous white band encircling the crown of that species. It differs also in having the middle and larger wing coverts ending with rufous—the latter only being so in *lessoni*.

3. Mecocerculus uropygialis.

Plumage above of a dull olivaceous-brown, darker on the head; there is a faint line of grayish-white extending from the bill over the eye; rump pale ferruginous; tail of a dull liver-brown, the feathers at the base edged with dull rufous; middle and larger wing coverts blackish-brown, ending in white tinged with rufous; quills blackish-brown; under wing coverts pale yellow; inner margins of quills very pale salmon color; chin and upper part of throat gray; neck in front clouded with light olive-brown; breast, abdomen, and under tail coverts pale yellow; upper mandible black, the under light brown, darker at the end; legs dark brown.

Length $4\frac{1}{4}$ in.; wing $2\frac{1}{2}$; tail 2; bill $\frac{5}{16}$; tarsi $\frac{11}{16}$.

Habitat. South America. Supposed to be Ecuador. Type in my collection.

Remarks. This species somewhat resembles *M. leucophrys*, but it is of a paler yellow on the under plumage, with a much smaller and weaker bill. Its rufous uropygium will readily distinguish it from that species.

4. Pogonotriccus plumbeiceps.

Head above and hind neck dark plumbeous; a line of grayish-white between the bill and the eye; upper plumage bright yellowish-green; tail light umber-brown, with the outer margins of the feathers the color of the back; wing coverts black, conspicuously edged with clear pale yellow; quills brownish-black, edged with yellow; chin grayish-white; under plumage yellow, clear and bright on the abdomen, with the breast greenish; bill black; feet brown.

Length $4\frac{1}{2}$ in.; wing $2\frac{3}{8}$; tail $2\frac{1}{2}$ tarsi $\frac{9}{16}$.

Habitat. Bogota. Type in Mus. Smithsonian Institution, No. 47105.

Two specimens are in the collection presented to that Institution by the Hon. A. A. Burton.

5. Myiozetetes rufipennis.

The plumage above is of an olivaceous-brown, with the margins of the feathers light dull rufous; the top of the head is black, with a conspicuous crown spot of bright orange; the crown is encircled with a rather narrow band of white, connecting on the hind head, and just meeting in front at the base of the upper mandible; lores and sides of the head, including the eyes, brownish-black; tail feathers umber-brown, all of them have both webs bordered with cinnamon-red; the primary and secondary quills are bright cinnamon-red on both webs, except on a small portion of their ends, where they are umber-brown, of which color are the tertiaries and the middle and larger wing coverts, and all of them are conspicuously margined with cinnamon-red; throat white, with a very slight yellowish tinge; under plumage and under tail coverts bright clear yellow; there is a brownish spot on each side of the breast; bill and legs black.

Length (skin) $6\frac{1}{2}$ in.; wing $3\frac{7}{16}$; tail $2\frac{7}{8}$; bill $\frac{9}{16}$; tarsi $\frac{3}{4}$.

Habitat. Valencia, Venezuela. Type in my collection.

This specimen is from one of the collections made on the recent expedition to South America for scientific explorations, of which Prof. Jas. Orton was the head, and by whom it was presented to me. The collections in Venezuela were made by Messrs. W. B. Gilbert and R. H. Forbes, of Williams College. The above bird was obtained by the latter gentleman.

Remarks. The character which most distinguishes this species from all others is the greater extent of rufous coloring on the wings and tail; besides, the bill is much larger and stouter.

M. erythropterus, Lafr., the type of which is in the Mus. of the Boston Soc. of N. H. (and which seems to be a valid species, though I believe it is not generally recognized as such), comes nearest to the present bird in the rufous character of the quill feathers, but that has the wing coverts olivaceous, with very narrow, paler edges, not at all red; the tail is olive-brown, without any red; the edges very narrowly paler or light greenish-olive. The locality given is "Brazil."

6. Myiozetetes inornatus.

Upper plumage light-brown, scarcely olive; crown, sides of the head, and lower part of the hind neck, of a fine deep brown; the feathers of the crown are much elongated; there is no bright crown spot; a broad and conspicuous white band occupies the front, the sides of the crown and the hind head; the wings and the tail are of a rather light umber brown, with no indications of rufous margins; the wing coverts are colored like the back, and are also of an uniform color; the throat is white; under plumage and under wing coverts bright yellow; inner margins of quills very pale yellowish; bill black, the under mandible brownish at base; tarsi and toes brownish flesh-color.

Length (skin) $6\frac{3}{4}$ in.; wing $3\frac{3}{4}$; tail $3\frac{1}{4}$; bill $\frac{9}{16}$; tarsi $\frac{3}{4}$.

Habitat. Valencia, Venezuela. Type in Museum of Vassar College. Collected by W. B. Gilbert, Aug. 1867.

Remarks. This appears to be an adult bird, but with no brightly colored crown spot, but has a lengthened crest, and is broadly white on the sides of the crown; the color below is not so bright as in the preceding species, and the bill is narrower.

7. Lesbia ortoni.

Male. Entire upper plumage and wing coverts of a rich glossy purple; the concealed bases of the feathers are green; upper tail coverts similar in color to the back, but marked centrally between the purple and green with crimson; the tail feathers are brownish black, except the two central, which are green; the ends of the eight middle feathers are largely marked with a deep vinous bronzy crimson, most in extent on the short central feathers; the long outer feather on each side ends with obscure bronzy green; the outer edge of the lateral feather is buff for three-quarters its length from the base—this color occupying only about one-third the width of the web; the under surface of the tail is steel blue, bronzy at the ends of the feathers; the shafts of the two long lateral feathers are whitish at base for about half their length; wings brownish purple; the throat gorget is of a brilliant metallic pale green; the sides of the neck, breast, upper part of abdomen and sides are of a shining green; lower part of abdomen ashy buff; bill and feet black.

Length (skin) $5\frac{3}{4}$ in.; wing $2\frac{1}{4}$; tail, lateral feathers, $3\frac{7}{16}$; short central feathers $1\frac{1}{16}$; bill $\frac{1}{2}$.

Habitat. Quito Valley, Ecuador. Type in Museum of Vassar College, Poughkeepsie, N. Y.

It is very gratifying to me to introduce this remarkably fine species, bearing the name of my friend Prof. Jas. Orton, of Vassar College, whose large collections in various branches of Natural History, made in Ecuador and on the Upper Amazon, have proved of great scientific value.

Remarks. The single specimen above described was sent to Prof. Orton (since his return from Ecuador) from the Quito Valley, where it is said to be rare. It is of the same form and dimensions as *Lesbia glyceria, Bonap.*, as illustrated by Mr. Gould in his plate of that species (Mon. of Trochilidae), except that the outer tail feather is narrower—being apparently about two-thirds the width given in his figure. They are clearly allies, and should be classed together. Mr. Gould puts *glyceria* in *Cometes*, as having more affinity to that genus, on account of its broad tail feathers, which are narrow in *Lesbia*. The outer tail feather of the bird before me is about intermediate in width between *gly-*

ceria and *Lesbia amaryllis.* In both *glyceria* and *ortoni* the tail is shorter than in members of *Cometes* or *Lesbia.* The bill is not so strong as in *Cometes*, but is like that of *Lesbia.* Perhaps the two species should be placed in a new genus. The upper coloring of ortoni is somewhat like that of *Ramphomicron microrhynchus*, but is of a lighter shade and less shining. In the under plumage it resembles *L. amaryllis*, but the breast is of a darker green—more uniform in color, as the buff bases and edges of the feathers are less apparent. The gorgets of *amaryllis* and *ortoni* are much alike in color and extent.

8. Accipiter nigroplumbeus.

The entire upper plumage, with that of the neck, breast, and sides, are blackish-plumbeous, the color on the under surface scarcely lighter; chin and upper part of throat of a dull ashy plumbeous; abdomen dark brownish cinnamon; thighs and under tail coverts plumbeous like the breast, but with an intermixture of dull cinnamon; tail above pale umber brown, crossed with four broad black bars; underneath it is of a clear gray, with dark brown bars; the ends of the feathers are white; wing coverts and tertiaries the color of the back, the latter marked with concealed spots of white; the larger quills are dark brown above, with darker indistinct bars; the quills underneath are marked with blackish bars, alternating with white ones at their bases, and gray ones towards their ends; the under wing coverts are of a dull rust color, with obscure narrow blackish bars; bill blackish horn color, the tooth edged with white; tarsi and toes pale yellow.

Fourth quill longest, second and seventh equal, the first one and a quarter inches shorter than the second; tarsi very slender.

Length (skin) $10\frac{1}{2}$ in.; wing $6\frac{3}{4}$; tail 6; tarsi $1\frac{3}{8}$; middle toe and claw 1[illegible].

Habitat. Quito Valley, Ecuador. Type in Museum of Vassar College.

It came in a small collection sent to Prof. Orton (together with the preceding species), and submitted to me for examination. It was marked "rare."

Remarks. I have endeavored faithfully to identify this with some described species, but without success. Its dimensions are about the same as those of the male *A. ventralis* (P. Z. S., 1866,

p. 303), since figured (Exotic Orn., Part II., Jan. 1867), but the coloring below is very different. Of this last species I have a female from Bogota, which agrees quite well with the description of the specimen, mentioned by Scl. and Salv. (Exot. Orn.) as being in the British Museum. The feathers of the sides and thighs are of a clear rufous; the breast is paler and duller, on which there are whitish transverse markings. The under tail coverts are nearly white.

It measures, length 12 in.; wing 8; tail $6\frac{1}{2}$; tarsi $2\frac{1}{8}$.

Notes on rare or little known Species.

1. Icterus auratus, Bonap.

Since the completion of my "List of a Collection of Birds from Northern Yucatan," Prof. Baird sent me two specimens of an *Icterus* belonging to that collection, which had been overlooked. They were also submitted to Mr. Cassin after he had finished his monograph of the ICTERIDÆ. He considered the species to be undescribed; but I am of the opinion that, had he carefully examined it, at the time of investigating for his Monograph, his conclusion would have been different, and its true position would have been assigned it. It is without question, I think, *Icterus auratus*, *Bonap.*, Consp. Av. 1, p. 435, as it agrees with the description of that species, and for which the same locality is given, viz., Yucatan.

The bird to which Mr. Cassin has applied this name, is a species that has generally been confounded with *I. xanthornus*, and does not answer Bonaparte's description in Consp. Av., as I will presently point out.

I think Mr. Cassin was misled, in part, by taking it for granted that the specimen which Bonap. states (Compt. Rend., 1853, p. 835) is in the Brussels Museum, when speaking of the species confounded with *xanthornus*, is one and the same as *I. auratus* of his Consp. Av., a specimen of which he also says is in the Brussels Museum. I infer that he means two distinct birds, as he makes no allusion in Comptes Rendus to his previous description in Consp. Av. of *I. auratus*, which he surely would have done had he considered them identical.

Bonaparte's description is as follows:—

"Icterus auratus, Du Bus, Mus. Brux. ex Yucatan.

"Flavo-aurantius: gula late, alis, caudaque nigris; tectricibus alarum minoribus flavissimis; mediis, remigibusque albo-marginatus; rostro brevi, crassiculo, recto."

The following description is that of the Smithsonian specimen from Merida, Yucatan, No. 36,835:

Male. General color reddish orange; the feathers of the neck and back have their ends dusky; lores, feathers at base of under mandible, chin and throat black; tail and wings black; bend of the wing and smaller wing coverts orange yellow, the feathers edged with black; the middle coverts are largely marked with white, greater coverts with white on their outer webs at the end; quill feathers margined with white; under wing coverts yellow; bill black, the under mandible plumbeous at base; tarsi and toes black.

Length 8 in.; wing $3\frac{5}{8}$; tail $3\frac{3}{4}$; tarsi $\frac{7}{8}$.

It will be seen that it has essentially the characters of the orange coloring, and the white middle wing coverts which apply to *I. auratus*.

Its deeper orange-yellow, the middle wing coverts conspicuously ending in white, and its more restricted throat patch, are marked points of difference between this and the bird considered to be *auratus* by Mr. Cassin, which is of a lighter, less orange-yellow, with the black of the throat continuing on the breast, and with no white on the middle wing coverts, but it has a rather narrow edging of white on the greater coverts. This agrees with Bonaparte in Compt. Rend. of "ailes d'un noir de jais, et presque pas de blanc."

The Smithsonian specimen, marked "*I. auratus*" by Mr. Cassin, is from Ed. Verreaux, and labelled "*Icterus xanthornus*; *I. Mexicanus*, Bp. M. S. *plus grand*," and from "*Mexique*."

The locality of Mexico, I think, is questionable. I have specimens from Trinidad and St. Martha, and doubt its inhabiting north of the Isthmus of Darien.

According to Bonaparte (Compt. Rend. as above) this species should be called *I. nigrogularis*, Hahn, V. t. 1.

Mr. Cassin doubted this being the bird described by Hahn, as he places his name as a synonym of *I. xanthornus* with a ? The length (7 in. 4 lines) given by Hahn agrees best with *I. xanthornus.* The other measures fully 8½ inches, and is larger in all its other proportions. Hahn says in his description: "The upper and lower part of the back, &c., brilliantly yellow." It then would seem the middle of the back was not so. In this it also agrees with *I. xanthornus*, which has that part tinged with green; besides, he states it to be *Oriolus xanthornus*, *Gm.* From his plate but little can be judged. It is, to be sure, of an uniform yellow on the back, but that may be the fault of the colorist. The description and dimensions, I think, are all that need be considered.

After a due consideration of all the facts, I think Hahn's name should not be adopted for the larger bird, but as Bonaparte in Comptes Rendus points out very clearly the differences between the two species, in my opinion its proper designation is *Icterus nigrogularis*, *Bonap.*

The name of *Mexicanus*, aside from being inappropriate, seems to have no special claim for its adoption.

Hahn's figure and description were taken from a specimen in the Munich Academy of Science, an inspection of which would surely determine whether it is the larger or smaller species.

2. Todirostrum plumbeum. (Gm.) S. N. 1, p. 444.

The plumage above is grayish plumbeous, the lores, front, and crown, as far as on a line with the back part of the eye, black; tail black; the outer web of the lateral feather with its tip and also that of the next white; smaller wing coverts colored like the back, the middle and larger coverts black, edged with white; quills brownish black, the secondaries narrowly and the tertiaries more widely bordered with white; entire under plumage creamy white; under wing coverts and inner edges of quills white; bill black, the under mandible whitish horn-color below; tarsi and toes brownish black.

The tail is graduated, the first outer feather about three-quarters the length of the longest, the next intermediate.

Length (skin) $3\frac{1}{2}$ in.; wing $1\frac{3}{4}$; tail $1\frac{1}{2}$; bill $\frac{9}{16}$; tarsi $\frac{3}{4}$.

Habitat. "Guasipati, Guayana, Venezuela."

Specimen in my collection.

It was kindly presented to me by Dr. R. P. Stevens, our fellow-member, who brought a collection of birds from near the locality above given, where he was superintending an important gold-mining enterprise.

Remarks. This is without doubt the *Plumbeous Tody* of Latham, from whom Gmelin compiled his description, and it would seem to have escaped observation since that time. The only recent notice I find of it is in Bonaparte's Consp. Av. under *Todirostrum*, where he has "quid *Todus plumbeus, Gm.; Todirostrum plumbeum, Gray;*" it was therefore unknown to him.

As will be seen, it agrees closely with Latham's description. He also says: "Bill like *Cinereous Tody.*" On comparing the bills of the two species they are strikingly alike.

The specimen came in spirits, to which is possibly due the creamy coloring of the under parts.

The locality given by Latham is Surinam.

3. Brachygalba lugubris. (Sw.)

In the collection made in Venezuela (on Prof. Orton's expedition) by Mr. W. B. Gilbert, I find a specimen of *Brachygalba* obtained at Valencia, which I think is *Galbula lugubris*, Sw. (An. in Men., p. 329). No specimen of it appears to have come under the notice of any naturalist since he described it in 1838. In Jardine's Contributions to Ornithology, 1852, Mr. Sclater describes *Galbula inornata* (afterwards placed in *Brachygalba*), which has been thought by some ornithologists to be the same as Swainson's species.

In Mr. Sclater's synopsis of *Galbulidæ*, published in 1853, under *G. inornata*, he says: "Is this the species Swainson intended to describe under the name of *G. lugubris*, An. in Men. p. 329? There are two very noticeable points in which his description does not agree with the present bird. First, he states that it is a three-toed species; secondly, that the '*lower part of the body and vent are white.*' Now here we have four toes and a *black* vent. Cabanis, in the third volume of Schomburgk's *Reisen in British Guiana*, identifies the present bird with Swainson's; but the examples in the Berlin Museum do not appear to have been of Sir R. Schomburgk's collecting, but to have been received from Venezuela. I cannot help fancying that Swainson's bird is different from the present, and remains still to be *re-discovered.*"

The bird now before me seems to verify Mr. Sclater's conclusion that Swainson's bird was to be re-discovered. It has the essential requisite of a white vent, and agrees so well with Swainson's description in all other particulars, that I think their identity hardly admits of a doubt. The only discrepancy to reconcile is that of its having four toes, instead of three; the hind toe is quite small, and in a hasty examination might be overlooked, or possibly have been wanting in Swainson's specimen from some organic cause.

The specimen before me has the head, upper part of the back, the breast, and sides of a rather light brown; the lower part of the back, the wings, and central tail feathers are of a glossy light green, with a purplish tinge; the throat, middle of breast and abdomen, vent, bend of the wing, and bases of quills are white; the abdomen is blotched with deep bright rufous; there is a postocular stripe of pale ashy rufous, which connects with an imperfect collar of the same color over the hind neck; bill black.

It measures, length $6\frac{1}{4}$ in.; wing $2\frac{3}{4}$; tail $2\frac{1}{2}$; bill $1\frac{3}{4}$.

This specimen is now in the Museum of Vassar College.

Its lighter brown coloring, the decided green of the back from the junction of the wings downwards, as well as of the wings and tail, the white under tail coverts, and its longer and narrower bill, show its distinctness from *inornata*.

I have specimens of *inornata* from the Napo, and it was also brought by Dr. Stevens from Venezuela.

XVI.—*On the Names Applied to Pisidium, a Genus of Corbiculadæ.*

BY TEMPLE PRIME.

Read September 6th, 1869.

THE genus *Pisidium* was characterized by C. Pfeiffer* in 1821. Until the year 1801 the species belonging to this genus were placed as follows: By Muller † (1774) under *Tellina*, by Scopoli ‡ (1777) under *Sphærium*, by Poli § (1791) under *Cardium*, and by Draparnaud ‖ (1801) under *Cyclas* (*Sphærium*).

I shall now review what has been done since that time.

Physemoda.

In 1820 Rafinesque ¶ divides the *Corbiculadæ* into four subgenera, and places the species of *Pisidium* under the head of the subgenus *Physemoda*, which he characterizes thus:—

"One intermediary tooth in one valve; shell somewhat transversal."

Rafinesque's arrangement has never been adopted; the characters are insufficiently expressed, and are based solely upon the hard parts of the animal. Moreover, he is unfortunate in the selection of one of the two species which he gives as types of his subgenus, namely, *Cyclas lacustris*, which is a *Sphærium*.

Galileja.

There seems to be much uncertainty concerning this name. Deshayes ** (1854) places it under the synonomy of *Pisum* (*Pisidium*), and refers to it as having been described (1839) in the Corrispondenza Zoologica.†† He also quotes Philippi.‡‡ Deshayes §§ further places under the synonymy of *Pisum* (*Pisidium*)

* Pf.; System. Anord.
† Müller, Verm.
‡ Scop., Introduct.
§ Poli, Test. Sicil.
‖ Drap., Tabl. Moll.
¶ Ann. Gen. Sci. Phys. et Nat., v., 319.
** Brit. Mus. Cat. Conchif., 274.
†† Corrispondenza Zoologica, etc., Oronzo Costa, 1839.
‡‡ Philippi, Enum. Moll. Sicil., II., 214, 1844.
§§ Brit. Mus. Cat. Conchif., 279.

pulchellum, a certain *Galileja tenebrosa* (da)? Costa, which, on the authority of Philippi, is supposed to have been described in the Corrispondenza Zoologica. On consulting Philippi I find only the following reference; it is in the addenda: "Synonymis *Pisidii fontinalis*, *Galileja tenebrosa*, Costa, Corrisp. Zool., etc."

Gray* (1847) places *Galileja* under the synonymy of *Pisum* (*Pisidium*), but refers to it as having been described in 1846, without, however, quoting any authority.

Pisum.

Gray † (1847) is the first who applies this name to *Pisidium*, on the supposition that the genus characterized as *Pisum* by Megerle ‡ von Mühlfeldt (1811) was identical with it, and must consequently, by virtue of the laws of priority, supersede it.

An examination of Megerle's description, and of the authorities referred to by him, sets this question at rest, and shows, without a doubt, that the authors who have adopted the name of *Pisum* for *Pisidium* have been in error.

Megerle, in his description of *Pisum*, says: "The hinge has (*keine Seitenzähne*) no lateral teeth." To any one at all familiar with the characters of *Pisidium* this remark is conclusive. Megerle further quotes two authorities, as describing the type of his genus (*Pisum Gallicum*), Linnæus and d'Argenville. On an examination of the reference in Linnæus,§ we find *Tellina Gallica*. The description of this species throws no new light on the question further than that it is stated as having "dente solitario." We are, however, referred to another authority, which is the same as quoted by Megerle, namely, d'Argenville. D'Argenville ‖ gives the following description and figure of the shell referred to by

* Proc. Zool., Lond., xv., 185.

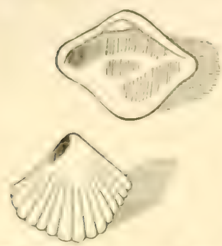
† Proc. Zool., Lond., xv., 184.

‡ Mag. Gesell. Naturf., Berlin, v., 57.

§ Gml. Syst. Nat. 305, spec. 88.

‖ D'Argenv. Conchyl. 285, pl. xxvii., f. xi., 1772 and '92.

Megerle and Linnæus: "Eine etwas ungestallte Kammuschel,



ohne Ohren von beiden Seiten abgezeichnet. Sie ist ursprünglich aus der Marne und sehr gemein. Doch könnte sie wohl aus dem Fluss nicht eigentlich, sondern aus dem Meer hineingeführet worden seyn."

With these facts* before us it is not possible to suppose that Megerle in describing *Pisum* proposed establishing a genus similar to *Pisidium*.

Deshayes † and H. and A. Adams ‡ both adopt *Pisum* for *Pisidium*.

Musculium.

During the years 1806–8, H. F. Link published a series of catalogues of the collections of the University of Rostock, to wit:

Beschreibung § der Naturalien; Sammlung der Universität zu Rostock, von Dr. H. F. Link. Rostock. Gedruckt by Adlers Erben.

Erste Abtheilung; zum Weihnachtsfest, d. 25 Dec. 1806 (p. 1–48).

Zweite Abth.; zum Osterfest, d. 29 Marz 1807 (p. 49–98).

Dritte Abth.; zum Pfingsfest, d. 17 Mai 1807 (p. 99–165).

Vierte Abth.; zum Weihnachtsfest, d. 25 Dec. 1807 (p. 1–30).

Fünfte Abth.; zum Osterfest, d. 7 April 1808 (p. 1–38).

Sechste Abth.; zum Pfingsfest, d. 5 Juni 1808 (p. 1–38).

Comparatively few copies of this work were distributed. The greater part seem to have remained in the stores of the University. Oken is the only naturalist who seems to have had any acquaintance with these publications, until they are mentioned by Herrmannsen. ‖

In the third of these catalogues, May, 1807, page 152, Link

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* It is not in my province to determine what d'Argenville's shell actually is—it being merely my intention to show that it does not belong to the genus *Pisidium*. Were I, however, to venture an opinion, I should say it was a fossil. As for its being a marine living shell, as is hinted, it is hardly possible, when we reflect that the Marne flows into the Seine at Paris,—a point more than one hundred miles from the sea.

† Brit. Mus. Cat. Conchif., 220, 1854.

‡ H. and A. Ad., Gen. Rec. Moll., II., 660, 1858.

§ For further information see Proc. Zool. Lond., xix., 228, 1851; and the Vol. for 1862, page 226.

‖ Herrm. Index, Gen. Mal. Primord., 1846–7.

establishes the genus *Musculium*, under the following description: "Sumpfershale. Die Schalen gleich, rund, schliessen überall. Das Schloss mit zwei kleinen Zähnen, *ohne Seitensähnen;* Vorder-und Hinterspalte ziemlich gleich: das Band auswendig. *M. lacustre* (*Tellina*), Gm. p. 3242; Ch. vi., f. 13, f. 135."

The species referred to by Link as typical of his genus (*Sphærium lacustre*) places *Musculium* under *Sphærium*, and not under *Pisidium*, as stated by Herrmannsen.*

Link, in his description of *Musculium*, commits a grave mistake in asserting the want of lateral teeth—a character existing in no European fresh-water bivalve. Prof. Mörch attributes this error to a misprint.

H. and A. Adams † adopt *Musculium* in the early part of their work, but eventually it is changed to *Pisum*.

Euglesa, Pera, Cordula.

These three genera were published for the first time in ‡1852, though Leach established them 1818–20, on specimens in the British Museum.

In the description of *Euglesa*, Leach says: "The umbones are central, or situated a very little behind the middle of the shells;" and that "The tracheal tubes are exserted." *Pisidium* being inequilateral and having but one tracheal tube, the species of *Euglesa* cannot be referred to it, but must be classed under *Sphærium*.

Jenyns,§ Bourguignat ‖ and Deshayes ¶ differ with me, and have placed the single species of this genus, *E. Henslowiana* under *Pisidium*.

Pera and *Cordula*, from the descriptions given, are simply synonyms of *Pisidium*.

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* Proc. Zool. Lond., xix., 232, 1851. In several of my papers on the *Corbiculadæ* I have made the mistake of mentioning Gray's name in connection with *Musculium* instead of Herrmannsen's.

† H. and A. Ad. Gen., Rec. Moll., II., 1858.

‡ Leach, Moll. Brit. Synop., edit. Gray, 291, 292.

§ Trans. Phil. Soc. Cambr., vi., 1832.

‖ Rev. Mag. Zool., 1854.

¶ Brit. Mus. Cat. Conchif., 274, 1854.

XVII.—*List of the Species of* MOLLUSCA *found in the Vicinity of North Conway, New Hampshire.*

BY TEMPLE PRIME.

Read December 6th, 1869.

I AM induced to give the following to the public, from the fact that I have not been able to discover any account of the *Mollusca* of New Hampshire, and in order, moreover, to contribute to our knowledge of the distribution of our *Mollusca*.

In the enumeration of the land shells, the system I have followed is the one recently adopted by Messrs. Binney and Bland,* though I have retained the old generic names.

Family HELICIDÆ.

1. *Helix arborea*, Say. Common.

2. *Helix viridula*, Menke (*electrina*, Gould). Pfeiffer (Mon. v. 147) has both the above specific names in the synonymy of *H. pura*, Alder. Moderately abundant.

3. *Helix indentata*, Say. Moderately abundant.

4. *Helix minuscula*, Say. Common in woods.

5. *Helix exigua*, Stimpson. Common in woods.

6. *Helix fulva*, Drap. (*chersina*, Say.). The specimens are of a depressed, rather than of the elevated form from Alabama, which I have seen in Mr. Bland's cabinet.

7. *Helix lineata*, Say. Common.

8. *Limax campestris*, Binney. Common.

9. *Helix alternata*, Say. Rather rare.

10. *Helix striatella*, Anthony. Common in woods.

11. *Helix labyrinthica*, Say. Common in woods.

12. *Helix monodon*, Rackett. In woods, rare.

13. *Helix albolabris*, Say. An unusually depressed form. Not common.

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* Smithsonian Miscellaneous Collections, 194.—Land and Fresh Water Shells of North America, Part I.: Pulmonata Geophila. By W. G. Binney and T. Bland. Washington. 1869.

14. *Helix thyroides*, Say. Not common.

15. *Bulimus lubricus*, Drap. Very rare; but one specimen found.

16. *Pupa muscorum*, Linn. (*badia*, C. B. Adams). Not uncommon.

17. *Succinea obliqua*, Say. Quite common.

Family PHILOMYCIDÆ.

18. *Tebennophorus Carolinensis*, Bosc. Very common in woods.

Family CORBICULADÆ.

19. *Pisidium abditum*, Hald. Common everywhere.

I call attention to the fact that though I examined a great number of localities, I was not able to find one of our most common species of *Helix*, *H. pulchella*, Müller. I have no doubt, however, that in time it will be discovered in New Hampshire, as it is put down by Bland and Binney as ranging from Canada East to Nebraska.

XVIII.—*Notes on Lingual Dentition of Mollusca.*

BY W. G. BINNEY AND THOMAS BLAND.

No. I.

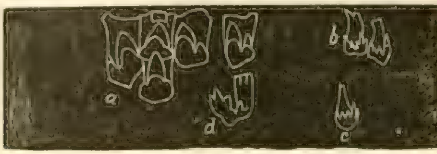
Read November 15th, 1869.

THE illustrations given in this paper are from figures obtained by the use of photographic negatives in a magic lantern, and reduced by photography. The negatives were taken by our friend Mr. Sam. Powel, of Newport, R. I., to whom we are indebted for valuable aid in the study of lingual dentition.

Succinea Nuttalliana, Lea.

The specimen from which was taken the lingual membrane here figured was labelled by Mr. Lea. It was received from the Smithsonian Institution. No locality is given for the specimen, but it was preserved in the same bottle as *Ancylus Newberryi*, *Pompholyx effusa*, *Fluminicola Nuttalliana*, and other species of the Pacific coast.

Fig. 1.



Lingual dentition of Succinea Nuttalliana, Lea.

Lingual membrane broad. Teeth 19.1.19, in almost straight transverse rows. Centrals short, stout, obtusely tricuspid, the central cusp with a long acute point, attached to a quadrate plate, the upper edge of which has a central quadrangular spot of thinner texture, easily mistaken for a complete cutting away of a portion of the plate. Laterals on somewhat oblong plates which bear on their outer upper corner a small quadrangular expansion, stoutly and obtusely bicuspid, the larger cusp surmounted by a long acute point; base rounded. Uncini on plates with rounded bases and attenuated and serrated apices, irregularly denticulated.

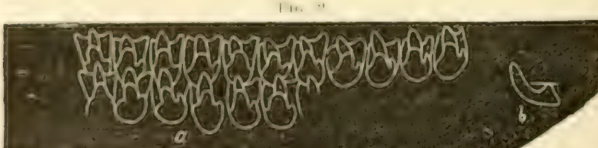
Fig. 1, *a* shows two centrals and two laterals, with a third lateral detached: *b* and *c* show uncini from the left of the median line; *d* the eighth lateral, partly in profile.

The jaw of *Succinea Nuttalliana* has a perfectly smooth anterior surface.

Bulimulus pallidior, Sowerby.

Lingual membrane broad, with numerous nearly straight transverse rows of 40.1.40. teeth. Centrals with one long blunt

Fig. 2.



Lingual dentition of Bulimulus pallidior, Sowb.

median, and two obsolete, small side cusps; plate subquadrate, rounded at base, excavated at its upper margin, and with small square, lateral expansions. Laterals much like centrals in shape, unsymmetrical, the inner side cusp being still more obsolete; base and inner side of plate forming one regular outward curve; upper edge of plate horizontal, with one lateral expansion only at its outer corner. Uncini on long, narrow, low, subquadrate plates, with one long, curving, blunt denticle, and one short blunt denticle at its outer side.

Fig. 2, *a* shows two incomplete rows of centrals and laterals; *b* one of the uncini, near the extreme lateral edge of the membrane.

The jaw has already been described (Land and Fresh-water Shells of North America, Part I., p. 196).

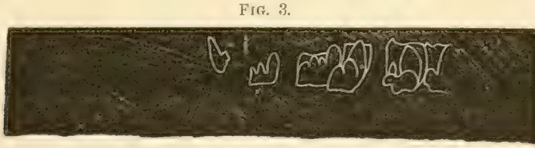
This species is from Lower California.

Helix tumida, Pfeiffer.

The specimen which furnished the lingual membrane here described was received from Messrs. Gloyne and Vendryes, of Kingston, Jamaica, to which Island the species belongs.

H. tumida is placed by v. Martens (Die Heliceen, 2d ed., 145) with several other Jamaica species, and *H. pemphigodes*, Pfr., of Cuba, in the subgenus *Cysticopsis* of Morch.

Fig. 3.



Lingual dentition of Helix tumida, Pfr.

Lingual membrane with numerous straight rows of 22.1.22 teeth. Centrals with three stout cusps, the middle one very large, on a subquadrate plate which has square lateral expansions above. Laterals of same form as centrals, but lacking the inner side cusp and inner lateral expansion. Uncini with one large and several smaller blunt cusps, attached to a long, subquadrate plate.

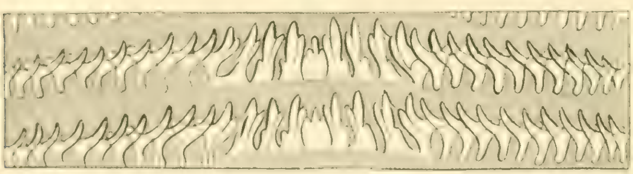
The figure presents one-half of one central, the first lateral, and several uncini (the fourth, fifth, and twelfth) to show variations in their form; also the thirteenth tooth in profile.

The jaw is long, narrow, slightly arched, blunt at ends, with a slight, broad, median projection. There is a long, narrow, conical projection springing upwards from about the centre of the anterior surface of the jaw, of the same color, material, and consistency as the jaw itself. This is not the muscular attachment which often adheres to the jaw after it has been extracted. Jaw with delicate distant longitudinal striæ.

Zonites lævigata, Pfr.

(See Land and Fresh-water Shells of North America, Part I., p. 287.) The wood-cut here given was engraved from a drawing

Fig. 4.



Lingual dentition of Zonites lævigata, Pfr.

by Dr. Leidy, prepared for, but not published in, the "Terrestrial Mollusks of the United States." The drawing was at once recognized on our recently obtaining the lingual membrane of the species.

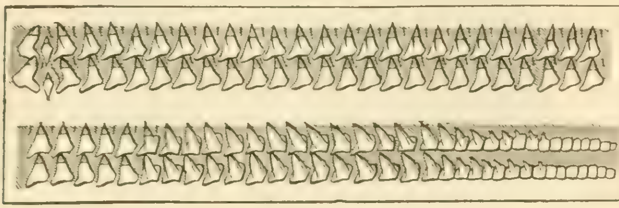
Teeth 17.1.17, arranged in curving transverse rows. Centrals short, stout, rounded at sides, square at base, apex with three short and pointed cusps, the middle one longest. Laterals long, narrow, tricuspid, the outer cusp very short and sharp, the central cusp extremely long, bulging at sides, tapering to an acute point; inner cusp almost as long as central cusp, narrow, pointed; third and fourth laterals merging into the uncini, which are aculeate, as common to the genera *Zonites* and *Hyalina*. The centrals are on a long, narrow plate, whose four sides curve rapidly inwards. The laterals are on plates long, narrow, curving outwards in an arcuate manner.

An extremely instructive lingual, showing the merging of laterals into uncini more completely than in any we have previously examined.

Veronicella Floridana, Binney.

(Terr. Moll. U. S., II., p. 17.) On p. 306 of Land and Freshwater Shells of North America, Part I., we figured the lingual

FIG. 5.



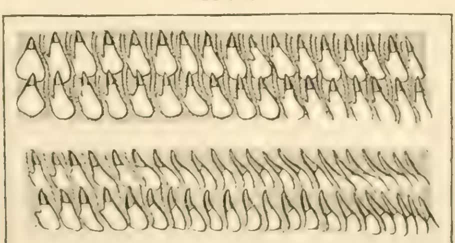
Lingual dentition of Veronicella Floridana, Bin.

dentition of this species, as drawn by Mr. Morse. We now give a figure drawn by Dr. Leidy for the "Terrestrial Mollusks of the United States," but not included in that work. The details of the separate teeth are much more accurately shown in the new figure. It will be noticed that Dr. Leidy gives 58.1.58 teeth, Mr. Morse 41.1.41, and our text (p. 304) 48.1.48.

Limax flavus, Linn.

A figure of the lingual dentition of this species, drawn by Dr. Leidy, is also given, for comparison with that of Mr. Morse, on

FIG. 6.



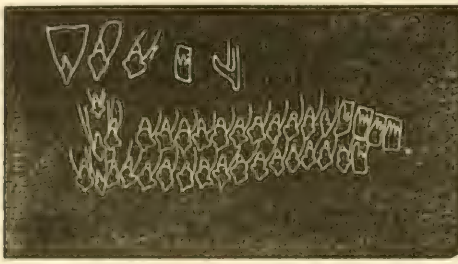
Lingual dentition of Limax flavus, L.

p. 63 of Land and Fresh-water Shells, Part I. Here also the number of teeth varies, as in *Veronicella Floridana*, described above.

Melampus bidentatus, Say.

The specimen which furnished the lingual membrane figured was collected at Newport, R. I., by Mr. Sam. Powel.

Fig. 7.



Lingual dentition of Melampus bidentatus, Say.

Lingual membrane broad. Teeth 33.1.33. Centrals small, upright, with rounding base and bulging sides, reminding one somewhat of the ace of clubs, its apex elongated, terminating in a distinct, acute denticle; this central is attached to a very large triangular plate, greatly expanded above. Laterals uniform, larger than the centrals, of the same shape, but less symmetrical, and with a much more extended and narrower basal projection; these laterals are perpendicular, but are attached to obliquely curving plates, long and narrow, each plate being detached. There are about thirteen of these laterals, in almost straight horizontal lines, on both sides of the median line. The uncini change abruptly from the laterals, are in oblique rows, are attached to upright, oblong plates, square at top and base, diminishing as they pass off laterally; the uncini are rather square, their broad, simple apices are armed with three strong denticles, the inner denticle being the largest.

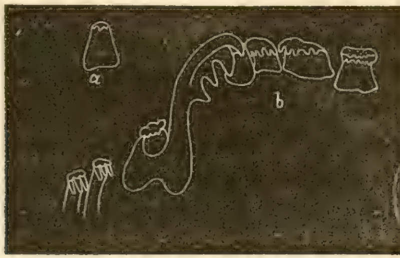
The figure represents two rows of centrals with the laterals to the right of the median line and a few uncini. The upper line of figures gives the central, the first two laterals, one of the uncini, and one of the laterals in profile, all detached.

The teeth of this membrane are so nearly on a plane as to allow one photograph to bring out all the details.

Helicina occulta, Say.

Lingual membrane long and narrow. Teeth 00.5.1.5.00, in transverse, arching rows. Centrals upright, longer than wide, widest at the horizontal base, slightly narrowing towards the apex, which is nearly as wide as the base, broadly recurved and

FIG. 8.



Lingual dentition of Helicina occulta, Say.

denticulated at its cutting edge. First lateral oblong, shorter than the central, rounded at base, narrowed towards the apex, which is broadly recurved and denticulated; this lateral is inclined obliquely from the central, its apex being reflexed in the same direction. The second lateral resembles the first lateral in every particular, but is much less wide. Third lateral perpendicular, longer than broad, triangular, its apex small, reflexed and denticulated. Fourth lateral very long, irregular, jaw shaped, its lower edge for one-half its length furnished with four strong, large, acute, beak like denticles; the left end of this lateral is produced in a horizontal direction, at right angles to the direction of the balance of the tooth, is excavated above and below, and in some instances appeared to have a wing-like expansion behind the uncini. Fifth lateral quite small, subcircular, its apex broadly reflected and denticulated, the whole tooth fitting into the upper excavation of the horizontal portion of the fourth tooth. The uncini, more than twenty-five in number, are long, slender, crowded, the apex reflexed and continued in three fringe-like denticles.

There seems to be great uniformity in the teeth of the different transverse rows, but there are in some instances five beak-like denticles on the fourth lateral. It is difficult to follow this tooth behind the crowded uncini, but we are confident that in some instances it is very much more expanded than shown in the figure, resembling a gull's wing. The first beak-like denticle seems to be on the same plane as the upper portion of the tooth; the other three are on the same plane as the lower portion; this is shown in the figure by the line running parallel to the upper edge of the tooth. The apex of the first denticle seems often to be recurved.

The fifth lateral is with much difficulty found under the microscope. It is on a different plane from the other teeth, and is crowded into the excavation in the fourth lateral. It seems often wholly filled up with foreign matter, not being as readily cleaned as the other teeth, even in a solution of potash.

The whole lingual is a very difficult study, and requires numerous views to bring out the details of its structure by photography. It is owing only to the untiring perseverance of Mr. Powel that we are able to illustrate it satisfactorily.

Fig. 8, *b*, shows the central and one-half of one transverse row of the laterals, with two uncini only. The balance of the uncini curve rapidly outwards and downwards, giving to the entire transverse section of the lingual membrane the usual strongly arched outline. (See Land and Fresh-water Shells of North America, Part III., fig. 216.)

Fig. 8, *a*, represents the third lateral, which is not well shown in its crowded position, as in *b*.

On p. 108 of Land and Fresh-water Shells of North America, Part III., a fac-simile is given of Troschel's figure of the lingual dentition of the other species of the United States, *Helicina orbiculata*. A comparison of the two figures will show that the species differ in their lingual dentition as widely as in their shells.

The specimen from which the membrane was extracted was found living by Mr. E. R. Leland, who gives the following notes of its station :—

"The locality in which I found the *Helicina occulta* is a fishing station known as Whitefish Bay, six miles north of this city (Milwaukee, Wisconsin), on the slope of the lake bluff, which at that point is somewhat wet and boggy, with a growth of pines, tamaracks, juniper, and some deciduous trees. They were under dead leaves beside logs; on the 30th of May and 6th of June, 1869, they were in considerable numbers, though they could hardly be said to be abundant. I have not visited that place since the latter date. On the 19th inst., however, I found a few specimens in a ravine near the lake, about two miles and a half north of the city—making in all some twenty-five specimens found, among which are two young ones with an acute carina."

The locality is an interesting one, showing the possibility of a tropical genus existing in a cold latitude. The discovery of Mr. Leland is of far greater importance, however, in proving beyond doubt the fact of *Helicina occulta* actually existing at the present time. The species is found very plentifully in a fossil state in the post-pleiocene of the Western States, and is generally supposed to be extinct. Dr. Binney has (Terr. Moll. I., 183, 184) argued at length against this opinion, and figured specimens apparently recent (Ibid. III., pl. lxxiv., fig. 1); he also referred to this species the shell found living in Western Pennsylvania by Dr. Green, and described by him as *Helicina rubella*. Specimens in an apparently recent state have also been received by us from Sheboygan, Wisconsin, and through the Smithsonian Institute from Lexington, Virginia, collected in the latter locality by Mr. McDonald. Fresh specimens were, however, so rare that belief in the extinction of the species prevailed generally. Dr. Gould referred (Terr. Moll. U. S., II., 352) *Helicina rubella* to *Helicina orbiculata*, a recent species found as far north as Tennessee, and finally in the Land and Fresh-water Shells of North America, Part III., *Helicina occulta* is removed from the catalogue of recent species and quoted only among the fossils.

Mr. Leland has now reversed this decision by finding the animal actually living. It is in consequence fair to presume that the Sheboygan specimens are also recent, as well as those from Lexington, Virginia, and that the species, though, perhaps, rarer than formerly, is still to be found in the Western States.

Those persons not having access to Doughty's Cabinet of Natural History will be interested to know that *Helicina rubella* was found on hills not far from Pittsburg, Pa., on the old post road from that place to Wheeling. Dr. Green received it from a friend, and immediately questioned its origin, but was assured that it had been actually found living on more than one occasion.

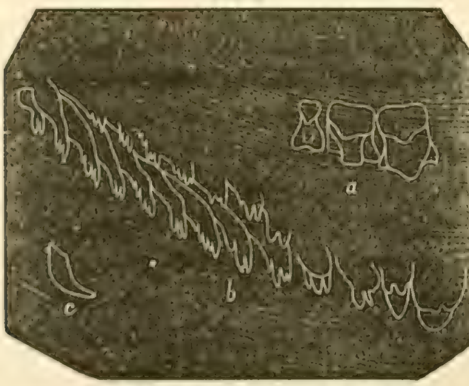
We presume that Prof. Kirtland (Ohio Report) refers to the same individuals as received by Dr. Green, when he speaks of a species of *Helicina* being found on the hills adjacent to the Ohio river.

Mr. Say described *Helicina occulta* from fossil specimens from a bluff near New Harmony, Ind. He did not notice it living, nor has any author done so. The name occurs, indeed, in several catalogues of Recent Species, but we have never known it to be found with the living animal until now.

Pompholyx effusa, Lea.

The shell from which was extracted the lingual membrane

FIG. 9.



Lingual dentition of Pompholyx effusa, Lea.

here described is one of the original lot received from California, from which the species was described. It was labelled by Mr. Lea.

A figure of the shell, with descriptions of the external characters of the animal, will be found in Land and Fresh-water Shells of North America, Part II., p. 73–74. As there has been some discussion in regard to this species having two pairs of eyes, we will here repeat that the eyes are situated in the place usual in the Limnæidæ.

Lingual membrane broad, with 22.1.22 teeth. Central teeth upright, narrow, widening and knobby at the base; apex recurved, and produced into an obtuse beak. Laterals nine on each side of the central line, in a straight transverse row, wide, quadrate, apex recurved, prolonged beyond the base of the tooth in a more or less broad blunt beak. Uncini about thirteen on each side of the median line, in oblique transverse rows, not attached to a plate, simple and not recurved; the first eight from the extreme lateral edge of the membrane long, narrow, arm-shaped, terminating in a wrist-like contraction and hand-like expansion, strongly digitate. The remaining uncini gradually changing into the shape of the laterals, but still not merging into them, the line of demarcation being strongly marked.

There is great variation in the beak-like projection of the recurved apex of the laterals, and still more in the digitation of the uncini.

The jaw is long, narrow, slightly arcuate, with blunt ends; anterior surface smooth.

By the characters of its lingual dentition, and its horny jaw, *Pompholyx* appears nearly related to *Planorbis*.

Fig. 9, *a*, represents the central and two laterals to the right of the median line; *b* gives one full series of uncini to the left of the median line; and *c* one of the uncini in profile.

Planorbis trivolvis, Say.

The specimen from which was extracted the lingual membrane here figured was collected at Newport, Rhode Island, by Mr. Sam. Powel.

Lingual membrane broad, with slightly curving rows of teeth.

Teeth 19.1.19. Centrals sub-oval, rounded at base, narrowing toward the top, which is squarely truncated; apex broadly recurved into an obtuse beak, beyond which are two long, narrow, tusk-like projections. First seven laterals uniform, in an almost straight transverse series, detached, inclining obliquely toward the median line, large, square, broadly reflexed, extending beyond the base in a wide, blunt beak, at each side of which are

Fig. 10

Lingual dentition of Planorbis trivolvis, Say.

usually one or more small denticles. These laterals pass gradually into the uncini, which are in curving rows, long, narrow, widely recurved, with variable, strong, beak-like digitations on their apices and outer sides.

There is great variation in the digitations on the uncini, no two of which appear alike. The laterals also vary somewhat in the breadth of their recurved beaks.

Fig. 10, *a*, represents two central teeth with two of the first laterals on the left of the median line; *b* the merging of the laterals into the uncini; and *c* extreme uncini. *b* and *c* are taken from the right of the median line.

Tulotoma magnifica, Conrad.

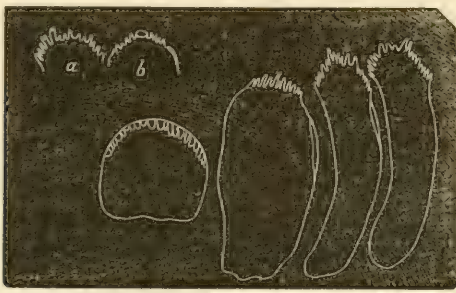
Through the kindness of Dr. E. R. Schowalter, of Uniontown, Alabama, we are able to describe the lingual dentition of *Tulotoma magnifica*, Conrad. The specimens received from Dr. Schowalter were taken in the Coosa river, Alabama.

It will be seen that in its lingual dentition *Tulotoma* is more closely allied to *Vivipara* (as suggested by Gill, Proc. Acad. N.

Sc., Phila., 1863) than to *Melantho* and *Lioplax*. (See Land and Fresh-water Shells of North America, Part III., pp. 16, 35, 55, etc.)

Lingual membrane long, with the arrangement of teeth usual to the family. Teeth 3.1.3. The centrals are subcircular, with a truncated, irregularly horizontal base; the apex recurved, channelled, and obtusely knobbed or denticulated. The first lateral is about as wide as the central, oblong, bulging at the sides, truncated and horizontal at base, its apex deeply digitated or fringed, some of the denticles being recurved at their apices. The second

FIG. 11.



Lingual dentition of Tulotoma magnifica, Conrad.

lateral is laminar, narrowing slightly towards the truncated base, curving outward from the central tooth, its apex with long fringe-like denticles, some of which are recurved, others obtusely knobby. The third lateral resembles in shape and size the second, but is somewhat less curved, and has shorter, less delicate denticles.

There is considerable variation in the number, length, delicacy and arrangement of the denticles on the different teeth. In some cases they are very broad, with simple recurved edges. In others they are long, narrow, and bifurcate. Again on many teeth the denticles are not absolutely separated one from the other, but the end of the tooth is rather deeply channelled.

The variations occur in the laterals, the centrals being more uniform. The side edge of the laterals is sometimes recurved for a considerable length.

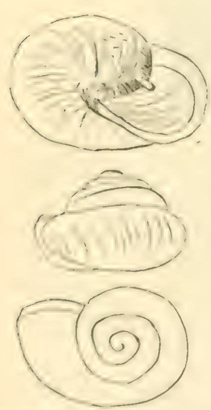
In figure 11 outlines are given of one central tooth and the three laterals of one side of the lingual membrane, with (*a* and *b*) the apices of two separate laterals, to show variation in the denticulations.

The generic characters of the animal of *Tulotoma* never having been given, we add them here. Foot moderate, not produced beyond the snout. Color dark blue. Head and snout small. Lingual teeth as described above. Right tentacle broad. Left cervical lappet small; right larger, trough-shaped. Branchial laminæ numerous, long, narrow, crowded in a double row.

Mesodon leucodon of Rafinesque.

The name *Mesodon leucodon*, Raf., has found its way into the books as a synonym of *Helix thyroides*. As no description of any such species was ever published by Rafinesque, we have expressed the opinion that it was originally a manuscript name sent by Rafinesque to Ferussac. (Terr. Moll. U. S., IV., 54.) Since that time we have seen a manuscript work by Rafinesque, entitled "Conchologia Ohioensis," given by Prof. Haldeman to the Smithsonian Institution. In this there occurs not only a description, but a figure of *Mesodon leucodon*. These are here copied as conchological curiosities. They have, of course, no scientific value.

Fig. 12.



Mesodon leucodon thyroide.

"Mesodon Leucodon. Roussâtre, varié de petites taches brunes, irregulières, provenantes de l'animal; très finement strié entravers; levre bordi aigu, réfléchi; dent blanche, oblique au milieu de la bouche; forme bombée, convexe, obtuse; opercule collé, membraneux."

The operculum referred to is no doubt the epiphragm.

In the same manuscript are other figures scarcely recognizable, but one of *Mesodon labiatum*, a species not described in any printed work, seems to represent the carinated form of *Helix pal-*

Fig. 13.

Mesodon labiatum.

liata. A copy of this figure is here given.

Note on **Vivipara lineata,** Valenciennes.

By W. G. Binney.

When studying the Viviparidæ of North America in preparing the Smithsonian "Land and Fresh-water Shells of North America, Part III.," I found in use, both in published works and in collections, the name *Paludina lineata* of Valenciennes for a species of *Vivipara* of the United States. From the work of Humboldt and Bonpland I obtained the description of Valenciennes, of which an English translation is here given :—

Paludina lineata.—This species resembles that of the Seine. It is equally ventricose, but has a thinner shell. Shell ventricose-ovate, thin, diaphanous, with delicate transverse striæ; greenish horn-color, with numerous transverse greener vittæ. Whirls five, last one large, ventricose, and equalling in height one-half the entire length of the shell. Besides the striæ of growth, there are numerous transverse, very fine lines. The whirls are not flattened towards the moderate suture. Apex acute. Color green, sometimes somewhat corneous ground, on which are a large number of bands of a deeper green and variable width, sometimes merely linear. On the upper whirls the bands are obsolete. Apex not eroded in any of a large number of individuals.

Operculum brown, thin, horny, covered with numerous concentric, not spiral lines. Found in Lake Erie by M. A. Michaud, who found one shell full of young, as in the case of our species, which proves the species to be viviparous. There is reason to believe the other species also are so, though in the most natural genera species vary in being both oviparous and viviparous. The genera of colubers and vipers among the reptiles are an exampie of this, while the Mollusca furnish more numerous ones.

Length 1 inch 3 lines.

It needed but a glance at this description to convince me that it was never drawn from a specimen of the species to which the name *lineata* has been applied by American authors. It was equally clear to me that the description was not applicable to any species known to inhabit the region indicated by Valenciennes. I was obliged, therefore, in the work referred to (p. 31), to leave it a doubtful species, with the hope of its eventually being rediscovered.

Here the matter rested, until an opportunity occurred of clearing up all doubt regarding the identity of *Paludina lineata*, Valenciennes. While in Paris, in 1867, it occurred to me to look among the shells at the Garden of Plants for the original specimen of Valenciennes. Through the kindness of Prof. Lacaze-Duthiers every facility for the search was given me. I very soon found the desired type, glued to a card tablet and labelled, in the handwriting of Valenciennes, "Paludina lineata, Val., dans Humboldt et Bonpland, tome II. Du lac Erie, l'Amérique du Nord, par M. Michaud;" but below was written in the same hand "C'est faux, elle vient de l'Inde."* Here then was a simple solution of the difficulty. The species is not American. It is the well-known Eastern shell figured by Küster as *Paludina Bengalensis* (Chemn., ed. 2, figs. 15, 16). Other specimens from Delhi, Bengal, &c., are labelled *P. lineata*, also in Valenciennes' handwriting; on one tablet *Pal. fasciata*, Gray, is given as a synonym.

A few days after this interesting discovery at the Garden of Plants I was looking at a copy of Humboldt and Bonpland's "Recueil d'Observations, &c." at the house of M. Crosse. Turning to the description of *Paludina lineata*, I found a marginal note referring the species to Bengal instead of Lake Erie. Recognizing the handwriting of Valenciennes, I called the attention of M. Crosse to it, and learnt that the book had actually belonged to Valenciennes, at the sale of whose library it was bought by M.

* Paludina lineata, Val., in Humboldt and Bonpland, vol. 2. From Lake Erie, North America, by Mr. Michaud. This is a mistake, the shell comes from India.

Crosse. Here, then, was an additional proof of the erroneous habitat originally given by Valenciennes.

I should add that the shell found by me labelled as the type of *Paludina lineata* in the Garden of Plants answers well to the description of Valenciennes.

The facts given above remove *Paludina lineata* from the catalogue of American *Viviparidæ.* Unfortunately, however, the name *lineata* remains to burden and confuse our synonymy. Haldeman, surely without critical examination, referred Valenciennes' description of *Pal. lineata* to the North American species described by Say as *Paludina vivipara.* Haldeman has been blindly followed by most American authors, and by Küster, who further adds to the confusion by a typographical error, using *linearis* instead of *lineata* in a single instance, a name which some have tried to perpetuate.

This confusion would have been avoided by a reference to the original description of Valenciennes, instead of accepting the name from correspondents or books. It is one of the greatest faults of American writers on Conchology thus to accept names, without reference to original descriptions.* Until this fault is corrected, the disgraceful confusion of our synonymy will be worse confounded.

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* An instance of the mistakes thus arising is to be found in reference to this very species of Valenciennes. A writer in the Proc. Ac. Nat. Sc, Phila. (1862), 451, notes the fact of a certain species of North American *Vivipara* being characterized by *four* spiral red bands, and further insists on the permanency (invariability?) of the characteristic as a guide in distinguishing it from an allied European form which has but *three* bands. Yet this author refers this strictly four-banded species to *Paludina lineata*, Valenciennes, a species described not as having *four* red spiral bands, but as having a *large number* of bands of a deeper *green* and variable width, sometimes merely linear. Surely, if the species invariably has four bands, such a description as the last cannot apply to it.

XIX. *Notes on Species of the Family* CORBICULADÆ, *with Figures.*

BY TEMPLE PRIME.

(Continued from Vol. viii. page 418.)

Read November 22d, 1869.

Genus CORBICULA.

53. Corbicula ammiralis, nov. spec.

C. testa trigona, subtriangulari, æquilaterali, compressiuscula, solidiuscula; latere antico rotundato, postico brevi, subtruncato, margine inferiore arcuato; umbonibus parvulis, obtusis; pagina interna violacea; sulcis irregularibus, quantummodo obsoletis; epidermide olivaceo-lutescente vestita; cardine incrassato.

FIG. 70.

Corbicula ammiralis.

Long. 14; lat. 13; diam. 7 mill.

Hab.—Saigon, Cambodiæ. Collect. Morelet et Prime.

Closely allied to species from the same region, *Corb. Lydigiana*, *erosa* and *castanea*, though smaller than either of them. Compared with *Corb. castanea*, it is more triangular, the hinge-margin is more angular, and the hinge itself is stronger. It differs from *Corb. Lydigiana* in being less solid, less triangular, less inflated, less heavily sulcated, and in having an epidermis of a different color and which is not glossy.

54. Corbicula gubernatoria, nov. spec.

C. testa ovato-transversa, compressiuscula, æquilaterali; extremitatibus subrotundatis; umbonibus parvulis, rotundatis; sulcis obsoletis; epidermide pallide viridi-flavescente, subnitente, vestita; pagina interna candida; dentibus violaceis.

FIG. 71.

Corbicula gubernatoria.

Long. 16; lat. 13; Diam. 8 mill.

Hab.—Saigon, Cambodiæ. Collect. Morelet.

In outline and size this species presents some similarity to *Corb. occidens.*

55. Corbicula Delessertiana, nov. spec.

C. testa ovato-transversa, æquilaterali; extremitatibus rotundatis; regulariter striata; umbonibus tumidis, prominentibus, colore violaceo subradiatis; epidermide nitente viridescente vestita; valvis intus violaceis.

Long. 20; lat. 17; diam. 11 mill.

Hab.—Smyrna, Asiæ Minoris et Egypta. Collect. Morelet et Prime.

The specimens of this species in the cabinet of M. Morelet came from Smyrna, and those in mine from the Pyramids, but I have been unable to detect any material difference between them.

Named in memory of Baron Delessert, of Paris, who was in possession of the original Lamarck collection.

56. Corbicula imperialis, nov. spec.

C. testa ovato-transversa, compressiuscula, æquilaterali; latere antico rotundato, postico subtruncato; umbonibus brevibus; margarita violacea; regulariter et densè striata; epidermide subnigra, nitente vestita.

Long. 27; lat. 23; diam. 14 mill.

Hab.—Pondicherry, Indiæ. Collect. Prime.

57. Corbicula Amazonica, Anthony, nov. spec.

C. testa ovato-trigona, obliqua, compressiuscula, subinæquilaterali; latere antico breviore, rotundato, postico elongato, subangulato; umbonibus prominentibus, obliquis; regulariter et densè striata; epidermide olivacea vestita; valvis intus violaceis; sinu pallii brevi.

Long. 18; lat. 16; diam. 10 mill.

Hab.—Flumen Amazonicum, Americæ Meridionalis. Collect. loco Cambridge dicto, Mass., et Prime.

This species was found in the stomach of a fish collected by Professor Agassiz's expedition to Brazil, in the Amazon river. Very closely allied to *Corb. obsoleta* from Uruguay; it is, however, smaller and less heavy; it may possibly prove to be the young of that species.

61. Corbicula baronialis, nov. spec.

C. testa ovato transversa, compressiuscula, subæquilaterali; latere antico rotundato, postico subtruncato; umbonibus brevibus; epidermide flavescente vestita; sulcis irregularibus, quantummodo obsoletis; valvis tenuibus, intus albidis.

Long. 17; lat. 14; diam. 9 mill.

Hab.—Portum Mortoni, Australiæ. Collect. Prime.

62. Corbicula consularis, nov. spec.

C. testa ovata, solidiuscula, tumidula, æquilaterali; latere antico rotundato, postico subtruncato; umbonibus tumidulis; striis regularibus, distantibus; epidermide flavescente, maculis subnigris plus minusve notata, nitente, vestita; valvis intus albidis.

Long. 17; lat. 14; diam. 10 mill.

Hab.—Malacca. Collect. Prime.

63. Corbicula episcopalis, nov. spec.

C. testa subtrigona, inæquilaterali, compressiuscula; latere antico dilatato, postico quantummodo abrupto; umbonibus tumidulis; regulariter sulcata; epidermide pallide viridi-flavescente, maculis subnigris plus minusve notata, nitente, vestita; valvis solidis, intus pallide violaceis; cardine incrassato.

Fig. 72.

Corbicula episcopalis.

Long. 16; lat. 14; diam. 9 mill.

Hab.—Cambodia. Collect. Morelet.

Compared with *Corb. Larnaudieri*, from Siam, it is larger, heavier, and less transverse.

Genus Cyrena.

13. Cyrena tribunalis, nov. spec.

C. testa trigona, inæquilaterali, tumida; latere antico rotundato, postico angulato, longiori; densè et regulariter striata;

epidermide olivacea vestita; valvis solidis, intus albidis, ad margines violaceis; sinu pallii cuneiformi.

Long. 55; lat. 45; diam. 33 mill.

Hab.—Ecuador, Americæ Meridionalis.

XX.—*Review of the Fish of Cuba belonging to the Genus* Trisotropis, *with an Introductory Note by J. Carson Brevoort.*

By Felipe Poey.

Read December 8th, 1869.

INTRODUCTORY NOTE.

The genus *Serranus*, as established by Cuvier, brought together a number of fish which had been scattered in at least twelve other genera by various authors. Cuvier divided it into three groups, which, however, are not well defined. In the "Histoire des Poissons," vol. ii., 1828, one hundred and seven species are described, collected from all the tropical and subtropical seas. Dr. Albert Günther, in his Catalogue, vol. i., 1859, describes one hundred and thirty-five species, and enumerates many others which he had not seen or identified. He proposes groups without generic names, founded in part on characters that vary with age, and which bring together species that inhabit widely remote seas. Mr. Th. Gill, in the Proceedings of the Academy of Sciences of Philadelphia, 1862, p. 236, and in 1865, p. 104, separates the West Indian and Atlantic American species into distinct genera that appear well founded. Professor Poey, of Havana, who has done so much for the natural history of Cuba, and who is particularly well acquainted with the ichthyological fauna of that island, has adopted Mr. Gill's genera in his *Synopsis Piscium Cubensium*. In this catalogue he enumerates forty-nine species of West Indian *Serranini*. Three are found on the Atlantic coast of the U. S., as far north as New York. No ichthyological fauna of our coast south of Charleston has been published, but no doubt many *Serranini* will be found there which are on Professor Poey's lists. J. C. B.

Characters of the genus. The genus *Trisotropis* was well established by Mr. Gill in the Proceedings of the Academy of Natural Sciences of Philadelphia, 1865, p. 104, in order to include a group of fish of the subfamily of *Serranini*, family *Percidæ*. It may at once be distinguished by the very projecting lower jaw; the mouth opening beyond the eyes, which last are high up; the fin-ray formula, D. XI. 16—17, A. III. 11; the squarely truncated caudal with two short points; the small and numerous scales covering all the head to the end of the snout, even on the maxillaries, where they are very small, and on the base of the membrane supporting the vertical fins. The jaws, besides the external row, have card-like and movable ones; the skull is broad and flattened above, with very low occipital ridges. Other details may be found in Mr. Gill's article above quoted. I will add that the canines are short and robust, the nostrils close together, the anus a little advanced. The teeth of the vomer form a half circle. The last spiny ray of the dorsal is longer than the one in front of it; the anal spines are small, feeble, and covered by the skin; the scales, hardly ciliated, are almost always covered by the epidermis; very small scales mixed with the large ones are sometimes found, looking like small glands under the epidermis. The color in all the Cuban species is of a brown violet, with spots or wavy bands of dark brown, sometimes accompanied with reddish spaces. The upright fins often have a narrow white border; the intestine is small, with the usual circumvolutions, sometimes a little gathered into a ball behind; the cæcums very long, about twelve in number; the air-bladder is narrow; the suborbital bones are five in number, and there is also a small bone strongly imbedded in the post-frontal, besides the ordinary supra-temporal bones. Each maxillary has a labial. Vertebræ 10—14, the six first without transverse apophysæ.

These fish are common, and almost all of them become very large; they are good to eat, though sometimes suspected of being noxious when of large size. They are known in Havana under the names of *Bonaci* or *Aguaji*, and also *Abadejo;* this last one improperly applied, for in Spain it is applied to a kind of cod. The ones called Abadejo differ from the others by their lips being green towards the corners of the mouth, by the whitened margin of the pectoral, as also by a projecting spur on the angle of the preopercle.

The genus *Epinephelus* of Bloch, as limited by Mr. Gill, approaches *Trisotropis*, but differs by the form of the skull, the rounded caudal, and the small number of articulated rays in the anal, generally 9, and sometimes 8. I would, however, observe that the *Epinephelus morio*, Val. (*erythrogaster*, DeKay), has a caudal like *Trisotropis.*

The object of this review is not to give a complete description of each species, but to give some of their distinctive characters, and to correct some errors of synonymy. Besides, the species being well known, I will refer to the preceding general characters, and for fuller details to the authors quoted. I here quote my *Memorias Sobra la Historia Natural de la Isla de Cuba*, tome ii., 1860, and my *Repertorio Físico-Natural de la Isla de Cuba*, 1867, 1868, in which my *Synopsis Piscium Cubensium* forms the last half of the second volume.

Trisotropis cardinalis.

Serranus cardinalis. VAL., in C. V. Poiss. ii., 378.
" *rupestris.* VAL., " " ix., 437.
Bonaci cardenal. PARRA, tab. 16, fig. 1.
Johnius guttatus. SCHN., in Bloch, Syst. 77.

The back is red, the lower parts of the body violet, the trunk covered with blackish quadrilateral spots; the lower parts of the head and stomach with rounded reddish spots, which cover also a great part of the fins. In the adults the black spots are smaller and rounded, and the red ground color not so marked; but it is found on some parts at all ages. The pectorals have an orange border, not distinct in the young ones. The extent and intensity of the red color is proportioned to the depth of the waters it frequents. The preoperele is rounded and finely denticulated.

It attains a weight of 25 pounds. Is found, according to M. Valenciennes, at St. Domingo and St. Bartholomew. Popular name in Havana, *Bonaci cardenal.*

Schneider knew this species only through the text and figure of Parra; and although the name of *guttatus* has the priority, it cannot be preserved because at the time Valenciennes was writing there was another *Serranus* which Linnaeus, and also Bloch, had named *Perca guttata*, which is now the *Petrometopon guttatus*, same as *Serranus coronatus*, Val., of which the *S. nigriculus* is only a darker variety. There was also the *Bodianus guttatus*, Bloch, from the East Indies, which is the *Epinephelus argus*, Bl., Syst., and the *Cephalopholis argus*, Schneider, the same, according to Dr. Günther, as the *Serranus myriaster*, Val. There was, besides, the *Serranus guttatus*, Val. (*nec.* Bl.), also from the East Indies, which according to Günther is the *cyanostigmatoides* of Dr. Bleeker.

Valenciennes gives the *S. cardinalis*, from Parra, without having seen a specimen of it; and it is not surprising, therefore, that he afterwards should have made it the *S. rupestris*, when he received it from St. Domingo.

Trisotropis petrosus.

Serranus petrosus, Poey, Mem. ii., 136; Repert. ii., 55.

Ground color of the body a rather light-brownish violet, covered with pretty close-set round spots of a reddish brown, of about the size of the pupil of the eye; besides which large quadrilateral spaces may be indistinctly traced along the trunk. There is no red on the body or fins, which are of a dark brown, except the pectoral, which are black with a broad, bright orange border, distinctly marked, at least in the large specimens, the only ones that I could observe. The preoperele is rounded. It reaches a weight of 25 pounds. I sent, at the request of M. Agassiz, a specimen 720mm long to the Museum of Comparative Anatomy, at Cambridge, Mass. In Havana it is called *Bonaci de piedra.*

After describing this species in my Memorias, I made it, in my Synopsis, p. 282, a variety of the *Trisotropis cardinalis*, because I believed that the round spots were peculiar to the adults, and that at the same time the red color disappeared; but I now believe that our fishermen are right in considering it a distinct species.

Trisotropis brunneus.

Serranus brunneus, POEY, Mem. ii. 131; Rep. ii. 156; Syn. 284.
" *arara*, POEY (*nec* VAL.), Mem. ii. 132.
" *decimalis*, POEY, Mem. ii. 138 (*aculeis erroneis*).
" *cyclopomatus*, POEY, Mem. ii. 353.
" *latepictus*, POEY, Mem. ii. 353.

The whole body covered with large irregularly quadrilateral spots of a violet brown, separated by pale rivulations which run together under the stomach. The fins are brown, and the margin of the pectorals, not at all or else a little bordered with orange, without definite limits. In this the species chiefly differs from *T. petrosus*. I sent a specimen to the Cambridge Museum, $1250^{mm.}$ long, weighing 66 pounds. In the young specimens the form and size of the spots vary greatly, which caused me to mistake varieties for species. The preopercle is rounded. Its popular name is *aguaji*.

See for comparison the notes on my fifth species, the ***Bonaci** arara* of Parra.

I at first believed that the *Serranus undulosus*, Val., Poiss. ii. 295, from Brazil, might be the same as the Cuban species; but having received it from Paris through M. Aug. Duméril, 8 inches long, I saw that the caudal was slightly rounded, which is not a difference due to age, as I found on comparing it with young specimens observed in Havana. The brown undulations, oblique on the cheeks, horizontal on the body, the yellow base of the anal and of the soft dorsal, would bring the Brazilian specimen near to my *Trisotropis aguaji*. It is probable that the *Serranus undulosus*, attributed to Valenciennes by Dr. Günther, Cat. i. 143, does not belong to the original type, as it has yellow pectorals.

There is a *Serranus brunneus*, which is the *Epinephelus brunneus* of Bloch, tab. 328; but from its rounded caudal and its anal noted as III. 8, it belongs to the genus where Bloch placed it.

Trisotropis aguaji.

Trisotropis aguaji, POEY, Repert. ii. 229; Synopsis, 284.

It is well distinguished from the preceding species by the color of the vertical fins, in having the caudal, the anal, and soft dorsal half yellow, which covers the base, and half dark brown which covers the broad border. I sent a very large stuffed specimen to the Cambridge Museum, about 1110$^{mm.}$ long, which is figured in my MS. portfolio, as well as one other of 1120$^{mm.}$ The popular name is *aguaji*.

Trisotropis bonaci.

Serranus bonaci, POEY, Mem. ii. 129, Rep. ii. 155; Syn. 283.

Bonaci arara, PARRA, tab. 16, fig. 2.

Johnius guttatus, var. SCHN., in Bl. Syst. 77.

I only once met with a large specimen, 425$^{mm.}$ long; and would have liked to find several, in order to confirm more completely the specific characters shown in my drawing and in my *Memorias*; namely, the whole body covered with rounded spots of a light reddish brown, on a darker violet-brown ground. It had, however, no large flexuous quadrilateral spots. The fins are of a more or less brownish green. The preopercle is rounded.

I believed, though with some doubt, when I wrote in my *Memorias*, ii. 130, "that the *Serranus arara* of Val., Poiss. ii., 377, was the same as the *Bonaci arara* of Parra," to which he joins it; but I have since seen that it is the same fish as the one figured by M. Desmarets, *Dict. Class.*, which is no other than the *Epinephelus lunulatus* of Bloch.

Trisotropis camelopardalis.

Serranus camelopardalis, POEY, Mem. ii. 132; Syn. 283.

This species, like the *T. cardinalis* in shallow water, has the upper parts of the body of a more or less bright red, according to the depth it inhabits. It has been observed that, contrary to the usual rule in the seas of Cuba, the deeper this fish is found, the brighter are its colors. The lower parts are duller. Eight pale brownish violet bands fall from the back towards the middle of the body; one on the nape, four under the spiny dorsal, and three under the soft dorsal. The sides and the abdomen have round spots of a brownish red on a violet ground. Pectorals dirty red.

Preopercle rounded. This fish becomes large; the one described is 510$^{mm.}$ long, and its fin ray formula is D. XI. 16, A. III. 10, according to my drawing; which, however, would be exceptional, as regards the anal, for the normal number in the genus is III. 10.

Trisotropis tigris.

Serranus tigris, VAL., Poiss. ix. 440.
  " *felinus*, POEY, Mem. ii. 134.
  " *rivulatus*, POEY, Mem. ii. 135.
  " *repandus*, POEY, Mem. ii. 135.

Vide POEY, Repert. ii. 155; Synopsis, 283.

This fish differs chiefly from the preceding one by the total absence of the red color, but it has the vertical bands and the ventral spots, which is the reason that it is also commonly known as *Bonaci gato.* The violet brown is therefore the general ground color of the body. Pectorals reddish brown, with an orange border. I have seen several a foot long, the one described being a foot and a half. Valenciennes' specimen was from St. Domingo.

Trisotropis calliurus.

Mycteroperca calliurus (lege *calliura*), POEY, Repert. i. 181, 409; Syn. 286.

This and the following species form a group to which the vulgar name of *Abadejo* is applied, having greenish lips and a salient angle on the preopercle. This species is easily recognized by its closely set nostrils and by the caudal, each ray of which ends in a point. Pectorals bordered with white. Body brown, with a violet tinge, covered with round yellowish spots, which disappear on the dried skin. I have had them 500mm. long.

Trisotropis interstitialis.

Serranus interstitialis, POEY, Mem. ii. 127; Syn. 285.

Also an *Abadejo*, distinguished by its nostrils and caudal as before. The general color brown, shaded into violet; all the body except the head crossed in every direction by lighter lines, to such a degree that it appears to be covered with square spots of the size of the pupil, separated by narrow intervals, which may be seen to a certain extent on the dried skin also. Pectorals brown, with a black border ending in white; lips greenish; preopercle angular. Length 380mm.

Trisotropis chlorostomus.

Trisotropis chlorostomus, POEY, Rep. ii. 231; Syn. 285.

Distinguished from the preceding species by the spots being rounded, smaller, and wider apart. Length 330mm. I have several eight inches long, which have a caudal like the earlier ones of this genus. Vulgar name, *Abadejo*.

Trisotropis dimidiatus.

Serranus dimidiatus, POEY, Mem. ii. 129; Syn. 285.

The body is dark brown, tinged with violet above, and light brown, tinged with pink, below; a black spot on each side of the caudal peduncle; front of the dorsal greenish yellow. I have seen none over a foot long. It has the characters of the *Abadejos*.

Trisotropis falcatus.

Serranus falcatus, POEY, Mem. ii. 138; Syn. 285.

This *Abadejo* has only been seen once as long as 370^{m}. The body is brown, covered with darker brown spots; the caudal appears forked, on account of the long outer rays. The fifth and sixth soft rays of the anal are prolonged in a point; edge of the pectorals orange.

XXI.—*Note on the Hermaphroditism of Fish.*

BY FELIPE POEY.

Read December 20, 1869.

THE indications given by Cavolini, and the judgment passed upon them by Cuvier and Valenciennes, may have led us to suspect the existence of normal hermaphroditism in certain fish, but Dufossé alone has the credit of having proved the existence of it, in 1856, on three ACANTHOPTERYGIANS of the PERCOID family, belonging to the genus *Serranus*, namely, *S. scriba*, *S. cabrilla*, and *S. hepatus*. Each individual of these three species produces eggs which it impregnates as soon as they are ejected. These facts are all the more remarkable as Müller * has said: " The separation of the sexes is so constituted, that the VERTEBRATA and the ARTICULATA exhibit no signs of normal hermaphroditism."

I have since called attention to a similar occurrence in *Mesoprion ambiguus*,† which I described and figured, showing the organs of generation. Having been able to examine but one specimen, I am ignorant as to whether the hermaphroditism be normal or accidental.

I will now add that I have discovered hermaphroditism in two other species of the PERCOID family, namely, in *Lutjanus Ca-*

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* See paper by Dufossé, Ann. des. Scie's. Nat., 4me sér., vol. v., p. 295, pl. viii.

† Mem. sobre la Hist. Nat. de la Isla de Cuba. vol. ii. p. 152, pl. xii.

ballerote, which species is placed by Bloch* under the genus *Anthias*, and was confounded by Cuvier with his *Mesoprion cynodon*; the specimen measuring fifteen inches in length; and also in *Ocyurus chrysurus*, which is placed by Bloch under his genus *Sparus*, and by Cuvier among the *Mesoprions*. I found this to be the case in the latter several times, and more especially so in a specimen of twenty-one inches. I have forwarded one of eighteen inches to Professor Agassiz, Director of the Museum of Comparative Anatomy of Cambridge.

In the three species above named the male genital organ and the female organ present themselves as closely joined one to the other. They are readily distinguished by means of their color and the granulation. In all instances the milt is in a greater state of advancement than the ovaries.

XXII.—*Lepidopterological Miscellanies. No.* 2.

By Coleman T. Robinson.

Read December 20, 1869.

NOCTUIDÆ.

Hypena baltimoralis.

Hypena baltimoralis. Guenée, Delt. et Pyr., p. 34, 1854.

Hypena baltimoralis. Walker, List Lep. B. M., Part xvi. p. 31, 1858.

Hypena benignalis. Walker, List Lep. B. M., Part xvi. p. 32, 1858.

Expanse, 32–35 mm.

Habitat.—Pennsylvania, New York.

This species is closely allied to the European *H. crassalis*, and varies in a similar manner. In some specimens the large blackish brown patch attains the internal margin of the anterior wings.

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* Bloch, Systême, etc., p. 310.

Hypena bijugalis.

Hypena bijugalis. Walker, List Lep. B. M., Part xvi. p. 32, 1858.

Expanse, 27–31 mm.

Habitat.—New York.

Hypena manalis.

Hypena manalis. Walker, List Lep. B. M., Part xvi. p. 33, 1858.

Expanse, 20–23 mm.

Habitat.—New York.

Hypena internalis. n. s.

Palpi long, laterally compressed, blackish, except the naked white tips of the third joint. Head and thorax very dark brown or blackish. Abdomen fuscous above with blackish tufts on the segments; beneath paler, except at the tip.

Anterior wings blackish brown, with a median, a subterminal, and a terminal line of indistinct pale yellow or whitish dots. The median line of dots ends on internal margin in a large, circular, pale yellow spot which is the prominent distinctive mark of the species. A small, distinct tuft of black scales on the disc. Fringes blackish.

Posterior wings and fringes very dark fuscous, the latter interrupted with paler scales. Under surface of both pairs fuscous, with improminent, cellular dark dots.

Expanse, 29–31 mm.

Habitat.—Pennsylvania.

Hypena evanidalis. n. s.

Palpi long, laterally compressed, dull brownish ochreous; third joint minute, almost enclosed by the scales of the second joint. Frontal tuft prominent, pale ashen brown, as are also the head, thorax, and abdomen above.

Anterior wings dull pale ashen brown, shaded terminally with fuscous. A broad, dark brown or blackish patch on the costa extending from the base to the middle is indistinctly limited on the disc, and contains in its lower portion two pairs of small distinct raised tufts of black scales, the first pair in the centre, the second nearer the costa at the end of the disc. A subterminal and a terminal line of dark dots. Fringes pale interrupted with fuscous.

Posterior wings pale fuscous; fringes paler. Beneath, the posterior wings have a distinct fuscous cellular spot, and a central band which extends indistinctly across the anterior pair.

Expanse, 30 mm.

Habitat.—Pennsylvania.

CRAMBIDÆ.

Schœnobius sordidellus. Zeller.

Chilo sordidellus. Zincken, Mag. Ent. iv. p. 247, 1821.

Schœnobius sordidellus. Zeller, Chilo. et Cramb., p. 4, 1863.

Not having seen specimens of this species I translate the original description from Germar and Zincken's *Magazin der Entomologie.* Professor P. C. Zeller remarks in his monograph that he had seen a single specimen from Zincken's collection.

"Agrees in size and form with *Chilo gigantellus*, dirty ashen gray with a silky lustre. The ashen gray palpi are as long as the thorax; the antennæ ashen gray, black beneath, with two rows of fine, short lateral hairs. The anterior wings are more obtuse than pointed, of a uniform dirty ashen gray color above and beneath, with a row of 8–9 black points before the fringes, and a single similar point in the middle of the upper surface. The posterior wings are hardly paler than the anterior pair, and have on both sides before the fringes a row of black points, which are prominent and distinct near the apices, becoming fainter and nearly obsolete towards the anal angle. Head, thorax, abdomen, and the very long legs ashen gray. This specimen is a male, and the female probably has pointed wings. Found near Savannah, Georgia."

The European species (*Sch. gigantellus*), with which this species is compared above, is much larger than any others before me, and measures 31–35 millimetres.

Schœnobius longirostrellus. Zeller.

Chilo longirostrellus. Clemens, Proc. Ac. N. S. Phil., p. 205, 1860.

Palpi pale yellow, white beneath; head and thorax pale yellow. Anterior wings pale yellow, tinged with a darker shade along the costa. There is a dark dot on the centre of the wing beyond the disk, and a distinct, oblique, fuscous line from the apex passes just without this spot to the middle of internal margin. A row of indistinct terminal points. Fringes pale yellow. Posterior wings and fringes very pale yellow. The under surface of both pairs very pale shining yellow.

Expanse, ♂ 23, ♀ 27 mm.

Habitat.—Massachusetts, Pennsylvania, New York.

Allied to the European *forficellus*, but differs from it in its smaller size, the less acute apices of the male, its paler color, and less prominent markings.

Schœnobius melinellus.

Chilo melinellus. Clemens, Proc. Ac. N. S. Phil., p. 205, 1860.

Palpi, head, and thorax ochreous, the palpi pale internally. Anterior wings varying from pale to dark ochreous, shaded more or less prominently with fuscous above the middle from the base to apex. A dark fuscous dot, sometimes obsolete, at the end of the cell, and a more or less prominent oblique streak from the apex to the middle of the wing There are *no terminal dark dots* before the ochreous fringes. Posterior wings and fringes white or pale yellowish white.

Expanse, ♀ 24–28 mm.

Habitat.—Pennsylvania, New York.

This species agrees most nearly of any in my collection with Dr. Clemens' brief description.

Schœnobius clemensellus.

Chilo aquilellus. Clemens, Proc. Ac. N. S. Phil., p. 205, 1860.

The name given this species having already been used by Treitschke and other authors for a European species, I have thought it best to make the above change. Not having recognized the insect, I append the original description.

"Dark fuscous. Fore wings with an ochreous streak along the submedian nervure and its nervules, and those beneath likewise touched with the same hue. Hind wings yellowish fuscous."

Schœnobius dispersellus, n. s.

Palpi, head and thorax dull tawny. Anterior wings dull testaceous clouded with fuscous. A broad fuscous shade extends from near the base through the middle of the wing to below the apices, which are much shaded with the same hue. There is a blackish dot at the end of the disc, and an improminent oblique fuscous line running from the apex parallel with external margin half across the wing. Terminal points minute, blackish. Fringes dull testaceous. Posterior wings and fringes glossy white. Abdomen and anal tuft white.

Expanse, 30–35 mm.

Habitat.—New York (Putnam Co.), Texas.

This is our largest species, and appears to be less common than any of the preceding.

Schœnobius unipunctellus, n. s.

Palpi, head and thorax fuscous. Anterior wings uniform dark fuscous with a large, prominent black dot at the end of the cell on the middle. Posterior wings and fringes pure white. Abdomen and anal tuft white or very pale fuscous.

Expanse, 20 mm.

Habitat.—Texas.

The uniform dark color and prominent black discal dot readily distinguish this species.

Schœnobius tripunctellus, n. s.

Palpi, head and thorax whitish cinereous, the former white beneath. Anterior wings whitish cinereous, finely powdered with pale fuscous scales. On the fold at basal third an improminent dark dot, a similar more prominent dot on the middle at the end of the disc, and a third below it near internal margin. Terminal dots dark fuscous, minute. Posterior wings, fringes, and under surface of both pairs glossy white. Abdomen and anal tuft white.

Expanse, 22 mm.

Habitat.—Texas.

Prionopteryx nebulifera, Stephens.

Prionopteryx nebulifera. Stephens, Ill. Haust., iv. p. 317, 1834.

Prionopteryx nebulifera. Zeller, Chilo. et Cramb., p. 13, 1863.

Prionopteryx nebulifera. Wood, Index Ent., p. 214, Pl. 47, fig. 1484, 1854.

Prionopteryx achatina, Zeller.

Prionopteryx achatina. Zeller, Chilo. et Cramb., p. 13, 1863.

Prionopteryx incertella, Zeller.

Chilo incertellus. Zincken, Germar's Mag., iv. p. 253, 1821.

Prionopteryx incertella. Zeller, Chilo. et Cramb., p. 14, 1863.

Paucity of material prevents a detailed description of this curious genus at present. There are specimens in the collections of Mr. Charles A. Blake and the American Entomological Society in Philadelphia, as well as of a Texan species in my own.

Genus CRAMBUS. Fabricius.

Crambus minimellus, n. s.

Palpi whitish beneath, above and laterally shining dark fuscous. Head and thorax dark fuscous. Anterior wings glossy fuscous, with a broad whitish or ashen stripe from the base above the middle, ending acutely at apical third. This stripe is limited beneath by a line of dark brownish fuscous scales, and an oblique similar line from the middle of costa limits it outwardly. The costa is narrowly shaded with fuscous above the stripe and the latter contains one or two fuscous streaks in its upper portion. A dark brown subterminal line runs obliquely outwardly from costa at apical third, and forming an obtuse angle, runs thence parallel with external margin to internal angle. This line is thickened inwardly just below the middle of the wing. A distinct white apical stripe extends obliquely inwardly enclosing the apex of the broad longitudinal stripe. Terminal line dark brown. Fringes dark fuscous.

Posterior wings and fringes and under surface of both pairs glossy pale slate color.

Expanse, 13–15 mm.

Habitat.—Pennsylvania (Theo. Bunte).

The acute apices, small size, and white longitudinal stripe on the fore wings are distinguishing marks of this species. Some worn specimens are very pale, but the brownish fuscous lines appear to be constant and always distinct.

Crambus satrapellus, Zeller.

Chilo satrapellus. Zincken, Germ. Mag., iv. p. 247–8, 1821.

Crambus satrapellus. Zeller, Chilo. et Cramb., p. 16, 1863.

Having no specimens from the Southern States, I give a translation of the original description.

"Appears on a casual examination very much like *Chilo pascuellus*, but is essentially different, and, especially the female, much larger. Palpi and head yellowish gray; antennæ yellow above, gray beneath; thorax golden yellow. The anterior wings have the same form as *pascuellus*, except the apices, which are more prominent; they are golden yellow, ferruginous on costa and around the silvery stripes. A broad silvery stripe bordered with ferruginous extends from the base through the middle of the wing, ending in a sharp point near external margin. This stripe throws out an awl-shaped branch from the middle of its inner margin towards internal angle, but does not reach it. Immediately above the point of the silvery stripe and parallel with it a small spindle-shaped silvery spot bordered with ferruginous, with its outer point in the angle of a once bent dull silvery line which crosses the wing before the outer margin. Beyond this line four black short streaks in the lower half of the wing, between the nervules. Costal portion of the apex ferruginous, the outer half silvery white. Posterior wings uniform glossy white. Under surface of fore wings yellowish gray, of the hind wings white with a yellowish-gray front margin. Abdomen and legs grayish white."

"Expanse of the male 13½ lines, of the female 17 lines. The male occurs of a smaller size, sometimes not larger than *C. pascuellus*."

"This species inhabits the vicinity of Savannah, Georgia."

Crambus bipunctellus.

Crambus bipunctellus. Zeller, Chilo. et Cramb., p. 23, 1863.

Palpi, head and thorax pure white. Abdomen and anal tuft white.

Anterior wings white, with two prominent blackish dots, the first on the fold just beyond the middle of the wing, the second beyond and above the first, near the costa at apical third. There is a pale ochreous subterminal line which curves boldly outwardly below the costa, and is somewhat thickened into dots between the nervules. A terminal row of black dots. Fringes white.

Posterior wings above and beneath white, broadly shaded centrally with pale fuscous. Under surface of anterior wings fuscous to outer third, which latter portion with the fringes is pure white.

Expanse, 22–24 mm.

Habitat.—Ohio, Illinois, Pennsylvania, and Virginia.

XXIII.—*New Species of Cuban Fish.*

BY FELIPE POEY.

Read January 17, 1870.

Mesoprion rosaceus, Poey.

I MUST doubtless have often seen this fish in Havana, taking it to be a variety of the *M. analis*. It was not until 1869 that, noticing the different size of the eye, I examined it more closely, comparing it with the above species and with the *M. Campechanus*, which last had better be named *Campechianus*.

Length of specimen 700 mm., or 27.56 inches. Height of body almost equal to length of head, and three and a half times in total length. Eye about one-sixth of head, placed rather high, and half way from snout to membranous tip of opercle. Posterior nasal opening elongated, and one diameter from eye. Anterior opening small, round, nearer to the other than to the end of the snout above the premaxillary. With the mouth artly open, the end of the maxillary is on a perpendicular, passing a little back of the posterior nostril. Preopercle a little emarginate, with its denticulations irregular and not very prominent. The tuberosity of the interopercle hardly visible. No spines on the opercle.

The premaxillary teeth strong and short, their base being half the height. The three or four first ones on each side are double the size of the next ones, which are twelve in number. A broad band inside these of small card-like teeth, rather larger in front, and quite immovable. The lower maxillary teeth resemble the upper ones, but the anterior ones are not so large. There are a few small inner teeth in front. The vomer has a small triangular patch, without any prolongation behind. The palatine teeth are very small. The tongue rather obtuse and completely smooth.

D. 10, 14; A. 3, 8.—The dorsal, equally divided into a spinous and a soft portion. The spines increase in length from the first to the fifth; the last being the shortest. The anal has a point formed by the fourth and fifth branched ray. The caudal is crescent-shaped. The pectoral is three quarters the height of the body, and the ventral two-thirds of the pectoral.

The lateral line is parallel to the back. I neglected counting its scales, but there are about fifty-five. There are eight rows of scales above and fifteen below the lateral line. The exposed margin is finely ciliated; the base cut square and with thirty-six parallel flutings, not reaching the centre. Scales of the opercles rather large; none on the limb of the preopercle, and the rest of the head naked, excepting two double rows, of which one covers the temples near the great surscapular scale, and the other less distinct behind the eye.

The general color is pink, with silvery reflections on the margin of the scales. An indistinct blue line above the eye, which has a red iris. A carmine red spot above the axilla. The fins have a pale reddish tinge. The caudal yellowish towards the margin. When young, it probably has a lateral spot, as in others of the same group.

The skull is narrow, owing to the near approach of the parietal ridges. The occipital ridge is high and truncated behind. The articular apophysæ of the prefrontal are long and oblique. Orbit rounded; its longitudinal diameter three and a half times in the basal length of the skull.

The flesh is hard to cook; it swells, twists, and remains hard, though its flavor is not bad; and this may serve to distinguish it from the two species which I compare with it.

At the first glance it might be taken for the *M. Campechianus*, which has also a pink color and large eye; but which has two rough plates on the tongue, the preopercular angle well denticulated, a shorter snout, the orbit more oval, the teeth on the jaws thinner, particularly the anterior ones of the premaxillary; the band of inside teeth narrower, and almost obsolete on the lower maxillary; the patch of vomerine teeth prolonged in a long point behind, which last character, together with the asperities on the tongue, are strong distinctive marks.

The *M. analis* has the same teeth as the *rosaceus*, the smooth tongue, and the pointed snout; but the general color inclines to violet, though some are met with of a mahogany color; in the young the body is streaked with longitudinal blue lines, which do not disappear on the head; the vertical soft fins are of a fine carmine, the anal particularly so. The eye is much smaller, for a specimen as large as the *rosaceus* above described has the eye eight and a half times in the length of the head, which makes the snout more pointed; the mouth is smaller, the tuberosity of the interopercle more prominent.

This large and fine fish is sold in the market under the name of *Pargo*, like the previous one. It bears the number 321 in my manuscript atlas.

Ocyurus lutjanoides, Poey.

This fish, if not undoubtedly belonging to the genus *Ocyurus* of Prof. Gill, of which the *Mesoprion chrysurus* is the type, comes nearer to it than to any other genus, by the bifurcation of its caudal, deeper than in *Lutjanus jocu*, *caxis*, *caballerote*, etc. The pointed snout and the long canines would bring it among these last. From its colors, the fishermen are led to consider it a hybrid between the *M. chrysurus* and the *L. caxis*. They often thus dispose of a new fish, as in the case of the *Ocyurus ambiguus* and *aurovittatus*. But as such hybrids are rare among fish, and especially so among these genera, it is, I believe, right to consider the present species as a good one.

Total length 290 mm., or 11.45 inches. The height of the body, equal to the length of the head, is contained three and two-third times in the total length. The eye is rather high up, and half way from snout to tip of opercle. The nostrils are on the middle of the snout, rather wide apart, the posterior one oblong. The mouth is small, for the ends of the maxillaries are under the posterior nostril. The preopercle is only slightly notched, finely denticulated; the opercle without a spinous point. The teeth are on one row, the canines rather long, and behind them there are asperities; the palatine arch has teeth, and the tongue is rough. The lateral line has about fifty-five scales, six rows above and fifteen below it; there are scales on the opercles and temples, the rest of the head naked. The scapular bones show outside. There are very small scales on the interstitial base of the soft rays of the vertical fins. D. 10, 14; A. 3, 8.

The posterior borders of the dorsal and anal are rounded; the caudal lobes are elongated, but less so than in the *M. chrysurus*; the pectoral is pointed, contained four and a half times in the total length. The three first spiny rays of the dorsal gradually increase in length, the last, or tenth one, not longer than the preceding ones. The soft rays of the dorsal and anal are all branched and flattened.

The color is a brownish green, the abdomen paler. Six brown bands fall vertically from the back over the sides; a broad and interrupted stripe, of a greenish color, extends from the upper part of the opercle to the base of the caudal, resembling the *Ocyurus chrysurus* and *aurovittatus.*

I have seen this fish but once, and I sent the specimen to the United States, either to Prof. Agassiz or to Mr. Brevoort. It bears my No. 163.

Gymnothorax obscuratus, Poey.

I found this fish but once in Havana, and sent the specimen to Prof. Agassiz, to add to the rich ichthyological collections which he has gathered in Cambridge. It is one of the same group to which belong the species *infernalis*, *erebus*, *rostratus*, etc., in my Synopsis.

It is 618 mm., or 24.33 inches long; the anterior portion of the body forming the trunk being to the caudal portion as one to one and a third (270 + 348), which last is gradually more and more compressed. The length of the head to the branchial opening is equal to the difference between the trunk and tail, viz.: 78 mm. The mouth, deeply cleft, is to the head as 8 to 17; the eye being over the middle of the upper jaw, and its diameter is one-sixth of its length. The posterior nostril is in front of the eye; the anterior one is tubular, and at the tip of the snout. The mouth is bordered by three pores above and below.

The teeth of the nasal plates are long, vertical, sharp, three in number on the middle line, and six on the outside, not so long, with shorter ones between these last; the vomerines are short, and on one row. The palatines are small, excepting a few longer ones in front. On the lower jaw they are small, recurved, with two longer ones on each side in front.

The body is marbled with brown on a greenish ground, which is dark enough to almost obscure the marblings, which are composed of close-set spots, as large as the pupil of the eye, often bordered on one side with a white edging; the spot sometimes being all white, especially on the front of the body. The individuals of the same age of allied species do not show this coloring. The abdomen and throat are paler, without marblings, but with some spots of a dirty white. The head has, on each side near the head, six lines or longitudinal folds, the longest prolonged under the lower jaw. On the dorsal, which begins near the middle of the head, there are some oblique folds. The rays of the fins are very slight and very numerous. The dorsal has a blackish border, sometimes interrupted by white; its height, over the anus, is one-quarter that of the body, and increases gradually on the tail. The anal is one-third the height of the dorsal; all black, with a white border. The iris is yellow. It bears No. 736 in my Atlas.

Peristedion micronemus, Poey.

It is the same as the one described by me as the *P. imberbe*, in the Memorias, II., p. 367; Repert. II., pp. 158, 304, 462. With the lens, a very small tentacle is seen near the angle of the mouth on each side. On this account I have to change the specific name. The original was sent to Cambridge, Mass.

Rhinogobius contractus, Poey.

This species is to be added to my Synopsis in the Repert. II., p. 395. I described it under the genus *Chonophorus*, in my Memorias, II., p. 424. The transverse diameter of the head is a third smaller than in the *R. bucculentus*.

Acanthurus chirurgus, Bl.

The couple of lines of description, which are given in my Synopsis (Repert. II., 355), belong to the *phlebotomus*, as may be seen repeated farther on. This species has a prolonged body, vertical lines on the trunk, and oblique ones on the upright fins; the caudal a little forked.

Echelus caudilimbatus, Poey.

This species appears in my Synopsis (Repert. II., p. 424) under the genus Ophisoma, because the printer omitted to insert the name of the genus *Echelus* (Raf.), to which it belongs.

XXIV.—*On a New Product obtained by the Decomposition of Trichlormethylsulphonbromide.*

By O. Loew.

Read May 31, 1869.

If Trichlormethylsulphonbromide* be heated in a sealed glass tube in an alcoholic solution for several hours at 100° C., decomposition takes place. The contents of the tube will then show a considerable amount of sulphurous acid, and when mixed with water a heavy oil will be deposited; this being washed and

* I described the preparation of this body in the Am. J. Sci. for May, 1869.

ignited, 0.392 grm. ignited with caustic lime yielded 1.244 grm. AgCl + AgBr; this mixture was reduced by means of a piece of chemically pure zinc and hydrochloric acid; the weight of silver obtained was 0.853 grm.*

This shows 53.06 proc. Cl. and 41.33 proc. Br. which corresponds to the formula CCl_3Br. The theory requires 53.65 proc. Cl., 42.28 proc. Br., and 4.07 proc. C.

This combination must therefore be considered as Carbontrichlorbromide, and its formation takes place according to the following equation:—

$$\underbrace{(CCl_3)\ [SO_2]\ Br}_{\text{Trichlormethylsulphonbromide.}} = \underbrace{SO_2 + CCl_3Br.}_{\text{Carbontrichlorbromide.}}$$

In smell and solubility Carbontrichlorbromide bears great resemblance to tetrachloride of carbon; it boils at 98° C. and possesses great stability; it is not affected at ordinary temperature by nitric acid, potassa, and ammonia, but on boiling it with an alcoholic solution of caustic potassa, decomposition takes place, KBr, KCl, and K_2CO_3 being formed. On passing it through a red-hot glass tube it is decomposed into sesquichloride of carbon and bromine.

I made several attempts to obtain the unknown Trichlormethylsulphoniodide and – cyanide, but without success.

If Trichlormethylsulphonchloride be treated with an alcoholic solution of iodide of potassium, iodine will always be set free and trichlormethylsulphite of potassium formed.

$$(CCl_3)\ [SO_2]\ Cl + 2KI = \underbrace{(CCl_3)\ [SO]\ KO}\ + KCl + I_2$$

Other experiments to obtain a respective derivative of urea

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* When G = amount of AgCl + AgBr; g = weight of silver, x = unknown quantity of chlorine, y = unknown quantity of bromine, x and y are found by the following equations:

$$\text{I}\quad x + y = G - g$$

$$\text{II}\quad \frac{108x}{35.5} + \frac{108y}{80} = g$$

gave none of the results expected. Derivatives of urea, in which one atom of hydrogen is substituted by an organic sulpho-acid radical, are not known as yet; I tried, consequently, to cause Trichlormethylsulphonbromide to act on urea at about 120° C.; a double reaction took place: on the one hand the bromide was split up into sulphurous acid and Carbontrichlorbromide, and on the other hand the rest of the bromide was converted into Trichlormethylsulphurous acid.

I made several attempts to obtain the predicted, but yet unknown combination (CCl_2) $[SO_2]$, Dichlormethylensulphon.

I first treated an alcoholic solution of Trichlormethylsulphonchloride with metallic zinc. The mixture became boiling hot by itself, and Trichlormethylsulphite of zinc was formed:—

$$(CCl_3)\ [SO_2]\ Cl + Zn_2 = (CCl_3)\ [SO]\ OZn + ZnCl.$$

This Trichlormethylsulphite of zinc was dissolved in alcohol and the solution heated in a sealed tube to 150° C., but no change took place: the expected Dichlormethylensulphon was not formed. I then subjected the sodium and lead salt of Trichlormethylsulphurous acid to dry distillation, when I obtained a small amount of a crystalline body of a penetrating smell, which is the expected combination. On heating it sublimes, but the greater part of it is always decomposed into sulphurous acid and Perchlorethylene, which are the chief products of the dry distillation of a Trichlormethylsulphite; we obtain the following equations:—

$$\underbrace{(CCl_3)\ [SO]\ ONa}_{\text{Trichlormethylsulphite of Sodium.}} = NaCl + \underbrace{(CCl_2)\ [SO_2]}_{\text{Dichlormethylensulphon.}}$$

and

$$\underbrace{2\,(CCl_2)\ [SO_2]}_{\text{Dichlormethylensulphon.}} = \underbrace{C_2\ Cl_4}_{\text{Perchlorethylene.}} + SO_2$$

XXV.—*On the Number of Isomeric Bodies.*

By O. Loew.

Read May 31, 1869.

The rational formulæ of organic combinations differ so much among themselves at the present time, and are occasionally so incomprehensible, and on no reasonable ground, that it is of the greatest importance to Organic Chemistry when a man of Kolbe's learning undertakes to reconstruct the rational formulæ on as natural a basis as possible, and in correspondence with the true characters of bodies.

The chief feature in Kolbe's theory is Substitution, whereas other chemists, under the lead of Kekulé, follow that of Agglomeration, and of the so-called binding and linking of the atoms.

Taking an unprejudiced view of Kolbe's formulæ, it will be observed that they express all the decompositions which the body under consideration undergoes by means of different reagents, and that no other formulæ can explain the nature and the number of the isomeries, which are at times very numerous.

Considering by way of example the so-called ether radicals:

$$\text{Methyl} = \left.\begin{matrix} H \\ H \\ H \end{matrix}\right\} C \text{ and Ethyl } \left.\begin{matrix} (H_3C) \\ H \\ H \end{matrix}\right\} C \text{ have}$$

no monocarbolic isomeries; but when we take the next highest radical, "Propyl," we find two isomeries, which are represented by the following rational formulæ:

$$1.)\quad \left.\begin{matrix} \left.\begin{matrix} H_3C \\ H \\ H \end{matrix}\right\} C \\ H \\ H \end{matrix}\right\} C \qquad\qquad 2.)\quad \left.\begin{matrix} H_3C \\ H_3C \\ H \end{matrix}\right\} C$$

No. 1 is the true homologue of Methyl; No. 2 is the so-called isopropyl, a secondary radical, yielding no respective aldehyde.

Passing now to Butyl C_4H_9, when we define it as a derivative of Methyl, in which hydrogen is substituted for Methyl, Ethyl, or Propyl, we find already four isomeries.

$$1.)\quad \underbrace{\left.\begin{array}{l}\left.\begin{array}{l}\left.\begin{array}{l}H_3C\\ H_2\end{array}\right\}C\\ H_2\end{array}\right\}C\\ H_2\end{array}\right\}C}_{\text{True homologue.}} \qquad 2.)\quad \underbrace{\left.\begin{array}{l}\left.\begin{array}{l}H_3C\\ H_3C\\ H\end{array}\right\}C\\ H_2\end{array}\right\}C}_{\text{Second primary radical.}}$$

$$3.)\quad \underbrace{\left.\begin{array}{l}\left.\begin{array}{l}H_3C\\ H_2\end{array}\right\}C\\ H_3C\\ H\end{array}\right\}C}_{\text{Secondary radical.}} \qquad 4.)\quad \underbrace{\left.\begin{array}{l}H_3C\\ H_3C\\ H_3C\end{array}\right\}C}_{\text{Tertiary radical.}}$$

The next highest radical is Amyl C_5H_{11}, in which we find already eight isomeric *monocarbolic* radicals, namely, four primary, three secondary, and one tertiary. Adding all these monocarbolic and bicarbolic radicals, which are isomeric to Amyl, we obtain a much higher number (*vide* table).

The monocarbolic radicals of the formula of Capryl show seventeen isomeries. In this manner we obtain :

for Septyl, C_7H_{15} = 39 Isomeries,
for Octyl, C_8H_{17} = 89 "
for Nonyl, C_9H_{19} = 221 " and
for Decyl, $C_{10}H_{21}$ = 619, etc.

The general rule from Capryl up is expressed thus: that for a body of the general formula CxH_{2x+1}, there exist more than $2^{(x-2)}$ isomeric *monocarbolic* combinations, and less than $2^{(x-1)}$. If we apply this law upon Stearic acid = $(C_{17}H_{35})$ [CO] OH, we find that there exist more than 2^{16} = more than 131072 isomeries.

The different Stearic acids are probably very difficult to distinguish, even by means of polarized light, or by the melting point, but we cannot deny the possibility that at some future time we may be able to construct more delicate and subtle instruments to separate bodies, which, although only isomeric, do not show a striking chemical difference. An example illustrating these remarks very satisfactorily is shown by the Oil of Turpentine $C_{10}H_{16}$.

We know a great number of hydrocarbons which have this formula, for instance Oil of Lemons, of Cubebs, of Juniper, etc. The great difference in the smell leads us to the conclusion that there must be a difference in their chemical constitution. There are several other hydrocarbons of the formula $C_{10}H_{16}$ which show no difference in smell, although they differ from Oil of Turpentine in the power of turning the *plane of polarization*. Which is the fact that shows us that these bodies are not identical but are isomeric.

Kolbe considers the Oil of Turpentine as a dicarbol. Dicarbols are hydrocarbons in which two atoms of the same hydrocarbon are connected by a diatomic radical. According to Kolbe, Benzol is a tricarbol.

Kolbe * in his theory points out the analogy between diamins and triamins, the latter of which are known as bodies of a well-defined constitution. The ingenious theory of Kolbe has consequently a true and positive foundation, which is not the case with the so-called *Ketten theory* of Kekulé, which is founded on fancies and hypotheses.

We will now calculate how many isomeries exist in the derivatives of Ammonia; in a manner similar to the above we find for:

1.) Ethylamin,	2	isomeries.	(1 primary, 1 secondary.)
2.) Propylamin,	4	"	(2 prim., 1 second., 1 tert.)
3.) Butylamin,	8	"	(4 prim., 3 second., 1 tert.)
4.) Amylamin,	17	"	(8 prim., 6 second., 3 tert.)
5.) Caprylamin,	39	"	(17 prim., 15 second., 7 tert.)

These numbers are only calculated for the *monocarbols* contained in these bases. The general law is thus:

for a base of the general formula: $\left.\begin{matrix} C_xH_{(2x+1)} \\ H_2 \end{matrix}\right\} N$

there exist more than $2^{(x-1)}$ and less than 2^x isomeries.

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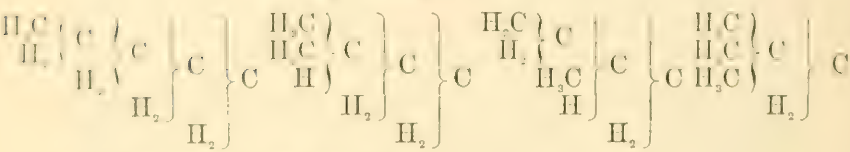
* I take this opportunity of calling attention to Kolbe's interesting work: Ueber die Constitution der Kohlenwasserstoffe."

If now we wish to see how many isomeries exist in the non-saturated hydrocarbons, in the oxy-amido-nitro products, we would be obliged to calculate an immense number of bodies. This example shows sufficiently how fruitful Kolbe's theory is, how the numerous isomeries may be explained, and what a prospect Kolbe opens for the existence of an immense number of bodies.

Isomeries of Amyl. C_5H_{11}

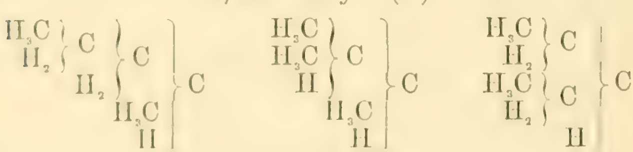
I. Monocarbolic radicals.

a, primary. (4.)

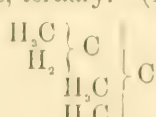


True Homologon to Methyl.

b, secondary. (3.)



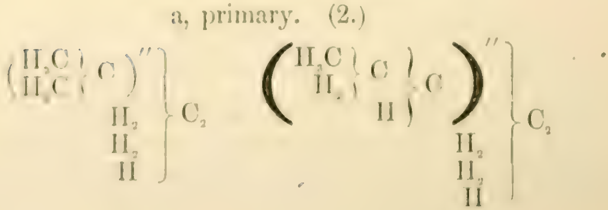
c, tertiary. (1.)



Isomeries of Amyl. C_5H_{11}

II. Dicarbolic radicals.

a, primary. (2.)



b, secondary. (3.)

$$\left.\begin{array}{r} \left(\left.\begin{array}{c} H_3C \\ H \end{array}\right\} C\right)'' \\ H.\ H_3C \\ H_2 \\ H \end{array}\right\} C_2 \qquad \left.\begin{array}{r} (H_2C)'' \\ \left.\begin{array}{c} H_3C \\ H_2 \end{array}\right\} C.\ H \\ H_2 \\ H \end{array}\right\} C \qquad \left.\begin{array}{r} (H_2C)'' \\ H_3C.H_3C \\ H_2 \\ H \end{array}\right\} C_2$$

Secondary dicarbol of the first order. Secondary dicarbol of the second order.

III. Tricarbolic radicals.

$$\left.\begin{array}{r} (H_3C.C)''' \\ H_3 \\ H_3 \\ H_2 \end{array}\right\} C_3 \qquad \left.\begin{array}{r} (HC)''' \\ H_2.H_3C \\ H_3 \\ H_2 \end{array}\right\} C_3$$

IV. Tetracarbolic radical.

$$\left.\begin{array}{l} C'''' \\ H_4 \\ H_4 \\ H_3 \end{array}\right\} C_4$$

XXVI.—*Results of a Microscopical Examination of Specimens of Sand obtained from an Artesian Well.*

BY ARTHUR MEAD EDWARDS.

Read January 10th, 1870.

THE specimens, five in number, were brought up from an artesian well or boring made at New Orleans, La., in the month of February, of 1868. The opening was not a true boring, as no boring instrument had been made use of, but was effected by means of driving down a sharp-pointed iron tube, for the purpose, if possible, of obtaining water; but, at the depth of thirty-two feet, gas of an inflammable character had been struck, which escaped in large quantities, so much so that it was for some time used for the purposes of illumination in a building near by.

Each specimen, as labelled, and the results of the examination, are as follows:—

A. "Sand from depth of 32 feet, in which gas was struck, Feb. 15, 1868."

This is a sand of an extremely fine texture, light grayish in color, and when viewed with the unassisted eye is seen to have scattered through it small black particles of matter. On account of the occurrence of the inflammable gas at this point, and the report that, from a similar well near by, fragments of blackened, wood-like material had been ejected, I was persuaded to examine these small dark-colored specks otherwise than microscopically, especially as that instrument had revealed no trace of organic structure of any kind in them. On heating one of them on a strip of platinum foil over a spirit-lamp, the black tint was burned off, leaving a white ash. This appeared to indicate the presence of organic matter, and a further examination proved it beyond doubt. A drop of pure oil of vitriol was heated in a watch-glass and a small fragment of potassium dichromate dissolved therein. To a minute portion of this liquid one of the black grains was added and heat applied; immediately the black particle was attacked, a gas given off, which was, without doubt, carbon dioxide, and the orange color of the liquid changed to a green, which was made apparent by placing the glass slip upon which the reaction took place over a sheet of white paper, showing that the dichromium trioxide set free by the action of the oil of vitriol had been converted into tetrachromium trioxide by the organic matter. This proves the small black particles to be carbonaceous, and I have detailed the process used to arrive at this result, as it is one which, familiar as it is to chemists, is not sufficiently well known to naturalists generally, and it can, at the same time, be very conveniently employed when examining small quantities of matter, even under the microscope. No other trace of organic remains of any kind was detected in this specimen.

B. "First sharp sand struck at a depth of 49 feet."

This specimen consists almost entirely of a clean, transparent, and colorless quartz sand, of which the particles are several times larger than those of the last specimen. It also contains numerous grains of the black, coal-like material found in the other, but in this case they are much larger, and yet reveal no organic structure, as they are opaque. Besides these, in this specimen I found a fragment of a molluscous shell, the genus of which I have been unable to satisfactorily determine, but I should judge it to have been a lamellibranchiate.

C. "52½ feet."

This is also a coarse sand, of a darker color than the last, finer in texture, and containing also black grains of organic origin. It also contains several fragments of the shells of mollusca, but no other remains of organized beings that I can detect.

D. "71 feet."

This specimen is by far the most interesting of the series, as it is evident to even the casual observer, unassisted by the microscope, that it is from a sea-bottom, having been formed where the water was in a comparatively quiescent state; that is to say, the particles of which it is made up are for the most part very fine, having scattered through them fragments of mollusca of several species, but in so fractured a condition that it would be somewhat difficult to determine even the genera. On acting upon a portion of this specimen with hydrogen nitrate, a violent effervescence took place, resulting, of course, from the solution of the molluscous shells present. Heat being now applied, most of the organic matter in the specimen was rendered soluble, and washed off with carefully filtered water, which was employed so that there might be no danger of introducing extraneous microscopic forms. By stirring up the sediment of matter unaffected by the hydrogen nitrate, after thorough washing, and permitting it to stand for a few seconds, all the coarser particles, consisting for the most part of sand, settled, while the supernatant water was cloudy from suspended particles. This was poured off, permitted to settle, and examined by means of the microscope. Besides fine particles of sand, there were found in it, as might have been supposed, scattered fragments, and in some cases perfect specimens of the silicious lorica of diatomaceæ. All of the forms detected, with a single exception, are marine in habit, and identical with those found living at the present day on the coast of Florida, South Carolina, and elsewhere. They are, for the most part, much broken, and often but one or two individuals have been seen; in fact, the number of specimens is very small, but still sufficient for identification. They are as follows:—

Actinoptychus senarius.
Amphora ——— ?
Auliscus pruinosus.
" *radiatus.*
Biddulphia rhombus.
Cocconeis scutellum.
Coscinodiscus eccentricus.
" *radiatus.*
" *subtilis.*
Cyclotella Dallasiana.
Diploneis ——— ?
Epithemia sorex.
Eupodiscus radiatus.
Gomphonema acuminatum.
" *marinum.*
Grammatophora marina.
Navicula ——— ?
Orthosira sulcata.
Plagiogramma Gregorianum.
" *pygmæum.*
Stauroptera aspera.
Synedra ——— ?
Terpsinæ musica.
Triceratium favus.
" *punctatum.*
Tryblionella punctata.
Sponge spicules.

Doubtless these remains of marine organisms are accompanied by partially decomposed organic matter, resulting from the deposited animals and plants, and it is from these as well as the diatomaceæ that the inflammable gas is derived, and there are chances at the same time that oil may be obtained from the same locality, as it has been demonstrated that the bitumen and oil of the Pacific coast is largely, if not wholly, derived from the enormous stratum made up for the most part of diatomaceæ with a few radiolaria, and extending from San Francisco to the lowermost portion of California on the slopes of the coast range of mountains. In this connection the examination by means of the microscope of such specimens as these becomes of interest, while.

at the same time, they present opportunities of ascertaining the variation which species are liable to, if any, in time. In the present case there has been no variation since the deposition of this stratum, now 71 feet below the surface, but the accumulation of subjacent strata may have been very rapid, so that these forms may be extremely recent. At all events the examination is of interest, and it is to be hoped that similar collections will be examined in the same manner, as, if no other immediate result is arrived at, yet, at least, contributions to a knowledge of the local distribution of these minute organisms will be obtained, and this is a point upon which it is desirable to obtain data, from its bearing upon geology, in which branch of science the diatomaceæ have already made their mark.

XXVII.—*On the genus* Pompholyx *and its allies, with a revision of the* Limnæidæ *of authors.*

By William H. Dall.

Read March 14, 1870.

The receipt, through the kindness of Mr. Harford, of a number of specimens of *Pompholyx* enables me to correct an error into which I had been led, and to add something to our knowledge of this singular mollusk.

In 1866, Mr. William M. Gabb furnished me with drawings and descriptions of the soft parts of the animal of *P. effusa*, Lea, taken from life. In both, it was represented as possessing two pair of eyes; one pair at the inner basis of the tentacles (as in *Physa*) and one at the tips of the tentacles (as in *Vertigo*).

On this point Mr. Gabb was positive, and, relying on his accuracy, I separated this mollusk from the other fresh water pulmonates, provisionally, in a sub-family by itself.

The assertion was soon called in question by Dr. J. E. Gray, Mr. Binney, and other eminent malacologists, but, from its extreme rarity, up to a very recent period, I have been unable to obtain specimens of the soft parts to confirm or disprove the accuracy of the statement.

Genus Pompholyx, Lea.

Proc. Phil. Acad. Sci. 1856.

Testa rotundo-gibbosa, subtus retrorsa, superne planulata, non umbilicata; spira depressa, apertura amplissima, subrotundata, effusa; labro acuto; labio incrassato planulato; operculum nullum.

The species of *Pompholyx* at present known are as follows:

Pompholyx effusa, Lea.

P. effusa, Lea, Proc. Phil. Acad. Sciences, 1856, vol. viii. p. 80.

Journ. de Conchyl. 2d series, ii. p. 208, 1857. H. & A. Ads. Gen. Rec. Moll. ii. p. 645, pl. 138, fig. 11.

Binney, L. & F. W. Shells of N. A. part ii. page 74, fig. 119. Dall, Proc. Cal. Acad. Sci. 1866, p. 266, fig. 28.

Testâ parvâ, striatâ, rotundo-gibbosâ, subtenui, effusa, luteo-corneâ, anfractibus trinis; supernè planulatis, infernè convexis; aperturâ sub-rotundâ, dilatatâ intus albidâ, maculatâ.

Hab. Sacramento River, Cal. Collection Smithsonian Institution, &c.

The figure in H. & A. Adams, Gen. Rec. Moll. pl. 138, fig. 11, represents this species much more characteristically than that in Binney, L. & F. W. Sh. of N. Am.

Pompholyx Leana, H. & A. Adams.

P. leana, H. & A. Ads. Proc. Zool. Soc. of London, 1863, p. 434.

P. testâ helicoidea, depressâ, tenui, epidermide viride obtecta, spira parva; anfr. $2\frac{1}{2}$; convexis, rapide accrescentibus, ultimo permagno; apertura patula; labio planiusculo, arcuato; labro simplici, acuto.

Alt. $1\frac{1}{2}$ lines. Lat. $2\frac{1}{2}$ lines. Hab. West Columbia. Coll. H. Adams.

The authors state that this differs from the last species, in being thinner and smaller, in the spire being more elevated and the aperture being less produced in front. It has not been figured, and no specimens have as yet reached this country.

Pompholyx, var. *solida*, Dall.

The specimens received from Clear Lake through Mr. Harford differ essentially from authentic specimens of *P. effusa*. The shells, when compared with the last mentioned species, differ in the following particulars:

The most noticeable difference is in the spire. In *P. effusa* it is nearly flat, so that the shell may be laid down upon the apex without falling to one side. In the species under consideration, the spire is elevated, the whorls are rounded below and slightly appressed against the suture, while in *P. effusa* they are not appressed. The apex of my specimens is more prominent than that of *P. effusa*, the shells are much more solid and strong. The last whorl of *P. effusa* is much larger, proportionally, than that of this species. In *P. effusa* the columella is prominent and the whorl falls away from it. In this species there is a prominent rounded ridge outside of the columella, and the latter is, so to speak, inside of the aperture of the shell, which is smaller proportionally, much less produced above, and less patulous than in *P. effusa*. A comparison of the dentition shows that the outer laterals of *P. effusa* are more denticulated, having from three to five dentations, while in this species there are normally only three denticles in the outer laterals. The inner portions of both ribbons are, of course, similar. I have examined a radula taken by Mr. Binney from an authentic specimen of *effusa*, and can testify to this.

The specimens in question are clearly not *P. effusa*, yet in the absence of typical specimens of *P. lævis* it still remains doubtful whether they belong to the latter species. Messrs. Adams' description answers pretty well, except that my specimens, instead of being thinner, are much more solid than the *effusa.* I propose, therefore, to indicate the species as *Pompholyx Leana*, var. *solida*, until more definite information be obtainable.

There can be no doubt that the anatomy of two such closely allied forms must be nearly identical, and there are probably no differences in the soft parts alone (except in the dentition of the outer laterals) by which the two species might be separated.

A careful examination of some 30 specimens from among those sent by Mr. Harford from Clear Lake have afforded the following notes.

External parts. The general accuracy of outline of the figure given (in the Proc. Cal. Acad. 1866, p. 268) is fully confirmed. No tentacular eyes are present. The foot is short, (about twice as long as broad), posterior extremity bluntly rounded as in *Planorbis*. The veil, or lips, are broad and semilunar. The mouth is minute and rounded-transverse.

The tentacles are rather short, stout and slightly larger at the tips than more posteriorly. They are marked by a central line of pigment cells which accompany the tentacular nerve, and in some individuals, near the tips, an aggregation of these pigment cells, forming a black patch or dot, was observed. This is unquestionably what was taken for a second pair of eyes by Mr. Gabb. In other individuals, however, the pigmentary deposit was nearly or entirely absent, and the tips of the tentacles were of a pale yellowish color. The colors, as far as could be determined from the specimens in glycerine, were as represented in the paper alluded to. The true eyes are sessile on the front of the head, near, but not on, the inner bases of the tentacles.

Nervous system. The œsophagus is surrounded by a nervous collar, with one large and one small ganglion, the latter above and the former below the throat. These ganglia are really composed of pairs, very closely united to each other. From the lower one the tentacular and the optic nerves are given out. Nervous branches radiate from the ganglia, but were too minute to be satisfactorily traced to their terminations.

Two branches extend from the upper ganglion to the vicinity of the heart, where another minute pair of ganglia was detected. From each of these a single nerve, which afterward divides, proceeds in a posterior direction.

Alimentary system. The œsophagus leaves the buccal mass with two sudden flexures; it then becomes slightly dilated and proceeds, curving with the shell, to the first half of the apical whorl. Here it turns sharply on itself, the reflected portion passing underneath the other, and, passing the posterior end, enters the anterior end of the stomach. The latter is ovoid, strongly muscular, and recalls in appearance the gizzard of a fowl. It is divided, apparently, into three indistinct regions, of which the two outer are really muscular fibre and the inner region is the cavity of the stomach. I found it full of comminuted vegetable matter, among which were many small grains of sand. Whether these are merely accidental, or serve the purpose of triturating the food, there are no means of determining.

The intestine leaves the stomach at the posterior end, and passes beneath it, forward, without any marked flexure, following the curve of the spire and opening on the left side of the neck, just within the mantle cavity and close to the opening of the vagina.

A gland of a yellowish color, emptied by a duct which passes into the throat, was supposed to be a salivary gland.

The liver is of a greenish brown hue, and extends nearly to the apex of the spire. It is of no definite shape, but fills the cavities between the lobes of the ovary and those in the region of the stomach; and is bounded, anteriorly, by the wall of the pulmonary chamber. It is well supplied with blood-vessels which ramify in every direction. The buccal plate is somewhat cordiform or rounded triangular. It is smooth and of a yellowish horn-color, but the cutting edge is slightly thicker than the rest. A blunted rounded point forms the centre of the cutting edge, which is simple and without notches or striæ. There are no accessory plates.

The odontophore is about four times as long as it is wide. It is broadly reflexed at its anterior extremity, and the surface is moderately convex.

The teeth are transverse in a line almost straight. The formula is 22—1—22, or forty-five teeth in a row, and there are about one hundred and fifty rows.

The central tooth is nearly twice as long as it is broad. The cusp is half as long as the base, and bifid or furnished with two minute pointed teeth at the posterior extremity, and occasionally two prominent tubercles on the base. The inner laterals are much wider than the central tooth, and the cusps are nearly twice as long as the bases. They are rounded-rhomboidal and slightly indented, having a trilobate appearance.

The decrease in width and the lobed appearance become more evident toward the margin of the odontophore. The cusps of the outer five rows are very much compressed, and hence have a tridentate rather than a trilobed appearance.

While the teeth appear to be of a purely chitinous consistency, and are quite insoluble in caustic potash, the buccal plate is liable to destruction from continued boiling in a concentrated solution.

Circulatory system. The heart is small and occupies a position midway between the buccal mass and the stomach, and laterally is between the oesophagus and the descending intestine. One principal blood-vessel supplies the liver and adjacent viscera, and another the buccal region, the tentacles, and the head. A small branch accompanies the ovarian duct and accompanying glands, while another supplies the stomach.

Reproductive system. The ovarian duct, or vagina, opens into the pulmonary chamber, close by the anus and just within the mantle margin. A small sac, the "genital bladder" of Leidy, is situated near the end of the vagina. Behind this, the oviduct is dilated, forming a fossa corresponding to the uterus. Further back a gland opens into the oviduct, beyond which the latter is again somewhat lobed and dilated. The ovary is formed of a number of lobes or tubes which are placed on the inner side of the liver and extend a short distance beyond it, into the apex of the spire. These are filled with a greenish substance consisting of nucleolated cells and ova in all stages of development which obtain previous to their extrusion.

The penis is contained in a sac (*preputium*) which opens on the side of the neck on a line with the tentacle and midway between the left tentacle and the mantle margin. The organ is short and stout, the *retractor muscles* were quite perceptible, and a triangular appendage, perhaps equivalent to the *flagellum*, was observed at the posterior end. The *vas deferens* is slender and is nearly enclosed by the *prostatic gland*, which is small and of an amber color. The *epididymis* is much convoluted and nearly as long as the vas deferens. The *testicle* is long, and composed of numerous minute tubes with innumerable ramifications.

Respiratory system. The opening of the pulmonary chamber is closed by a lobe of the mantle. The margin of the latter in some individuals is tuberculate (under a high power), while in others nothing of the kind was observed.

There was no perceptible cellular structure to the lung, but the walls of the chamber are highly vascular, and it occupies, when dilated, nearly half the last whorl. Myriads of a species of *cercaria* were observed in the chamber, in some individuals.

Special organs. The eyes are well developed. The *choroid* was thickly covered with black pigment. A well marked *vitreous humor* was observed, and there appeared to be a *crystalline lens.* The *sclerotic* coat is tough, and traversed by numerous blood-vessels. The eyeball is of an oval shape, and the axes of the two eyes appeared to be somewhat divergent.

The blind sac, described by Leidy, and which he suggests may be the seat of the sense of smell, is quite evident. It is a minute linguiform sac, reflected beneath the buccal mass.

The *auditory vesicle* is close behind it, and is of an oval shape, containing four or five otoconites. The tentacles are retractile at the bases, but only slightly so near the extremities.

The ova. These are laid on stones, shells, or the leaves of plants. They are covered by a round, flattened, slightly tuberculate capsule of leathery consistence, quite insoluble in water, alcohol, or glycerine. It is thin, brownish, and nearly transparent. These capsules are disk-like, and cover from five to ten ova, placed in a single layer embedded in a brownish jelly. Each ovum is contained in a transparent, tough, oval envelope. Those which I have examined contain all stages, from the simple ovum to the embryo mollusk encased in a shell of a single whorl, and with the eyes, tentacles, and viscera well advanced. The first indication of organization is the separation of the visceral mass from the embryonic foot. The mantle, eyes, and shell are developed early, but the tentacles only much later.

The ova are deposited in the months of May and June.

Notwithstanding the wide distribution and individual abundance of the *Pulmonata Limnophila*, there are so few figures of the lingual dentition that it is difficult to arrive at a decision in regard to the relations of this singular form. The following are the characters of the principal genera which have been definitely eliminated:

Limnæa (*stagnalis*, *palustris*).

Buccal plate arcuate, apex anterior, nearly smooth. Two smooth accessory lateral plates.

Tentacles triangular flattened; eyes sessile on their inner bases.

Genitalia on the right side. Foot bluntly rounded behind.

Mantle margin simple, not extending beyond the orifice of the shell.

Ova deposited in elongate cylindrical masses of jelly, without perceptible envelope.

Cusp of central tooth simply pointed, base bilobate. Inner laterals bicuspid, outer ones with more or less numerous notches.

Shell spiral, turreted, dextral or rarely sinistral.

Acella (*gracilis*).

Buccal plate arcuate, smooth, dark reddish brown. Lateral plates bluntly pointed.

Animal resembling *Limnæa*, with a more slender foot, posteriorly rounded.

Cusp of central tooth trilobed, the central lobe most prominent. Base strongly bilobed behind. First three laterals have the cusps strongly bidentate, the inner lobe having a notch on the inner side. This side is more strongly notched twice, in the next three laterals. In all, the cusps are longer than the base. Seventh and eighth laterals have four denticles on the cusp, two larger than the others. The ninth and tenth have five denticles, and the cusp of the eleventh is prolonged with six denticles. The two remaining pleurals are similar. The two inner uncini have an oval base, produced anteriorly, and five or six denticles on the rhachidian side. The next is bidentate at the tip and shorter, and the outermost is quite short and simple. The formula is 4.13.1.13.4. There are about sixty rows.

The ribbon is narrower than in *Limnæa*, and the shape of the rhachidian tooth differs slightly. These, with the characters of the shell, are hardly sufficient to constitute it as a distinct genus.

Amphipeplea (*glutinosa*).

Buccal plate arcuate, smooth. Two lateral accessory plates.

Tentacles triangular, moderately elongate ; eyes sessile on their inner bases. Genitalia on the right side.

Mantle much produced, nearly enveloping the shell. Foot bluntly rounded behind.

Ova deposited in kidney-shaped or cylindrical masses of jelly.

Teeth. Laterals ; first eight, quadrilobate, broad, with cusps very long in proportion to the base. The remainder with rhomboidal cusps, with from two to five denticles on the end, and one somewhat posterior to the rest, on the outer side of the cusp. Central tooth apparently simple. Formula, 24.1.24.

Shell few whorled, dextral, with a short spire, and the last whorl much inflated.

Planorbis (*corneus, lentus*).

Buccal plate arcuate, crenulate. Two narrow, delicate accessory plates.

Tentacles long, filiform; eyes on a tubercular expansion of the inner bases.

Genitalia on the left side. Foot very short, bluntly rounded.

Mantle margin simple, not extending beyond the shell.

Cusp of central tooth bidentate.

Laterals broad; inner tridentate, outer with more or less numerous notches.

Ova capsules rounded, in a delicate envelope.

Shell depressed, spiral or discoidal; dextral.

Gray figures the lateral jaws of *P. corneus.* I have obtained them from *P. lentus;* yet, as far as I know, they have not been noticed in the smaller species, although they probably exist, but of extreme delicacy, and cartilaginous consistency.

Camptoceras (*terebra*).

Buccal plate?

Tentacles filiform, blunt. Eyes large, situated between the tentacles.

Genitalia on the left side? Foot shorter than the aperture.

Mantle margin simple, not extending beyond the shell. The anterior part of the head moderately produced.

Teeth? Ova?

Shell sinistral, turreted, loosely coiled.

The only information which we have of this singular form is the description of Mr. Benson, who places it near *Ancylus.*

Acroloxus (*lacustris*).

Buccal plate strongly arched, papillose. Two lateral accessory plates, not continuous as in *Ancylus.*

Tentacles distant, stout, cylindrical, pointed; bases expanded; eyes near the inner sides.

Genitalia on the right side. Foot rounded behind.

Mantle margin simple.

Teeth?

Ova capsules discoidal, covered with a minutely tuberculose tough envelope.

Shell patelliform, apex dextral, margin simple.

Ancylus (*parallelus*, *fluviatilis*).

Buccal plate horseshoe shaped (in all the species?); (equivalent to the three plates of *Limnæa*, fused) smooth or papillose.

Tentacles short, blunt, cylindrical, dilated at the bases, widely separated. Eyes sessile on the inner bases.

Genitalia on the left side. Foot short, bluntly rounded behind.

Mantle margin simple.

Central tooth simple; inner laterals strongly bidentate; outer ones notched, much as in *Limnæa*.

Ova as in *Acroloxus*.

Shell patelliform, apex sinistral, margin simple.

These animals are monœcious, but cannot reciprocally impregnate one another at the same time.

They copulate only in pairs.

Gundlachia (*californica*, *Meekiana*).

Buccal plate?

"The soft parts agree so closely with the true *Ancyli* that I have not succeeded in finding any differences of importance—except the form of the visceral sac." Stimpson.

Genitalia on the left side?

Cusp of the central tooth bifid. Laterals with three or more oblique denticles.

Shell ancyliform, apex inclined to the right. In the adult shell a lamina closes two-thirds of the apex from the rest of the shell. In the cavity thus formed, some of the viscera are enclosed. Margin simple.

Ova?

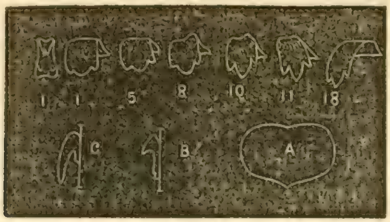
Latia (*ancyliformis*).

Dr. Gray gives the following description, which he says is imperfect, being taken from a dried specimen which had been soaked in weak potash and water:

Head with a short broad snout, rounded in front. Tentacula short, triangular. The eyes on the outer edge of their base. (?) Body subspiral, mantle submarginal continuous, simple. Pulmonary aperture on the hinder part of the right side, protected on the inner side by the process of the lamina. Foot oblong rounded at each end.

Shell crepiduliform, with a free lamina projecting from the septum on the right side; minute, spirally striated, apex spiral, epidermis thin, brown. · The statement in regard to the eyes demands further confirmation.

FIG. I.



Radula of Pompholyx solida.—A. Jaw. B. Section of central tooth. C. Section of first lateral tooth. 1 to 18, lateral teeth.

Pompholyx (var. *solida*).

Buccal plate flat, ovate-cordiform, apex anterior. No accessory jaws.

Tentacles moderate, stout, rounded and slightly expanded at the ends.

Eyes on the front of the head, near but not on the inner bases of the tentacles.

Genitalia on the left side. Foot bluntly rounded behind.

Mantle margin simple, not extending beyond the shell.

Central tooth small, bifid. Cusps of laterals broad, larger than the bases, trilobed; the outer more compressed slender tridentate.

Ova in a tough, flattened, and rounded capsule, few in number.

Shell of few whorls, dextro-spiral.

Carinifex (*Newberryi*).

Animal unknown. Mr. Lea had some alcoholic specimens, procured by Dr. Newberry, which cannot now be found.

From a cursory examination the animal appeared to resemble that of *Planorbis*, but the tentacles were shorter, as in *Pompholyx*. One shell, out of many dry specimens, alone contained the remains of the animal. By boiling these in potash, the odontophore was obtained. The jaw appeared to resemble that of *Pompholyx*, but was so injured by the process that its outline could not be made out.

FIG. II.

Radula of Carinifex Newberryi.—r.r. Central Teeth (deformed ?). A. Jaw (imperfect ?). The remainder of the figure is reliable.

The rhachidian tooth, in this specimen, was apparently malformed throughout the entire length of the ribbon. It was one-sided and unsymmetrical—not an uncommon malformation among pulmonates. A few more normal than the rest appeared to resemble the same tooth in *Pompholyx*, but possessed only one denticle instead of two. The entire odontophore resembled that of *Pompholyx*, except in its greater breadth and more numerous uncini ; and in the greater lateral prolongation of the bases of the teeth; while the cusps were somewhat smaller in proportion to the bases than in that genus.

The first lateral is broad trilobed and resembles the same tooth in *Pompholyx*, except in the wider base and slightly shorter cusp.

The same may be said of the next nine laterals. The eleventh and succeeding laterals, which, for distinction, I will call uncini, exhibit some difference of form. Their bases are much prolonged laterally, the shafts are slender, and the short rounded cusps carry from three to five denticles. These exhibit some irregularity, as is usual in this part of the ribbon. The extreme outer uncini have shorter shafts and bases, and the cusps are almost, if not quite simple. The line in which the teeth are set is more curved than in *Pompholyx*. The formula is 36.1.36, and there are about one hundred and fifty rows. The relations with *Pompholyx* are very close. Many small embryonic shells were found in the dried remains of the animal.

Physa (*fontinalis, heterostropha*).

Buccal plate chevron-shaped or triangular with the sides excavated; strongly striate, apex posterior; occasionally membranous or absent.

No accessory plates.

Tentacula filiform, long, with a small basal auricle. Eyes at the front of the head, near or on the inner bases of the tentacles.

Genitalia on the left side. Foot acutely pointed behind.

Mantle edge digitate or lobed, extending partly over the shell.

Teeth (*Physa humerosa* Gld. Arizona) alternate, differing widely from those of *Limnæa*. Central tooth wide. Base with projecting processes before and behind. Cusp consolidated with the base, quinquedentate. Laterals alternate. Principals strong, obliquely bent, comb-like, 96 in a row on each side. Secondaries, narrow, oblong, anteriorly depressed with a simple rounded cusp. Insertion between the principals. From their extreme tenuity these secondary teeth are liable to be overlooked. They are omitted in all the figures of the teeth of Physa, accessible to me.

Ova deposited in flattened oval masses, without perceptible covering except of jelly-like mucus.

Shell sinistral, turreted, edge continuous.

Bulinus (*hypnorum*).

Jaw strongly arcuated, thin, cartilaginous. No accessory plates.

Tentacles slender, long, filiform. Eyes sessile on a slight expansion of their inner bases.

Genitalia on the left side. Foot acutely pointed behind.

Mantle edge simple, not extending beyond the shell.

*Teeth strongly resemble those of Physa; centrals broad, base bifid before and behind. Shell elongate, sinistrally spiral, margin entire.

Ova capsules ovate cylindrical, without membranous envelope.

---

* *Bulinus nitens*, Phil., Lake Nicaragua.

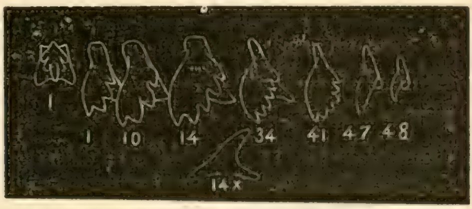
Physopsis (*Africana*).

Animal unknown.

Shell sinistrally spiral, ovate. Columella truncate, plicate, involute. Outer lip simple.

The truncation of the columella would seem to indicate important differences in the mantle edge.

FIG. III.



Radula of Chilina ovalis.—1. Central Tooth. 1–48. Laterals. 14X. Section of 14th lateral.

Chilina (*ovalis* Sby).

Teeth comb-like (see Fig. 3). Central quinquedentate, broad anteriorly. Laterals with the base prolonged anteriorly, beyond the insertion of the cusps; inner edges smooth, arcuated; outer edges denticulated. Jaw none. Formula 48.1.48.

Tentacles biangulate, rhombiform. Eyes sessile between the angles. Genitalia on the right side. Penis short, stout, opening on the neck behind the right tentacle. Testicle, etc., closely bound up in a muscular sheath which covers the male genitalia, as in *Siphonaria*. Vagina large, ovate, opening on the neck below the mantle edge. Posterior end recurved, oviduct long, slender; ovaries in the extremity of the spire. Genital bladder spherical, pedunculated on a very long tubular canal. Salivary gland spherical, enormous; of a yellow color. Buccal mass small; œsophagus slender, crop or stomach very small; descending intestine wound around the salivary gland and opening through the mantle lobe, as in *Siphonaria*, on the right side. Liver moderate, brown. Foot sharply pointed behind. Mantle edge provided with a prominent flattened lobe, covering the opening of the pulmonary cavity, otherwise not extending beyond the shell. Labia produced. Shell dextro-spiral. Columella involute, plicate or dentate. Outer lip acute.

These shells form the passage from *Physa* to *Siphonaria*. They somewhat resemble the former in their dentition and the latter in their internal anatomy, tentacles, and mantle-lobe. Dr. Gray placed them among the *Auriculidæ*, to which there is a superficial resemblance.

From the data above given, and information too lengthy to insert here, I have drawn the following generalizations in regard to the arrangement of these mollusks. The form of the tentacula is a character of minor importance, as is also the position of the genitalia. From the form of the foot and the buccal plates, with the characters of the dentition assisted by those of the anatomy and the shell, more satisfactory results have been obtained.

I would propose the following arrangement:

ORDER PULMONATA.

Sub-order Bassomatophora.

Group Limnacea.

Family LIMNÆIDÆ Brod. 1839.

Air-breathing, but usually fluviatile.

Foot rounded behind. Mouth furnished with a transverse buccal plate, and usually with two lateral accessory plates. Dentition consisting of a broad radula furnished with an inconspicuous rhachidian tooth, simple in form; and numerous nearly uniform lateral teeth which are furnished with recurved cusps, more or less denticulated; the denticulations being more numerous and the teeth more compressed toward the outer edge of the radula.

Sub-family Limnæinæ. Dall.

Lateral jaws present.

Rhachidian tooth simply pointed; laterals provided with numerous denticles.

Tentacles flattened. Genitalia on the right side.

Genus *Limnæa.* Lam. 1801.

Mantle not exterior to the shell. Shell turrited, usually dextral.

Sub-genus *Radix.* Mont. 1810.

Shell with the last whorl ventricose, aperture expanded, spire less than half the length of the shell.

Type *Radix auricularia*, = *L. auricularia.* Lin.

Sub-genus *Bulimnæa.* Hald. 1841.

Shell ventricose, spire short, aperture not expanded.

Type *Bulimnæa megasoma* = *Lymnea megasoma.* Say.

Sub-genus *Limnophysa.* Fitz. 1833.

Shell ovate-elongate. Spire as long or longer than the aperture, which is not expanded.*

Type *Limnophysa palustris* = *Limnæa palustris*, Linn.

Sub-genus *Acella.* Hald. 1841.

Central tooth trilobed.

Shell very slender. Aperture without folds, produced anteriorly, expanded.

Type, *Acella gracilis* = *Limnæa gracilis.* Jay.

Sub-genus *Pleurolimnæa.* Meek. 1866.

Shell like Acella, with slender, distant, longitudinal costæ; aperture narrowed instead of rounded anteriorly.

Type *Pleurolimnæa tenuicostata* = *Limnæa tenuicostata.* M. & H.

Fossil in the Eocene of Dakota.

---

* I cannot draw the line between this group and *Leptolimnæa*, Swains. *Limnophysa* has priority (1833). The greater proportion of the species which have been referred by various authors to *Bulimnæa*, also seem to belong to this section. I regard these sub-genera as for convenience only, and really expressing very slight characters.

Sub-genus *Limnæa.* Lam. 1801.

Spire produced, slender. Last whorl expanded, with a fold on the columella.

Type *Limnæa stagnalis.* Linn.

Genus *Amphipeplea.* Nils. 1822.

Mantle produced over the outside of the shell. Shell few whorled, dextral.

Type *Amphipeplea glutinosa.* Müll.

Genus *Erinna.* H. & A. Adams. 1858.

Animal yet undescribed. Shell ovate-globose, spire short, last whorl much the largest, spire obtuse. Columella straight, excavated, and with a curved elevated external ridge continued in front into the outer lip, which is simple and acute. Shell horny, striate longitudinally, dextral.

Type *Erinna Newcombi.* H. & A. Ad.

Genus *Strebelia.* Crosse and Fischer. 1868.

Shell involute; spire short, hardly perceptible; dextral. Animal unknown. ("Much larger than the shell," Berendt.)

Type *Strebelia berendtii* = *Physella berendti.* Pfr.

The fact that some species of *Limnæa*, proper, are dextral and some sinistral, is insufficient cause for placing the latter in a group by themselves, unless other characters are present, of which at present we have no information.

Sub-family PLANORBINÆ. H. & A. Ad.

Lateral jaws present.

Tentacles filiform. Foot short. Genitalia on the left side.*

Genus *Planorbis.* Guett. 1756.

Shell dextral, depressed.

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* If we consider the shells of this group as dextral, they offer the peculiarity of having the genitalia as in most sinistral shells. *Pompholyx* presents the same conditions, and is certainly dextral.

Sub-genus *Taphius.* H. & A. Ad. 1855.

Shell excavated beneath. Whorls rounded, columella rectilinear.

Type *Taphius andecola.* H. & A. Adams.

Sub-genus *Helisoma.* Swains. 1840.

Shell ventricose, whorls angulated. Spire sunk below the body whorl.

Type *Helisoma bicarinata* = *Planorbis bicarinatus.* Sby.

Sub-genus *Planorbis.* (Guett.) 1756.

Central tooth bilobed.

Spire depressed, whorls rounded, last whorl ventricose, aperture crescentic.

Type *Planorbis corneus.* Linn.

Sub-genus *Planorbella.* Hald. 1844.

Shell few whorled, aperture campanulate.

Type *Planorbella campanulata* = *Planorbis campanulatus.* Say.

Sub-genus *Adula.* H. Ad. 1861.

Whorls rounded and numerous. Deeply umbilicate on the upper and convex on the under side, aperture campanulate.

Type *Adula multivolvis* = *Planorbis multivolvis.* Case.

Sub-genus *Menetus.* H. & A. Ad. 1855.

Shell depressed, whorls rapidly increasing. Periphery angulated.

Type *Menetus opercularis* = *Planorbis opercularis.* Gld.

Sub-genus *Gyraulus.* Agassiz. 1837.

Shell rounded above, flat beneath, whorls few, rapidly increasing.

Type *Gyraulus albus* = *Planorbis albus.* Müll.

Sub-genus *Bathyomphalus.* Agassiz. 1837.

Shell depressed, many whorled, periphery simple.

Type *Bathyomphalus contortus* = *Planorbis contortus.* Linn.

Sub-genus *Anisus.* Fitz. 1833.

Shell greatly depressed, whorls very numerous, keeled.

Type *Anisus vortex* = *Planorbis vortex.* Linn.

Genus *Segmentina.* Flem. 1828.

Shell furnished with internal transverse laminæ or teeth ; depressed.

Sub-genus *Planorbula.* Hald. 1844.

Laminæ, except the last, absorbed in the adult.

Type *Planorbula armigera* = *Planorbis armigerus.* Say.

Sub-genus *Segmentina.* Flem. 1828.

Laminæ persistent.

Type *Segmentina lacustris* = *Planorbis lacustris.* Lightfoot.

(?) Sub-family CAMPTOCERINÆ. Dall.

Jaws ?

Shell sinistral. Foot short. Tentacles cylindrical, obtuse. Mantle not passing beyond the shell. Teeth ?

Genus *Camptoceras.* Bens. 1834.*

Shell with the whorls disunited, sub-angulate. Aperture entire, produced and reflexed anteriorly.

Type *Camptoceras terebra.* Benson.

Sub-family POMPHOLIGINÆ. Dall.

(= POMPHOLINÆ. Dall, 1866. olim.)

Buccal plate subcordiform. Laterals absent. Genitalia on the left side. Shell dextral, depressed, few-whorled.

* This genus may eventually prove to be more closely connected with *Pompholyx* than is evident from our present knowledge of it.

Genus *Pompholyx.* Lea. 1856.

Tentacles medium, stout, cylindrical, slightly globose at the tips. Genitalia on the left side. Teeth (See figure I.).

Shell few-whorled, last whorl ventricose. Aperture oblique, obtusely angulate below, entire.

Type *Pompholyx effusa.* Lea.

Genus *Choanomphalus.* Gerstfeldt.* 1860.

Animal unknown.

Shell deeply umbilicate, resembling *Tropidina.*

Type *Choanomphalus Maachii.* Gerst.

Genus *Carinifex.* W. G. Binney.† 1863.

Soft parts resembling *Planorbis.* Tentacles apparently shorter. (Lea.)

Teeth (See figure II.).

Shell with angulated whorls and a wide funnel-shaped umbilicus.

Type *Carinifex Newberryi* = *Planorbis Newberryi.* Lea.

Sub-genus *Vorticifex.* Meek.

Whorls rounded above. Adult shell smooth or marked by lines of growth. Young shell provided with strong transverse costæ.

Type *Vorticifex Tryoni,* = *Carinifex Tryoni.* Meek.

Fossil in the Tertiaries of Nevada.

The above name is proposed by Mr. Meek for the remarkable form above indicated, which was obtained by the U. S. Geol. Survey, of the 40th parallel, under Clarence King.

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* Mem. St. Petersburg Acad. Sci., ix. p. 527, 1860. See also Revue et Magas. de Zool. 1860, p. 527. Pl. 23. The typical species bears no little resemblance to *Carinifex*, and, though smaller, may be congeneric. It has several years' priority.

† *Megasystropha.* Lea. Neither genus was characterized by the author, and the former is in general use and has priority.

Family ANCYLIDÆ. Menke. 1828.

Lateral jaws present. Teeth resembling *Limnæa.* Shell patelliform. Hermaphrodite, but not capable of simultaneous reciprocal impregnation, as are the Limnæans.

Group A. Shell simple.

Genus *Acroloxus.* Beck. 1837.

Lateral plates not continuous with the jaw. Mantle margin simple, the pulmonary orifice closed by a small lobe. Tentacles subulate, stout, short. Genitalia on the right side. Shell with the apex inclined to the right.

Type *Acroloxus lacustris* = *Patella lacustris.* Linn.

Genus *Ancylus.* Geoffr. 1776.

Lateral plates fused with the jaw. Tentacles and mantle margin as in *Acroloxus.* Genitalia on the left side. Apex inclined to the left.

Type *Ancylus fluviatilis.* Müll.

Genus *Brondelia.* Bourg. 1862.*

Soft parts unknown.

Shell shining, with an undulated margin, caused by rounded ribs which radiate from the summit. Apex mammillated, slightly inclined to the left.

Type *Brondelia Drouetiana* = *Ancylus Drouetianus.* Bourg.

† Genus *Valenciennius.* Rousseau. 1842 (= *Valenciennensis* Rouss. 1842, et *Valenciennia,* Bourg. 1855.)

Shell large (125 mill. long, 72 broad, 77 high), thin, fragile,

* This genus inhabits the forests of Algiers, where two species are found on damp rocks away from the water.

† This remarkable genus is admitted here in deference to the opinions of MM. Deshayes and Bourguignat. It somewhat resembles *Camptonyx,* which Fischer has united with it, perhaps without sufficient cause, under the fourth generic name *Valenciennesia!*

with a capuliform apex, from which concentric undulations extend to the margin. At the short, or posterior extremity, two internal gutters or grooves (one on each side, the right hand one

the margin ; somewhat resem-
iphonaria in appearance. By
e is emarginated, especially on

us. Rousseau.
Crimea, with *Limnæa*, *Planor-*

HYSACEA.

SIDÆ. Dall.

al plate (when present) without
th with comb-like, alternating
entral tooth broad, bifid; cusp

y PHYSINÆ.

Drap. 1801.

l. Buccal plate chevron-shaped,
long. Shell sinistral.

a. Drap. 1801.
ovate, outer lip and columella

rap.

ella. Hald. 1842.
aperture very wide, with a well-

ald.

ostatella. Dall.
rse undulations or costæ.
Physa costata. Newcomb.

Family ANCYLIDÆ. Menke. 1828.

Lateral jaws present. Teeth resembling *Limnæa*. Shell patelliform. Hermaphrodite, bu[t not capable of simultaneous] reciprocal impregnation, as are t[he ...]

Group A. S[...]

Genus *Acroloxu[s]*

Lateral plates not continuous [...] simple, the pulmonary orifice cl[...] cles subulate, stout, short. Geni[...] with the apex inclined to the rig[ht ...]

Type *Acroloxus lacustris* = *P*[...]

Genus *Ancylus*.

Lateral plates fused with the [...] margin as in *Acroloxus*. Genita[...] clined to the left.

Type *Ancylus fluviatilis*. Mül[...]

Genus *Brondelia*.

Soft parts unknown.

Shell shining, with an undulat[...] ribs which radiate from the s[...] slightly inclined to the left.

Type *Brondelia Drouetiana* = [...]

† Genus *Valenciennius*. Rous[...] *nensis* Rouss. 1842, et *Vale*[...]

Shell large (125 mill. long, 72 [...]

* This genus inhabits the forests of Al[...] damp rocks away from the water.

† This remarkable genus is admitted [...] MM. Deshayes and Bourguignat. It so[...] Fischer has united with it, perhaps witho[ut ...] generic name *Valenciennesia*!

Accidentally omitted in making up the form: insert before "Group Physaceæ," p. 355.

Group B. Shell with an internal lamina.

Genus *Gundlachia*. Pfr. 1849.

Shell ancyliform; apex oblique, non-spiral, posteriorly inclined, basal side two-thirds closed by a flat lamina parallel with the plane of the aperture, soft parts resembling *Ancylus*.

Type *Gundlachia ancyliformis*. Pfr. Cuba.

(?) Genus *Latia*. Gray. 1849.

Shell crepiduliform, apex spiral, posterior; aperture with a posterior semilunar septum, furnished on the right side with a projecting, slender, free, somewhat twisted lamina. Exterior with a brown spirally striate epidermis. Tentacula short, triangular; mantle margin simple; pulmonary aperture on the right side. Foot rounded; teeth unknown.

Type *Latia neritoides*. Gray. New Zealand.

Page 343, line 28; for *ancyliformis*, read *neritoides*.

with a capuliform apex, from which concentric undulations extend to the margin. At the short, or posterior extremity, two internal gutters or grooves (one on each side, the right hand one being most prominent) extend to the margin ; somewhat resembling the siphonal groove of *Siphonaria* in appearance. By their terminations the peristome is emarginated, especially on the right side.

Type *Valenciennius annulatus.* Rousseau.

Fossil in the Tertiaries of the Crimea, with *Limnæa*, *Planorbis*, and other fresh-water shells.

Group Physacea.

Family PHYSIDÆ. Dall.

Foot pointed behind. Buccal plate (when present) without accessory laterals. Lateral teeth with comb-like, alternating with simple, cusps. Base of central tooth broad, bifid ; cusp with several denticles.

Sub-family Physinæ.

Genitalia on the left side.

Genus *Physa.* Drap. 1801.

Mantle edge digitate or lobed. Buccal plate chevron-shaped, or absent. Tentacles filiform, long. Shell sinistral.

Sub-genus *Physa.* Drap. 1801.

Shell moderately elevated, ovate, outer lip and columella simple.

Type *Physa fontinalis.* Drap.

Sub-genus *Physella.* Hald. 1842.

Shell globose, spire short, aperture very wide, with a well-marked fold on the columella.

Type *Physella globosa.* Hald.

Sub-genus *Costatella.* Dall.

Shell rounded, with transverse undulations or costæ.

Type *Costatella costata* = *Physa costata.* Newcomb.

Sub-genus *Isidora.* Ehr. 1831.

Shell with the whorls inflated, columella destitute of a fold, semi-umbilicated.

Type *Isidora contorta* = *Physa contorta.* Mich.

Sub-genus *Ameria.* H. Adams. 1861.

Spire short; whorls appressed, flattened, tabulate or carinate posteriorly. Last whorl much the largest.

Example, *Ameria scalaris* = *Paludina scalaris.* Jay.* Tampa Bay, Fla.

Sub-genus *Physodon.* Hald. 1853.

Shell solid, smooth, columella toothed, outer lip thickened.

Type *Physodon microstoma.* Hald.

Genus *Macrophysa.* Meek. 1865.

Spire very much elongated, whorls numerous, nearly equal; body whorl short; aperture less than one-fourth the length of the slender, cylindriform shell; apex obtuse.

Type *Macrophysa columnaris* = *Physa columnaris.* Desh. Fossil in the Eocene of the Paris Basin.

Genus *Bulinus.* Adans. 1757. (*Aplexa*, Flem.)

Mantle edge simple. Buccal plate cartilaginous. Tentacles long, filiform.

Shell sinistral, elongate; margin of aperture entire.

Type *Bulinus hypnorum.* Linn.

Genus *Physopsis.* Krauss. 1848.

Shell ovate, thin; outer lip acute, columella plicate, involute. Soft parts unknown.

Type *Physopsis africana.* Krauss.

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* A careful examination of a number of specimens of this singular form shows that it is distinct, and not a young *Planorbis*, as has been suspected. Most of the species of this group are from the Southern Hemisphere.

Family CHILINIDÆ. Dall.

Tentacles flattened. Mantle with a rhombiform lobe covering the opening of the pulmonic chamber. Shell dextral, columella plicate. Genitalia on the right side. Lateral teeth uniformly comb-like, with the bases prolonged before the insertion of the cusps. No accessory simple teeth. No jaw. Central tooth as in *Physa*.

Genus *Chilina*. Gray. 1840.

Type *C. fluctuosa.*

Sub-genus *Chilina*.

Shell with a short blunt spire, smooth epidermis, usually marked with bands of color and of more or less solid structure.

Type *Chilina ampullacea*. Sby.

Sub-genus *Pseudochilina*. Dall.

Shell thin, covered with a rough fibrous epidermis; spire elevated, acute.

Type *Pseudochilina limnæformis* n. s.

Testa acuto-conica, subtenuis; spira elevata, ad apicem acuminata; suturis subimpressis, anfr. VI.; apertura elongata; labro acuto; columella lata, plica valde munita, dente inconspicuo armata; epidermide aspera, semifibrosa, fusca.

Lon. 0.67, lat. 0.35. in. Defl. 58°.

Smithsonian Cabinet No. 5,908. Chili. Commodore Aulick, coll.

The curious epidermis and broad plicate columella alone distinguish this singular shell from a *Limnæa*.

NOTES.

The figures given by H. & A. Adams, of *Amphipeplea* are not good. Those of Moquin Tandon are much better.

Most of the figures of dentition of the fresh-water species given by Binney in the Land and Fr. Water Shells of N. Am. Part II., are far from good.

Some authors state that the lateral jaws of *Ancylus* are not continuous with the buccal plate. I have followed Moquin

Tandon, and Gray, who figure them as continuous. The greatest care and experience in observation is required to make reliable notes on the dentition.

Limnæria, H. & A. Adams, belongs to the *Otinidæ*.

Choanomphalus, Gerstfeldt, in the present state of our knowledge, cannot be positively placed; but, if not a *Tropidina*, is closely allied to *Pompholyx* and *Carinifex*.

Brondelia, Bourg., from its peculiar habitat, the impressed radiations and rounded ribs of the shell, as well as the polished periostraca, differs, in my opinion, sufficiently from the *Ancyli* to take rank as a genus. The type, which is from Algerian forests, is figured by Binney, L. and F. W. Shells of N. A., Part II., p. 146.

It is with great hesitation that I have followed Menke and Troschel in separating the *Ancylidæ* as a family. The difference in the mode of coition seems to be chiefly mechanical, caused by the form of the shell. This patelloid shape is the strongest character.

On the other hand, the form of the foot, the jaws, and dentition agree closely with the typical *Limnæidæ*. At any rate, the characters which separate them are far less valuable than those which distinguish the *Physidæ* from the *Limnæidæ*.

The sub-family *Camptocerinæ* seems necessary, from the very distinct characters which separate it from the other groups. I feel justified in separating it provisionally until more is known.

No one who has read the account of the growth of *Gundlachia*, by Dr. Stimpson (in Proc. B. S. N. H. 1863), can have much doubt that the genus *Poeyia*, Bourg., is a young *Gundlachia*, and there is much probability that *Ancylus Cumingianus*, of the same author, from Tasmania, is an immature *Latia*. There is a possibility that the latter genus (if the position of the eyes be correctly reported) may belong to the group, characterized by a rudimentary operculum, of which *Navicella* is the type. In so small an animal it might readily be overlooked or even be entirely absent.

It is to be hoped that the numerous observers who are furnished with microscopes will avail themselves of the riches which lie hidden in every brook and pool. The dentition and anatomy of our native species of *Physa*, *Limnæa*, *Planorbis*, as well as the *Viviparidæ* and the *Strepomatidæ* are almost entirely unknown.

The ribbon may be most easily obtained by boiling the animal in a test tube over a spirit lamp, in a solution of caustic potash. It can easily be found by pouring the contents of the tube into a smooth white saucer, or a deep watch-glass. The shell from which the animal was extracted should always be preserved, and the ribbon mounted, when practicable.

Great care is needed when inexperienced in such work, particularly when working with a low power, not to mistake the outline of the base of insertion of the tooth for its cusp. The latter is almost always transparent, and nearly invisible when compared with the base, which is usually dark yellow.

A good plan is, when specimens are plenty, to break up the ribbon after a close examination of it in the entire state. In this way the outlines of the edges of the cusps are more easily made out. Drawings, no matter how rude, should be made on the instant, and repeated until the entire accuracy of the outlines is beyond dispute. Some assistance may be obtained in such work from photography, which, uncorrected by a trained eye, is, however, very liable to mislead. The extreme anterior teeth are usually much worn and broken by use, and the extreme posterior ones are immature and not fully shaped. The middle of the odontophore affords the best examples.

The jaws are destructible in potash and should be examined *in situ*, by placing the animal on a needle stuck into a cork, which should be fixed on the stand of the microscope, and light should be condensed by a bull's-eye lens on the part of the animal which it is desired to observe; but not too strongly, or it will be burned or dried up.

Several specimens should always be examined when possible, as a certain range of variation is possible, and in this way a better general idea of the ribbon is obtained.

Much of the anatomy may be made out by crushing the fresh animal gradually under the cover of the live-box.

The viscera are liable to be misplaced by this process, and other specimens should be dissected with needles or fine scissors.

For works of reference, Leidy on the anatomy of the Terr. Gasteropoda of the U. S. (in A. Binney's Mon. Hel.) may be consulted for the land species;—while Bronn, and Moquin Tandon are almost the only ones who have given much information in regard to the anatomy of the fresh-water forms. Cuvier, Vogt, and Baudelot have added much information in detached papers in regard to a few species.

While authors may disagree as to the value of the lingual dentition as a basis for classification, yet all must admit that every reliable addition to our knowledge of the subject is of great importance, and the details of the anatomy much more so.

Huxley has recently classified the air-breathing Mollusca by the flexure of the intestine. While his generalizations have a very slender basis of fact, and are rejected by almost every malacologist, yet, until dissections on a more extended scale have been made, no one has the right to consider them as utterly absurd, nor yet to accept them as proven.

REFERENCES TO THE PLATE.

Fig. 1.—Dissection of *Pompholyx* var. *solida*, Dall; showing the digestive and female generative system, with the organs about the mouth, as if transparent.

a, Anus. b, Buccal plate. c, Crop. d, Auxiliary mucus gland. e, Outlet of stomach into intestine. f, Male aperture. i, descending intestine. k, Stomach. m, Buccal mass. n, Muscular band of stomach. o, Œsophagus. ov, Oviduct. p, Pulmonary cavity. r, Lingual ribbon. re, Rectum. s, Organ of smell surrounded by the salivary gland. t, Ovary. u, Uterus. x, Liver. z, Edges of mantle laid back.

Fig. 2.—Female reproductive system. b, Genital bladder. a, Uterus. s, auxiliary gland. v, Oviduct. o, Ovary.

Fig. 3.—Male generative system. a, Foramen. b, Penis c, Retractor muscle. d, Vas deferens. e, Prostate. f, Epididymis. h, Testicle.

Fig. 4.—Nervous system.

Fig. 5.—Circulation. h, Heart.

Fig. 6.—a, Top view of ova capsule of *Pompholyx solida*. b, Section of the same.

Fig. 7.—a, Shell of *Pompholyx* var. *solida*. b, Side view of the eye.

Fig. 8.—Teeth of *Physa humerosa* slightly separated. a. Uncinal teeth. b, Pleurals.

Fig. 9.—Teeth of *Pompholyx* var. *solida*. a, Rhachidian tooth. b, Side view. 1, First pleural. c, Side view. 5, Fifth pleural. 8, Eighth pleural. 10, Tenth do. 11, Eleventh do. 18, Eighteenth lateral or first uncinal.*

Fig. 10.—z, Rhachidian tooth of *Limnæa stagnalis*. x, ditto of *Planorbis lentus*. o, Rhachidian tooth of *Physa humerosa*.

Fig. 11.—a, Buccal plate of *Pompholyx* var. *solida*. b, ditto of *Physa acuta* (from Moquin Tandon.)

Fig. 12.—Buccal plate of *Limnæa stagnalis* (Moquin Tandon). l, l, Accessory lateral plates.

Fig. 13.—Rhachidian tooth of *Acella gracilis*, Jay.

Fig. 14.—Rhachidian tooth of *Carinifex Newberryi*.

* As comparisons may be instituted between this and other published figures of the dentition of *Pompholyx*, it may be well to state that some twenty-five specimens of the radula have been critically examined and compared, and their agreement with the present figure is indubitable. The specimens were examined by the writer, and also by Prof. Theodore Gill of the Smithsonian Institution, Mr. W. G. Binney, and Mr. Thomas Bland.

To Mr. Binney I am under great obligations for his kindness in assisting me to obtain for examination his original specimens of the radula of the typical *Pompholyx effusa*, and for opportunities of looking at his original photographs, taken from the same by Mr. Samuel Powel.

XXVIII.—*Index to the Literature of Uranium.*

By H. Carrington Bolton.

Read February 14, 1870.

Date.	Author.	Remarks.	References.*
1789	Klaproth..........	Original discovery.....	Klapr. Beitr., II, 197; Crell's Ann., 1789, II., 387; Ann. Ch. Phys. [1], IV., 162.
1789	Crell.	....	J. de Phys., XXXV., 391.
1790	Hecht	....	J. de Phys., XXXVI., 53.
1793	F. C. Fuchs......	....	Ueber Richter's Darst. d. Urans. Erfurt, 1793.
1798	Tychsen	....	Trommsd. J. de Pharm., V., 121.
1799	A. B..............	Note..................	Phil. Mag., 1799, 112.
1800	Ritter............	Magnetic properties....	Gilbert Ann., IV., 24.
1803	Proust............	"Silène"	Gilbert Ann., VII., 127.
1805	Richter...........	Researches............	N. Gegenst. d. Ch., I., 1; IX., 36; Gehlen's J., IV., 402.
1805	Bucholz...........	Researches............	Gehlen's J., IV., 17 and 134; Ann. Ch. Phys. [1], LVI., 142.
1807	Thomson..........	U. in sand from river Dee	Trans. Roy. Soc., Edinb., 1807; Phil. Mag., 1810, 98.
1811	John..............	Chromate.............	Schweigg. J., II., 382.
1813	Schönberg.........	Estim. of At. Wt.......	Schweigg. J., XV., 284.
1817	Chevreul..........	Carbonate of K. and U.	J. de Phys., LXXXV., 472.
1818	Berzelius..........	Selenate	Schweigg. J., XXIII., 457.
1819	Clarke............	Reduction of U. oxide..	Gilbert Ann., LXII., 353.
1820	Gahn..............	Blowpipe reactions.....	Schweigg. J., XXIX., 307.
1823	Brande............	Extraction	Quart. J. Sci., XIV., 86; Schweigg. J., XLIV., 1.
1823	Arfvedson.........	Researches............	Abh. d. K. Schw. Akad., 1822; Pogg. Ann., 1, 245; Schweigg. J., XLIV., 8; Ann. Ch. Phys. [2], XXIX., 148; Ann. Phil., N. S., VII., 253; Ann. d. M., X., 130; Berz. Jahresb., II., 120.
1823	Lecanu & Serbat..	Extraction	J. d. Pharm., IX., 141 and 279; Schweigg. J., XLIV., 35.
1823	Laugier & Boudet.	....	J. d. Pharm., IX., 145. XI., 286; Schweigg. J., XLIV., 40; Ann. Ch. Phys. [2], XXIV., 239.
1823	H. Rose..........	Sulphide	Gilb. Ann., LXXIII., 139.

* For explanation of abbreviations, see introduction to Dana's Mineralogy, 5th edition.

DATE.	AUTHOR.	REMARKS.	REFERENCES.
1823	Berzelius..........	Researches............	Pogg. Ann., I., 359; Ann. d. M. [1], X., 137 and 299; Schweigg. J., XLIV., 191; Berz. Jahresb., IV., 117.
1824	Berzelius..........	Ur. soluble in aq.......	Pogg. Ann., II., 149.
1825	Berthier...........	Oxide.................	Ann. d. M. [1], X., 141.
1825	Pleischl...........	Iodate................	Schweigg., XLV., 23.
1826	Berzelius..........	Sulph-arsenate........	Pogg. Ann., VII., 28 & 148.
1826	Berzelius..........	Sulpho-carbonate......	Pogg. Ann., VI., 456.
1826	Berzelius..........	Sulpho-molybdate.....	Pogg. Ann., VII., 276.
1827	Fischer............	Reduct. by metals.....	Pogg. Ann., IX., 264; J. pr. Ch. XXIV., 227.
1829	Fischer............	Reduct. by metals.....	Pogg. Ann., XVI., 125.
1829	Quesneville........	Extraction............	J. d. Pharm., XV., 493; Dingl. J., XXXIV., 143; Berz. Jahresb., X., 117; Schweigg. J., LVII., 127.
1830	Berthemot.........	Bromide..............	Ann. Ch. Phys. (2), XLIV., 387.
1831	Davis.............	Use as mordant........	Repert. Pat. Inv, March, 1831, 174; Dingl. J., XL., 152.
1831	Berzelius..........	Vanadate.............	Pogg. Ann., XXII., 63.
1832	Herschel..........	Separation from iron by K_2FeCy_3..............	Ann. Ch. Phys., XLIX., 310; Pogg. Ann., XXV., 627; Berz. Jahresb., XIII., 120.
1834	Persoz............	Separation by acetate lead................	Ann. Ch. Phys. [2], LVI., 333; J. pr. Ch., 1834, III., 216; L'Instit., No. 70, 299; Berz. Jahresb., XV., 195; Pogg. Ann., XXXIII., 248.
....	Persoz............	Separation by CuO and HgO...............	Ann. Ch. Phys. [2], LVIII., 202.
1834	Berzelius..........	Tellurate.............	Pogg. Ann., XXXII., 596 and 608.
1835	Berzelius..........	Pyroracemate..........	Pogg. Ann., XXXVI., 24.
1837	Heller............	Croconate and rhodizonate................	J. pr. Ch., XII., 228 and 239.
1837	Marchand.........	Sulphethylate.........	J. pr. Ch., XII., 264; Pogg. Ann., XLI., 629.
1838	Werner...........	Extraction............	Ann. Ch. Pharm., XXVIII., 240; J. pr. Ch., XII., 381; Dingl. J., LXVIII., 465.
1841	Regnault..........	Specific heat.........	Ann. Ch. Pharm., XXXVI., 108; Berz. Jahresb., XXI., 13.
1841	Plantamour........	Attempt to reduce protoxide..............	J. pr. Ch., XXIII., 230; Pharm. Centr., 1841, 592.

Date.	Author.	Remarks.	References.
1841	Rammelsberg......	"Sulphantimoniate" ..	Ann. Ch. Pharm., XL., 286.
1841	Marchand.........	Atomic Wt...........	J. pr. Ch., XXIII., 497.
1841	Wohler...........	Vd. in Uranpecherz....	Pogg. Ann., LIV., 600.
1841 to 1842	Péligot.........	Metallic U. and general researches..........	C. R., April, 1841, p. 735; J. pr. Ch., XXIII., 494; XXIV., 442; J. d. Pharm., XXVII., 525; Ann. Ch. Phys. [3], V., 1; Ann. Ch. Pharm., XLI., 141.
1841 to 1842	Péligot..........	Metallic U. and general researches..........	Ann. Ch. Pharm., XLIII., 255; Pharm. Centr., 1842, 321 and 847; Berz. Jahresb., XXII., 113; XXIII.; Pogg. Ann., LIV., 122.
1842	Ebelmen..........	Researches...........	Ann. Ch. Pharm., XLIII., 286; Ann. Ch. Phys. [3], V., 189; Pharm. Centr., 1842, 863; J. pr. Ch., XXVII., 385; Berz. Jahresb., XXIII.
1842	Wittstein..........	Extraction...........	Buchner's Repert., LXIII., 231.
1842	Delffs.............	Carbonate, &c.........	Pogg. Ann., LV., 229; Berz. Jahresb., XXIII., 201.
1842	Wöhler..	Preparation of cryst. UO	Ann. Ch. Pharm., XLI., 345; Berz. Jahresb., XXIII.
1842	Kühn	Criticism on Péligot....	Ann. Ch. Pharm., XLI., 337; Pharm. Centr., 1842, 324.
1842	Fresenius..........	Cyanide..............	Ann. Ch. Pharm., XLIII., 135.
1842	Wertheim.........	Acetates	Monatsb. d. Berl. Akad., 1842; J. pr. Ch., XXIX., 209; Ann. Ch. Pharm., XLIV., 274; Ann. Ch. Phys. [3], XI., 49; Pharm. Centr., 1843, 585; Pogg. Ann., LVII., 481.
1843	Rammelsberg......	Bromate	J. pr. Ch., XXIV., 285; Berz. Jahresb., XXII., 140.
1843	Berthier..........	Sulphite and separation	Ann. Ch. Pharm., XLVI., 184; Pharm. Centr., 1843, 382.
1843	Bonaparte	Valerianate...........	J. pr. Ch., XXX., 308; Pharm. Centr., 1843, 949.
1843	Köhnke...........	Technical uses.........	Wiener Polyt. J., 1843, 1117.
1843	Malaguti	Hydrated sesquioxide...	Ann. Ch. Pharm., XLVIII., 236; Ann. Ch. Phys., IX., 463; J. pr. Ch., XXIX., 231; C. R., XVI., 851; Pharm. Centr., 1843, 590; Berz. Jahresb., XXIV., 118.

Date.	Author.	Remarks.	References.
1844	Rammelsberg......	Protosalts.............	Ann. Ch. Pharm., XLVIII., 234; Pogg. Ann., LV., 318; LVI., 125; LIX., 10; Berz. Jahresb., XXIII.
1844	Rammelsberg......	Atomic Wt............	Pogg. Ann., LIX., 1; J. pr. Ch., XXIX., 234; Berz. Jahresb., XXIV., 117; Pharm. Centr., 1843, 577.
1844	Muspratt..........	Sulphites	Ann. Ch. Pharm., LV., 290.
1844	De la Provostaye ..	Crystallographic properties................	Ann. Ch. Phys., V., 47; VI., 165; Berz. Jahresb., XXIII., 213.
1845	Péligot............	Tartrates, &c..........	Ann. Ch. Phys., XII., 549; Ann. Ch. Pharm., LVI., 230; Pharm. Centr., 1845, 193.
1844	Bottinger..........	Separation	Ann. Ch. Pharm., LI., 407; Pharm. Centr., 1845, 107.
1846	Berzelius..........	....	Berz. Jahresb., XXV., 162.
1846	Peters.............	Extraction	Arch. d. Pharm., XLVII., 146; Pharm. Centr., 1846, 831.
1847	Arppe.............	Pyrotartrate...........	Inaug. Diss., Helsingf., 1847; Ann. Ch. Pharm., LXVI., 73.
1848	Werther...........	Phosphates & arsenates	J. pr. Ch., XLIII., 321; XLIV., 127; Ann. Ch. Pharm., LXVIII., 312; Pharm. Centr., 1848, 433; Instit., 1848, 393; J. d. Pharm. [3], XIV., 57; Phil. Mag. [3], XXXIII., 244; Jahresb., 1849, 418 and 1218.
1848	Péligot............	Atomic Wt............	Ann. Ch. Pharm., LX., 183; Ann. Ch. Phys. [3], XX., 329; J. pr. Ch., XLI., 398; C. R., XXII., 487; J. pr. Ch., XXXVIII., 152; Jahresb., 1848, 418.
1849	Patera............	Extraction on large scale	Wien. Acad. Ber., 1849, 353; Wien. Ber. Freund. d. Wiss., IV; J. pr. Ch., XLVI., 182; Jahresb., 1849, 274, 584.
1850	Patera............	Red sulphide..........	J. pr. Ch., LI., 122; Ann. Ch. Pharm., LXXXVI., 254; Pharm. Centr., 1851, 402; Jahresb., 1850, 313.
1852	Stokes............	Fluorescence of uranium glass...............	Phil. Mag. [4], IV., 388; Pogg. Ann., LXXXVII., 488; Am. J. Sci. [2], XV., 270; Jahresb., 1853, 140.

Date.	Author.	Remarks.	References.
1852	Gieseke	Extraction	Arch. Pharm. [2], LXIX., 150; J. pr. Ch., LV., 445; Dingl. J., CXXIV., 355; Pharm. Centr., 1852, 232; Jahresb., 1852, 779.
1852	Stokes	Detection U	Instit., 1852, 392; Jahresb., 1854, 125.
1852	Girard	Sulphite	C. R., XXXIV., 22; Ann. Ch. Ph., LXXXI., 366; Pharm. Centr., 1852, 100.
1852	Schabus	Crystallographic	Jahresb., 1852, 433.
1853	Patera	Extraction on large scale	Wien. Acad. Ber., XI., 842; J. pr. Ch., LXI., 397; Pharm. Centr., 1854, 236; Dingl. J., CXXXII., 36; Chem. Gaz., 1854, 178; Jahresb., 1853, 740.
1855	Werther	Fluorescence	J. pr. Ch., LXV., 349; Pharm. Centr., 1855, 605; Phil. Mag. [4], X., 390; Jahresb., 1855, 133.
1855	C. Gr. Williams	Oxychloride and organic bases	Chem. Gaz., 1855, 450; Pharm. Centr., 1856, 47.
1856	Patera	Purification of U. yellow	Dingl. J., CXLI., 372; Pharm. Centr., 1856, 843; Polyt. Centr., 1857, 75; J. pr. Ch., LXIX., 118; Oestr. Zeits. Berg u. Hüt., 1856, 31.
1856	Knop	Estimation	J. pr. Ch., LXIX., 401; Pharm.Centr.,1856,738 and 803; Jahresb., 1856, 728.
1856	Scheibler	Acetate of U_2O_3 and LiO	Pharm. Centr., 1856, 717.
1856	Keferstein	Crystallographic	Pogg. Ann., XCIX., 275; Jahresb., 1856, 380; J. pr. Chem., LXIX., 303.
1856	Péligot	Metallic U	C. R., XLII., 73; Instit., 1856, 29; J. d. Pharm. [3], XXIX., 203; Ann. Ch. Pharm., XCVII., 256; Pogg. Ann., XCVII., 630; J. pr. Ch., LXVIII., 184; Pharm. Centr., 1856, 223; Jahresb., 1856, 380; Phil. Mag., 1857, 123.
1857	Kessler	Extraction	J. d. Pharm. [3], XXXI., 182; C. R., XLVI., 530; Dingl. J., CXLIX., 77; Pharm. Centr., 1858, 336; Polyt. Centr., 1858, 1513; Jahresb., 1857, 199; Verh. d. Niederöstr. Gewerbevereins, 1858, 293.

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1858	Marbach	Optical examination....	Pogg. Ann., CIV., 422.
1858	Weselsky..........	Acetates	Chem. Gaz., 1858, 390; J. pr. Ch., LXXV., 55; Pharm. Centr., 1858, 610.
1858	Brianchon.........	Technical uses.........	Génie Indust., 1858, 147; Technologiste, 1858, 521; Polyt. Centr., 1858, 1242; Dingl. J., CXLVIII., 172; Chem. Centr., 1858, 698; Polyt. Centralhalle, 1858, 670.
1859	Hallwachs & Schafarik	Action of U. on iodide ethyle	Ber. Acad. Wiss. Wien. XXXIII., 569; Pharm. Centr., 1859, 163.
1859	Pincus	Estimat'n of phosphoric acid with acetate of U.	J. pr. Ch., LXXVI., 104.
1859	Wysocky..........	Extraction on large scale	Oest. Zeitschr. Berg. Hüt., 1859; Dingl. J., CLV., 305; Pharm. Centr., 1860, 327; Polyt. Centr., 1860, 139; Jahresb., 1860, 698.
1860	Anthon............	Extraction	Dingl. J., CLVI., 207 and 288; Zeitschr. Ch. Pharm., 1860, 412; Rep. Chim. Appl., II., 281; Pharm. Centr., 1860, 549 and 591; Polyt. Centr., 1860, 1118 and 1274.
1861	Drenkmann........	Historical résumé and researches...........	Zeitschr. ges. Naturw., XVII., 113; Jahresb., 1861, 255.
1861	H. Hermann.......	Researches............	Inaug. Dissert. Gött., 1861; Jahresb., 1861, 258.
1861	Fresenius..........	Estimation............	J. pr. Ch., LXXXII., 257; Chem. News, 1861, 150.
1861	Graham...........	Saccharate......	Ann. Ch. Pharm., CXXI., 52; Jahresb., 1861, 77.
1861	Pisani.............	Estimat'n and min. anal.	C. R., LII., 72 and 817; Rep. Chim. Pur., III., 222 and 639; Zeitschr. Ch. Pharm., 1861, 123; J. pr. Ch., LXXXV., 186; Pharm. Centr., 1861, 221; Chem. News, III., 211; Jahresb., 1861, 1030 and 824.
1862	Vogelsang.........	Technical.	Preuss. Zeitschr. Berg. H. ü. Salin., X., 168.

DATE.	AUTHOR.	REMARKS.	REFERENCES.
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1862	H. Rose..........	Estimation...........	Pharm. Centr., 1862, 863; Jahresb., 1862, 601.
1862	Brachet..........	Use of U. glass........	C. R., LV., 409.
1862	Parkmann........	Carbonate............	Am. J. Sci. [2], XXXIV., 321; Chem. News, 1863, 122; Pharm. Centr., 1864, 465.
1863	Guyard...........	Volumetric estimation..	Bull. Soc. Chim., 1861, I., 94; Jahresb., 1863, 692; Chem. News, 1864, 13; Zeitschr. anal. Ch., III., 376.
1864	Stolba............	Estimat'n. silico-fluoride	Zeitschr. Anal. Ch., III., 71; Pharm. Centr., 1864, 1053; Jahresb., 1864, 718.
1864	Remelé...........	Oxysulphide..........	C. R., LVIII., 716; Bull. Soc. Chim. [2], I., 36; N. Arch. Ph. Nat., XX., 52; Ann. Ch. Pharm. Suppl., III., 196; Pogg. Ann., CXXIV., 114; J. pr. Ch., XCIII., 316; Pharm. Centr., 1864, 596; Chem. News, X., 123 and 158; Jahresb., 1864, 234.
1865	Von Hauer...	Acetate..............	Pogg. Ann., CXXV., 149; Pharm. Centr., 1865, 735.
1865	Knop.............	Estimation...........	Pharm. Centr., 1865, 161; Jahresb., 1865, 223.
1865	Remelé...........	Oxysulphide..........	Pogg. Ann., CXXV., 209; Zeitschr. Anal. Ch., IV., 371; Zeitschr. Ch., 1865, 548; 1866, 471; J. pr. Ch., XCVII., 193 and 210; Jahresb., 1865, 221 and 726; Pharm. Centr., 1866, 628.
1865	Gibbs............	Separation...........	Sill. Am. J. Sci. [2], XXXIX., 58; Pharm. Centr., 1865, 407; Jahresb., 1865, 727.
1866	Elsner............	Volatility of U_2O_3......	J. pr. Chem., XCIX., 260.
1866	Bunsen...........	Flame reactions.......	Ann. Ch. Ph., CXXXVIII., 291.
1866	Wysocky.........	....	Oestr. Zeit. Berg. Hüt., 1866; Polyt. Centr., 1866, 1601.

Date.	Author.	Remarks.	References.
1866	Belohoubek........	Volumetric estimation..	J. pr. Ch., XCIX., 231; Zeitschr. Anal. Ch., VI., 120; Zeitschr. Ch., 1867, 121; Pharm. Centr., 1867, 656; Bull. Soc. Chim. [2], VII., 494; Jahresb., 1866, 809.
1866	Patera............	Estimation............	Dingl. J., CLXXX., 242; Zeitschr. Anal. Ch., V., 228; Bull. Soc. Chim. [2], V., 442.
1866	Patera............	Estimation............	Chem. News, XIII., 291; Polyt. Centr., 1866, 831; Jahresb., 1866, 809.
1866	Bolton............	Fluorides	Berl. Akad. Ber., 1866, 299; Inaug. Diss., Göttingen, 1866; Bull. Soc. Chim. [2], VI., 450; Zeitschr. Ch. [2], II., 353; J. pr. Ch., XCIX., 269; Pharm. Centr., 1866, 977; N. Arch. Ph. Nat., XXVI., 338; Jahresb., 1866, 209.
1867	Skey..............	Sulphocyanide.........	Chem. News, XVI., 201; Zeitschr. Chem. [2], IV., 123.
1867	Souchay..........	Estimation............	Zeitschr. Chem. [2], IV., 527; Zeitschr. anal. Chem., VI., 400.
1867	Scheller...........	Sulphites	Ann. Ch. Pharm., CXLIV., 238; J. pr. Chem., CIV., 56; Zeitschr. Chem., 1867, 522; Bull. Soc. Chim. [2], VIII., 417.
1867	Ed. Becquerel......	....	Etudes Chim. sur quelq. Métaux, chez Hachette, Paris, 1867.
1869	Péligot............	Metallic U............	C. R., LXVIII., 507; Ann. Ch. Pharm., CXLIX., 128.
1869	Heintz............	....	Ann. Ch. Pharm., CLI., 216.
1869	Reichardt..........	Phosphate.............	Zeitschr. anal. Chem., VIII., 116.
1870	Sorby.............	Spectrum of compounds of Zr and U........	Chem. News, April, 1870.

ACTION OF LIGHT.—PHOTOGRAPHY.

DATE.	AUTHOR.	REMARKS.	REFERENCES.
1805	Bucholz	Sulphate and alcohol, nitrate and ether	See previous section.
..	Gehlen	Oxychloride	
1841	Ebelmen	Oxalate, sulphate	
1842	Bonaparte	Valerianate	
1857	Burnett	Photogr. prints	Liverpool J. Phot., 1857 and 1858; Humphrey's J., 1857, 81; 1858, 44.
1858	Niepce de St. Victor	Absorption of light and use in printing	C. R., XLVI., 449; Instit., 1858, 73; Dingl. J., CXLVIII., 126; J. pr. Ch., LXXIV., 233.
....	"	....	C.R., XLVII., 866; Humphrey's J., 1858, 10; Dingl. J., CLI., 130; Jahresb., 1858, 20.
1859	"	....	C. R., XLIX., 815; Dingl. J., CLV., 456; Jahresb., 1859, 33.
....	"	....	Cosmos, XIV., 568; Polyt. Centr., 1859, 889 and 1032.
1858	Crespon and Godefroy	....	Polyt. Centr., 1858, 1509; Humphrey's J., 1858, 172.
1858	Hagen	Photographic printing	Ber. Akad. Wiss. Berl., 1858, 290; Brit. J. Phot., V., 75; Humphrey's J., 1858, 262; J. pr. Ch., LXXIV., 67; Dingl. J., CXLIX., 437; Pharm. Centr., 1858, 764; Institut., 1858, 268.
1859	N. de St. Victor and Corvisart	Oxalate	C. R., XLIX., 368; Institut., 1859, 287; Ann. Ch. Pharm., CXIII., 112; Dingl. J., CLVI., 38; Jahresb., 1859, 33.
1859	Corvisart	....	Jahresb., 1859, 33; Bull. Soc. Chim., 1862, 62.
1860	De Luynes	Printing	Photogr. J., 1860; Polyt. Centr., 1860.
1860	Burnett	Actinometry	Phil. Mag. [4], XX., 50 and 406.
1860	Wothly	Original announcement	Horn's Photog. J., XVI., 104.
1860	"	U. with $PtCl_2$	Polyt. Centr., 1860.
1862	Burghess	Toning bath	Polyt. Centr., 1862, 1590; Am. J. Photog., 1862.

Date.	Author.	Remarks.	References.
....	Simpson..........	....	Seely's Am. J. Photog., VII., 295.
....	Draper............	....	Brit. J. Photog., II., 241.
1865	Wothly............	....	Bull. Belge Photog., 1864; Seely's Am. J. Photog., VII., 1865.
....	"	Specification of patent.	Polyt. Centr., 1865, 943; Photog. Archives, 1865.
1865	Liesegang.........	Ammonio citrate.......	Chem. News, 1865, 103; Pharm. Centr., 1865, 1151.
1866	Bolton............	Oxyfluoride...........	See page—.
1869	Bolton............	Historical and general..	Am. J. Sci., 1869, Sept.

MINERALS.*

ABBREVIATIONS.—U., Uraninite; T., Torbernite; A., Autunite. See Dana. Min.

DATE.	AUTHOR.	MINERAL.	REFERENCES.
1727	Brückmann........	"Schwarz Beckerz"....	Magn. Dei, 204.
1747	Wallerius..........	"Beckblände".........	Wall. Min., 249.
1758	Cronstedt..........	"Swartblende"........	Cr. Min., 198.
1772	De Born...........	"Pechblende".........	Lithophyl. Born., 133.
....	"	"Mica viridis cryst."...	"
1780	Werner...........	"Grüner Glimmer".....	Ueb. Cronst., 217.
1787	Klaproth..........	"Uranerz"............	Mem. Akad. Berl., 1787, 160.
1789	"	"Uranit Spath".......	Schr. Ges. N. Berl. IX., 273.
1789	"	Analysis U	Klap. Beitr., II., 221.
1789	Werner............	"Chalcolith"	Berg. J., 376.
1789	"	"Pechblende".........	Berg. J.
1790	Klaproth..........	Analysis U............	J. de Phys., XXXVI., 248.
1792	Anonymous........	Analysis U	J. de Phys., XLII., 241.
1793	Karsten...........	....	Ueb. Wern. Verbess., 43.
1800	"	"Pecherz"............	Karst. Min. Tabell., 56.
1800	Champeaux........	Uranite................	Phil. Mag., 1800, 185.
1801	Haüy.............	Urane oxydulé.........	Haüy Traite.
1802	Sage.............	Analysis U	Phil. Mag. 1802; J. de Phys., LV., 314.
1802	Ekeberg..........	Found PO_5 in T.......	Ann. Ch. Phys. [1], XLII., 233.
1803	Ludwig...........	"Uranglimmer".......	Ludwig. Min., I., 55.
1805	Gregor............	Analysis T	Phil. Trans., 1805; Ann. Phil. V., 281.
1808	Vauquelin.........	....	Ann. Ch. Phys. [1], XLVIII., 277.
1814	Aiken	Uranite...............	Mineralog. Manual, 1814.
1817	Werner	"Feste Uranokker"...	Wern. Min. Syst., 26; Hoffm. Min., IX., a, 279.
1819	Berzelius..........	"Urankalk"..........	N. Syst. Min., 295; Ann. Chim. Phys. [2], XIII., 31.
1820	Jameson	"Uranmica"..........	Min. Syst., 1820.
1820	Breithaupt	"Uranphyllit"	Charak. d. Min. Syst.
1821	John.............	"Uranvitriol".	Chem. Unters., V., 254.
....	....	"Zippeite"	Schweigg. J., XXXII., 245.
1822	Pfaff.............	Analysis U...........	Schweigg. J., XXXV., 326.
1822	Berzelius..........	Hydrate	Ann. Ch. Phys. [2], XII., 31; Berz. Jahresb., I., 89.
1823	"	Analysis T............	Berz Jahresb., 1823, 137.
...	....	Analysis A............	Pogg. Ann., I., 374; Schweigg. J., XLIV., 29.
1823	Phillips...........	Analysis T............	Ann. Phil. [2], V., 57; Am. J. Sci. [1], VII., 380; Schweigg. J., XLIV., 42.
1823	Laugier..........	Analysis A............	Ann. Ch. Phys. [2], XXIV., 239.

* For many of the references the author is indebted to Dana's Mineralogy, 1868.

Date.	Author.	Mineral.	References.
....	Freiesleben........	"Lichtes Uranpecherz"	Beitr. Min. Kennt. Sachs., 187.
1824	Zippe.............	"Uranblüthe"........	Verh. Ges. Böhm. Prag., 1824.
1827	Zippe.............	"	Kastner's Arch., XII., 252; Berz. Jahresb., VIII., 198.
1830	Haidinger.........	"Johannite"..........	Abh. Böhm. Ges. Prag., 1830; Edinb. J. Sci. N. S., III., 306; Berz. Jahresb., XI., 208.
1832	Breithaupt........	"U. Gummierz"......	Charak. Min. Syst., 218.
1833	Kersten	"Gummite"..........	Pogg. Ann., XXVI., 492; Schweigg. J., LXVI., 18; Ann. Ch. Pharm., VIII., 285.
1834	Kersten...........	Uranpecherz	Pogg. Ann., XXVI., 491; Berz. Jahresb., XIII., 165.
1836	Gerhardt..........	"Uranpecherz"........	J. pr. Ch., IV., 54.
1837	Breithaupt........	"Uranerz"...........	J. pr. Ch., XII., 184.
1841	"	"Uranochalcite"......	Breit. Handb. Min., 173.
1843	Ebelmen..........	Analysis U............	Ann. d. M. [4], IV., 400; Ann. Ch. Phys. [3], VIII., 498; Berz. Jahresb., XXIV., 304.
1844	Rammelsberg......	Analysis U............	Pogg. Ann., LIX., 35; Berz. Jahresb., XXIV., 304.
1845	Teschemacher.....	....	Am. J. Sci. [1], XLVIII., 395.
....	Shepard..........	....	Am. J. Sci. [1], XLVIII., 395.
1845	Haidinger.........	"Uranin"............	Handb. Best. Min., 549.
....	"	"Zippeite"...........	" 510.
1847	Breithaupt........	"Schwer Uranerz"....	Handb., 1847, 803.
....	"	"Urangummi"........	"
....	"	"U. Pittinerz"........	"
1848	Th. Scheerer......	Analysis U............	Pogg. Ann., LXXII., 570; N. Jen. Lit. Ztg., 1848, 55.
1848	Werther...........	Uranit................	J. pr. Ch., XLIII., 332; Jahresb., 1848, 1218.
1848	Smith.............	"Medjidite"..........	Am. J. Sci. [2], V., 337; XI., 259; Ann. Ch. Pharm., LXVI., 254.
1848	Le Conte..........	"Coracite"...........	Am. J. Sci. [2], III., 173; Jahresb. 1848, 1167; 1853, 642.
1848	Genth............	Uranit................	Ann. Ch. Pharm., LXVI., 280.
1850	Whitney...........	Coracite	Am. J. Sci. [2], VII., 434; J. pr. Ch., LI., 127; Phil. Mag. [3], XXXVII., 153.
1852	Brookes & Miller...	....	B. & M. Min., 1852, 517.
1852	Haidinger.........	"Eliasite"............	Jahrb. G. Reichs., IV., 124.
1852	Vogl..............	"Liebigite"...........	Jahrb. G. Reichs., IV., 221.

Date	Author.	Mineral.	References.
1853	v. Hauer		Jahrb. G. Reichs., 1853, 105; J. pr. Ch., LXI., 391; Pharm. Centr., 1854, 334.
1853	Chapman	"Uranatemnite"	Chap. Pract. Min., 148.
1853	Ragsky	"Pittinerz"	Pogg. Ann. Ergänz., IV., 348.
1854	Dauber	Basic sulphate	Pogg. Ann., XCII., 251.
1857	Vogl	Basic sulphate	Min. Joach., 1857.
1857	Lindacker		Am. J. Sci. [2], XXV., 414; Min. Joach., 1857, 95 & 119; Jahresb., 1857, 694.
1857	Descloizeaux		Ann. d. M., XIV., 377.
1857	Genth		Am. J. Sci. [2], XXIII., 421; J. pr. Ch., LXXIII., 206; Jahresb., 1857, 663.
1859	Hermann	"Uranoniobit"	J. pr. Ch., LXXVI., 326; Bull. Soc. Nat. Moscou, 1859; Jahresb., 1859, 798.
1859	Hermann	"Pittinerz"	Jahresb., 1859, 798.
1859	Ordway	Basic sulphate	Am. J. Sci. [2], XXVI., 197; J. pr. Ch., LXXVI., 23.
1860	Theyer	Analysis U	Ramm. Handb., 1860, 175.
1861	Pisani	Analysis A	C. R., LII., 817; Jahresb. 1861, 1030; Rep. Chim. Pure, III., 222; J. pr. Ch., LXXXV.; Jahrb. Min., 1862, 601.
1865	Breithaupt	{ "Cuprouranit" } { "Calcouranit" }	Berg. u. Hüttenm. Ztg., XXIV., 302.
1865	Church	Analysis T	Chem. News, XII., 183; Jahresb., 1865, 911.

In addition to the above-mentioned periodicals, the following independent works may be consulted:

Berzelius' Lehrbuch; Gmelin's Handbuch; Graham-Otto's Lehrbuch; Pelouze et Frémy; Liebig & Wöhler's Handwörterbuch; Watt's Dictionary; Dana's Mineralogy; Rammelsberg's Mineralchemie; Rose's Chimie Analytique; Fresenius' Analysis; Muspratt's Chemistry, Bruno Kerl's edition.

ALPHABETICAL LIST OF AUTHORS.

XXIX.—*Report on the Mollusca of Long Island, N. Y., and of its Dependencies.*

BY SANDERSON SMITH AND TEMPLE PRIME.

Read May 23, 1870.

WITH the exception of a few passing remarks in Stimpson,* De Kay,† and Wheatley,‡ the only information we have on the Mollusca of Long Island is contained in Smith's § papers on the marine Mollusca of Peconic and Gardiner's Bays and of Little Gull Island.

Our labors extend over a period of more than eleven years, and during that time we have dredged several seasons in Peconic and Gardiner's Bays and at Huntington. We regret that circumstances have prevented us from exploring with the dredge the ocean shores of the island; we have, however, examined nearly all the beaches. Our researches for land and fresh-water shells have been carried on through nearly the whole island.

We would call attention to the fact of the discovery of a species of *Gundlachia*, a genus which, up to the present time, has not been found north of the District of Columbia. With regard to two species, *Astarte lunulata* and *Corbula contracta*, as will be seen in the enumeration, we have not been able to discover any evidence of their being found in the living state north of Cape Hatteras, though such seems to have been tacitly assumed to be the case. In connection with this subject we will mention the discovery on our ocean coasts, in the dead state, of *Arca ponderosa* of the South.

It would have been very desirable to have instituted a thor-

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* Stimp., Moll. N. E., 1851.

† N. H., N. Y., pt. v., 1843.

‡ Wheat. Cat. Shells U. S., 1845.

§ Ann. Lyc. N. H., N.Y., vii. 147, 1859; viii. 194, 1865.

ough comparison as to what Mollusca found in the vicinity are missing on Long Island, and *vice versâ*; owing to the paucity of material, we have been able to do so but very imperfectly. All we have is a Catalogue of the Mollusca of Connecticut by Linsley,[*] a Catalogue of the Mollusca of Staten Island by Hubbard and Smith,[†] and some collections made by ourselves, though not placed on record, in Westchester County, N. Y. We obtained the following results:—

MOLLUSCA FOUND IN CONNECTICUT[‡] NOT FOUND ON LONG ISLAND.

Pecten brunneus, St. (*fuscus*, Linsl.[§])
Nucula tenuis, Turt.
Modiola nexa, Gld.
Unio (7 species).
Alasmodonta (3 species).
Anodonta (7 species).
Sphærium simile, Say. (*Cyclas similis.*)
S. rhomboideum, Say. (*C. elegans, rhomboidea.*)
S. truncatum, Linsl. (*C. truncata.*)
Pisidium Virginicum, Bgt. (*C. dubia.*)
Lucina filosa, St. (*radula.*)
Astarte quadrans, Gld.
Aphrodite Grœnlandica, St. (*Cardium Grœnlandicum.*)
Menestho albula, Möll. (*Pyramis striatula.*)
Natica flava, Gld.
Fasciolaria ligata, M. & C. B. Ad.
Fusus Islandicus. (*corneus.*)
Buccinum zonale, Linsl.
Columbella rosacea, St. (*Bucc. rosaceum.*)
Mangelia harpularia, St.? (*Fusus harpularius?* Couth.)
Mangelia bicarinata, St. (*Pleur. bicarinata.*)
Bulla triticea, Couth.
B. debilis, Gld.
Ancylus rivularis, Say.
Ancylus tardus, Say.
Limnea caperata, Say.
L. decollata, Migh. et Ad.

[*] Amer. J. Sci., xlviii., 1845.

[†] Ann. Lyc. N. H., N. Y., viii. 151, 1865.

[‡] We have been obliged to pass over a number of species in Linsley's Catalogue, as they appeared to us, as having been insufficiently identified by the author, or as of very doubtful validity; and, moreover, several of those included must be considered as somewhat doubtful.

[§] The names in parentheses are those given by Linsley.

Tellina proxima, Br. (*Sanguinolaria sordida.*)
Solen viridis, Say.
Pholas cuneiformis, Say.
* *Teredo navalis*, Linn.
Amphidesma æquale, Say.
Chiton marmoreus, O. Fabr. (*fulminatus.*)
† *C. ruber*, Linn.
Margarita obscura, Gld.
Paludina integra, Say.
Amnicola lapidaria, Say.
A. Cincinnatiensis, Anth.
A. lustrica, Say.
A. pallida, Hald.
Valvata tricarinata, Say.
V. pupoidea, Gld.
Lacuna neritoidea, Gld.
Rissoa mighelsii, St. (*Cingula arenaria.*)
Turritella erosa, Couth.
L. elodes, Say.
L. catascopium, Say. (*emarginata.*)
Physa ancillaria, Say.
Planorbis lentus, Say.
P. campanulatus, Say.
P. deflectus, Say.
P. hirsutus, Gould.
Vertigo Gouldii, Binn.
Bulimus lubricus, Brug.
Helix fraterna, Say.
H. fuliginosa, Grif.
H. hirsuta, Say.
H. minuscula, Binn.
H. monodon, Rack.
H. Sayii, Binn.
H. suppressa, Say.
H. striatella, Anth.
H. subglobosa? Binn. = *H. hortensis.* (Introduced species.)
H. tridentata, Say.

Succinea obliqua, Say. (*campestris et ovalis*, Say.)

MOLLUSCA FOUND ON STATEN ISLAND, NOT FOUND ON LONG ISLAND.

‡ *Pisidium Virginicum*, Bgt.
Anodonta fluviatilis, Lea.
Martesia (*Diplothyra*) *Smithii*, Tr.
Planorbis deflectus, Say.
Vertigo Gouldii, Binn.
H. hirsuta, Say.
H. striatella, Anth.
H. minuscula, Binn.
H. suppressa, Say.
Succinea aurea, Lea.
‡ *S. Totteniana*, Lea.

* Probably "*dilatata*," St.

† Probably the red variety of *C. apiculatus*, which is not uncommon on Long Island.

‡ Discovered since the publication of the Catalogue of the Mollusca of Staten Island.

Pupa rupicola, Say.	*S. ovalis*, Gld.
Helix tridentata, Say.	*S. obliqua*, Say.

MOLLUSCA FOUND IN WESTCHESTER CO., N. Y., NOT FOUND ON LONG ISLAND.

Sphærium simile, Say.	*Physa ancillaria*, Say.
S. striatinum, Lam.	*Pupa armifera*, Say.
Pisidium Virginicum, Bgt.	*Helix tridentata*, Say.
P. compressum, Pr.	*H. monodon*, Rack.
P. æquilaterale, Pr.	*H. hirsuta*, Say.
P. Nov. Eboracense, Pr.	*H. suppressa*, Say.
Limnea caperata, Say.	*Succinea ovalis*, Say.

An examination of the above lists brings to notice the fact that though the sulcated species of *Sphærium* and *Pisidium* occur in the vicinity they have not been found on Long Island.

The following species occur in the Postpleiocene deposits of Gardiner's Island * :—

Pecten Magellanicus, Lam.	*C. unguiformis*, Lam.
Arca transversa, Say.	*Chemnitzia interrupta*, St.
Cardita borealis, Con.	*Purpura lapillus*, Lam.
Astarte sulcata, Flem.	*Nassa trivittata*, Say.
Venus mercenaria, Linn.	*N. vibex*, Say.
Mactra lateralis, Say.	† *Buccinum plicosum*, Menke.
Mya arenaria, Say.	*Columbella lunata*, Sowb.
Crepidula fornicata, Lam.	*Bulla canaliculata*, Say.

The following marine species, so far as we are aware, previously to our labors have not been found south of Cape Cod :—

Mytilus corrugatus, St.	*Leda sapotilla*, St.
M. lævigatus, St.	*Chemnitzia bisuturalis*, St.

C. seminuda, St.

The only marine species recorded on good authority within the range of Cape Cod and Sandy Hook, which have not been obtained on Long Island, are the following :—

* Ann. Lyc. N. H., N. Y., viii. 149, 1865.

† Discovered since the publication of the Catalogue.

Pecten Islandicus, Müll. Connecticut to Greenland, Behring's Straits, Spitzbergen to Drontheim.

P. brunneus, St. Connecticut.

Leda tenuisulcata, St. Newport to Nova Scotia.

Mytilus discrepans, Mont. Connecticut to Eastport, Europe.

Thyasira Gouldii, St. South Carolina, Stonington to Gulf of St. Lawrence.

Lucina filosa, St. Stonington (*fide* Linsley), Mass. Bay to Maine.

Astarte quadrans, Gld. Stonington to Casco Bay.

Aphrodite Grœnlandica, St. Stonington to Spitzbergen.

Martesia (*Diplothyra*) *Smithii*, Tr. Staten Island.

Ianthina fragilis, Desh. Oceanic.

Margarita obscura, Gld. Stonington to Nova Scotia; Finmark to North of Spain.

Lacuna neritoidea, Gld. New York to Newfoundland.

Scalaria multistriata, Say. Georgia to Buzzard's Bay.

S. Grœnlandica, Gld. Nantucket to Greenland.

Odostomia impressa, Say. South Carolina to Connecticut.

Tritonium pygmeum, St. Newport to Nova Scotia.

Mangelia bicarinata, St. Stonington (*fide* Linsley) to Gulf of St. Lawrence.

Bulla triticea, Couth. Stonington to Eastport.

The following species are either not mentioned at all by De Kay as New York species or doubtfully so :—

Anomia ephippium, Linn., var. *aculeata*.
Arca ponderosa, Say.
Nucula proxima, Say.
Leda sapotilla, St.
L. limatula, St.
Mytilus decussatus, Mont.
M. corrugatus, St.
M. lævigatus, St.
M. hamatus, Say.
Sphærium securis, Pr.
Pisidium abditum, Hald.
Assiminea ——
Skenea ——
Cæcum pulchellum, St.
C. Cooperi, Smith.
Cerithium Greenii, C. B. Ad.
C. nigrocinctum, C. B. Ad.
Vermetus radicula, St.
Scalaria lineata, Say.
S. Humphreysii, Kiener.
Eulima subangulata, St.
Stylifer ——
Chemnitzia producta, St.

C. bisuturalis, St.	*Rissoa Stimpsoni*, Smith.
P. variabile, Pr.	*Natica pusilla*, Say.
Montacuta elevata, St.	*Cerithiopsis terebellum*, St.
Cardita borealis, Con.	*C. Emersonii*, St.
Astarte lunulata, Con.	*Columbella Gouldiana*, Ag.
Cyprina Islandica, Lam.	*Pleurotoma cerinum*, K. & St.
Venus Manhattensis, Pr.	*Gundlachia Stimpsoniana*, Smith.
Mactra similis, Say.	*Vertigo milium*, Gld.
Cumingia tellinoides, Con.	*Helix Binneyana*, Morse.
Tellina tenta, Say.	*H. minutissima*, Lea.
Solemya borealis, Tot.	*Limax maximus*, Linn.
Solecurtus bidens, F. & H.	*Arion fuscus*, Müll.
Thracia Conradi, Couth.	*Loligo illecebrosa*, Lesueur.
Æolis vermiferus, Smith.	*Loligo Pealii*, Lesueur.

and all the Tunicata.

Solemya borealis, Tott. and *Thracia Conradi*, Couth. may still be considered doubtful, as only worn specimens or fragments are obtained.

Of the 149 marine species recorded on good authority between New York and Cape Cod (131 from Long Island), 49 appear to be at or near the northern limit of their geographical range,—extending from North Carolina, South Carolina, or farther south,—and of these only 10 pass Cape Cod into Massachusetts Bay; 47 are at the southern limit, 35 of which reach the Gulf of St. Lawrence, or farther north, and 12 extend only to Maine or Nova Scotia; 22 extend from North or South Carolina or farther south to the Gulf of St. Lawrence, or farther north, and 11 from the same southern limits only to Maine or Nova Scotia; 15 occur only between New York and Cape Cod, while 4 are found also in Massachusetts Bay; 1 is oceanic.

Referring them to Molluscan provinces, established by E. Forbes, the "Atlantic," extending from Florida to Cape Cod, the "Boreal" from Cape Cod to the Gulf of St. Lawrence, and the "Arctic," embracing all the region north of this, 52 occur only in the Atlantic province (including a very few which enter the Gulf of Mexico), of which 15 are confined to the extreme north of it; 37 are common to the Atlantic and Boreal provinces, of which 10 are almost confined to the first, and 12 to the last; 57 are common to all three provinces, of which 35 only reach the extreme northern part of the Atlantic province.

Ninety-four species in all are found on both sides of Cape Cod, or 64 per cent. of the entire number. This would at first seem to indicate a much less degree of distinctness between the molluscan fauna north and south of Cape Cod than really exists; but as 10 of these are southern species, extending only to Massachusetts Bay, and 47 northern ones, passing only a short distance south of the Cape, the remaining 35 species more truly represent the degree of similarity between the two provinces.

Twenty two species occur in Europe.

With regard to nomenclature, in the enumeration of the marine and fluviatile species, we have followed, with but one or two exceptions, that adopted by Stimpson, in his "Shells of New England." We are well aware that improvements might be made in the same, as this work has been published quite a number of years;* but so many changes have been made of late in nomenclature—some for the better, and very many more for the worse—that, for the present at least, we have determined to adhere to Stimpson's system. The land shells have been classed in accordance with the recent publication of Binney and Bland.†

We will here remark, that our types of the species enumerated in the following list have been placed in the Museum of the School of Mines, of Columbia College, N. Y.; the numbers appended to the names of the species in the list correspond with those placed on the specimens in the Museum. We have also

* 1851.

† Smith. Misc. Coll., 194. L. & F. W. Shells of N. A. Pt. 1. Pulmonata Geophila. W. G. Binney and T. Bland. 1869.

distributed a suite of types to the State Cabinet, and to the Long Island Historical Society.

Of the 182 species enumerated in our Report (including the unidentified ones of De Kay), 70 belong to the Lamellibranchiata; 1 to the Nudibranchiata; 61 to the Prosobranchiata; 7 to the Tectibranchiata; 40 to the Pneumobranchiata; 3 to the Cephalopoda. At least twenty, mostly undescribed, species of Tunicata, also occur in the waters of Long Island, making the entire number of known Mollusca exceed two hundred.

ACEPHALA.

Lamellibranchiata.

Anomiadæ.

1. *Anomia ephippium*, Linn. Common everywhere. Low water to 10 fathoms.

var. *aculeata*. Greenport, Little Gull Island, and Montauk.

Range—Florida to G. of St. Lawrence; N. Scandinavia to Madeira.

Ostreadæ.

2. *Ostrea borealis*, Lam., and varieties *Virginiana* and *costata*.

Range—Both shores of the Atlantic.

Pectenidæ.

3. *Pecten Magellanicus*, Lam. Coney Island.

Range—Sandy Hook to Labrador.

4. *Pecten irradians*, Lam. Everywhere; more abundant in the bays and harbors. Low water to three or four fathoms.

Range—Texas to Nova Scotia.

Arcadæ.

5. *Arca transversa*, Say. Everywhere; abundant in the bays. At Greenport three to ten fathoms.

Range—Georgia to Cape Cod.

6. *Arca ponderosa*, Say. A few dead valves were found on the ocean shore, near Fire Island Light.

Range—From Long Island to Tampa Bay.

7. *Arca pexata*, Say. Everywhere; more abundant on the ocean shore.

Range—Cape Cod to Texas.

Nuculidæ.

8. *Nucula proxima*, Say. Very abundant in the bays. From two to ten fathoms.

Range—S. Carolina to Nova Scotia.

9. *Nucula radiata*, De Kay. We have not been able to identify this species. East River, opposite Williamsburg (Stillman, *fide* De Kay).

10. *Leda Thraciæformis*, St. From the stomach of a codfish, taken off our coast (Jay, *fide* De Kay). Off Fire Island Light in ten fathoms. (U. S. Coast Survey, *fide* Stimpson).

Range—Fire Island beach to Greenland.

11. *Leda sapotilla*, St. Greenport, in three fathoms mud; rare and small.

Range—Greenport to Labrador and Northumberland Sound.

12. *Leda* (*Nucula*) *Gouldi*, De Kay. We have not been able to identify this species. One specimen from the Sound (De Kay).

13. *Leda limatula*, St. New York Bay (Wheatley). Huntington and Greenport; moderately abundant. In two to five fathoms mud. Much smaller than from north of Cape Cod. Average length, 0.8 or 0.9 inches; largest observed, 1.2 inches.

Range—N. Carolina to Nova Scotia, Northern Scandinavia. Kamschatka.

Mytilidæ.

14. *Mytilus decussatus*, Mont. A few dead specimens dredged from Gardiner's Bay.

Range—Gardiner's Bay to Greenland, North. Scandinavia to Scotland.

15. *Mytilus corrugatus*, St. One living specimen dredged in Gardiner's Bay, in about five fathoms mud.

Range—Gardiner's Bay to Greenland.

16. *Mytilus lævigatus*, St. New York Bay (Wheatley). One fresh valve dredged in Gardiner's Bay in about five fathoms mud.

Range—Gardiner's Bay to Greenland.

17. *Mytilus plicatulus*, Deshayes. Common everywhere. Littoral.

Range—Georgia to Gulf of St. Lawrence.

18. *Mytilus modiolus*, Linn. Common everywhere. At Greenport in ten fathoms or less.

Range—New York to Behring's Straits; N. Scandinavia to British Channel.

19. *Mytilus edulis*, Linn. Everywhere. Littoral.

Range—Tampa Bay to Greenland; N. Scandinavia to Mogador.

20. *Mytilus hamatus*, Say. New York Harbor, alive; attached to oysters brought from the South, in all likelihood very recently.

Range—New Orleans to New York.

Unionidæ.

21. *Unio complanatus*, Lea. Riverhead; moderately abundant.

Corbiculadæ.

22. *Sphærium partumeium*, Say. Astoria, Huntington, Riverhead, Southold, Greenport, Shelter and Gardiner's Islands, and Montauk.

23. *Sphærium securis*, Prime. Riverhead, Greenport, Shelter Island, and Montauk.

24. *Pisidium abditum*, Hald. Common.

25. *Pisidium variabile*, Prime. Centerport, very rare.

Kelliadæ.

26. *Montacuta elevata*, St. Greenport; only one valve.

Range—Greenport to Greenland.

27. *Kellia planulata*, St. Rare; at Greenport in mud, at low water, and at from four to six fathoms; at Little Gull Island under stones at low water; Montauk.

Range—Greenport to Greenland.

Lucinidæ.

28. *Lucina strigilla*, St. Coney Island.

Range—Florida to Nantucket.

Astartidæ.

29. *Cardita borealis*, Conrad. Montauk. A few dead specimens of a very small *Cardita*, belonging probably to this species, were dredged in Gardiner's Bay.

Range—Sandy Hook to G. of St. Lawrence, Labrador, Ochotsk ?

30. *Astarte lunulata*, Conrad. Huntington and Greenport, dredged in five to ten fathoms. Though not uncommon, and though the valves are often found united, we have never obtained this species in the living state; in fact, there is no evidence that it has ever been found alive north of Cape Hatteras. Linsley, who first detected it north, and who gave it the name of *A. mactracea*, had but one valve. Stimpson and Prime, who dredged it at New Bedford, found it under the same circumstances as ourselves.

FIG. 1.

Astarte lunulata.

Range—Tampa Bay to New Bedford.

31. *Astarte sulcata*, Flem. ("Rare," De Kay.)

Range—Stonington to Ochotsk; Nova Zembla to the Mediterranean. There is room for doubt as to the identity of the shells from all these localities.

32. *Astarte castanea*, Say. On ocean beaches. Common.

Range—Sandy Hook to Nova Scotia.

Cyprinidæ.

33. *Cyprina Islandica*, Lam. Montauk.

Range—Montauk to Greenland; N. Scandinavia to British Channel. Sicily ?

Cardiadæ.

34. *Cardium pinnulatum*, Conrad. Huntington Bay in five fathoms gravel; Peconic and Gardiner's Bays. Rare.

Range—Huntington to Labrador.

35. *Cardium Mortoni*, Conrad. Very abundant.

Range—Texas to Nantucket. Nova Scotia (Willis.)

Veneridæ.

36. *Venus mercenaria*, Linn. Universally distributed.

Range—Florida Keys to G. of St. Lawrence (Whiteaves).

37. *Venus notata*, Say. Sea beaches (De Kay).

Range—Georgia to Long Island.

38. *Venus gemma*, Totten. Abundant in bays and harbors. In mud, from low water to two fathoms.

Range—S. Carolina to G. of St. Lawrence.

39. *Venus Manhattensis*, Prime. Hell Gate, Huntington, and Greenport; at the latter place it is found in two fathoms mud, associated with *V. gemma*.

Range—New York to Greenport.

40. *Cytherea convexa*, Say. New York Bay (Wheatley), Rockaway, Easthampton, and Montauk.

var. *morrhuana*, Linsley. Huntington; in Lloyd's Harbor in one to two fathoms mud; in Gardiner's Bay. Rare.

Range—N. Carolina? Staten Island to Nova Scotia.

Mactridæ.

41. *Mactra lateralis*, Say. Bays and harbors. Greenport, in mud at two fathoms, and in sand at five or six fathoms.

Range—Tampa Bay to Cape Ann.

42. *Mactra solidissima*, Chem. Everywhere. Rare and small in bays and harbors.

Range—N. Carolina? New York to G. of St. Lawrence.

43. *Mactra similis*, Say. A few small specimens referred to this species were collected at Easthampton.

Donacidæ.

44. *Mesodesma arctatum*, Gould. Easthampton and Montauk. Common.

Range—Easthampton to G. of St. Lawrence.

45. *Donax fossor*, Say. Western extremity of the Island.

Range—Maryland to Long Island.

Tellinidæ.

46. *Cumingia tellinoides*, Conrad. Huntington, rare, all dead; Greenport, abundant dead, very rare alive. Montauk.

Range—S. Carolina to C. Cod.

47. *Tellina fusca*, Philippi. Abundant and large in bays in mud near low-water mark. Dredged at Greenport in sand at six fathoms; very small and light pink.

Range—Georgia to Arctic Seas. British Channel.

48. *Tellina tenera*, Say. Moderately abundant; one to eight fathoms; generally in sand, though sometimes in mud.

Range—S. Carolina to G. of St. Lawrence.

49. *Tellina tenta*, Say. Less abundant than T. tenera. At Greenport in mud at two fathoms, and in sand at six fathoms.

Range—S. Carolina to C. Cod.

Solemyadæ.

50. *Solemya velum*, Say. Huntington and Greenport. Rare. From one to ten fathoms mud and sand.

Range—N. Carolina to Nova Scotia.

51. *Solemya borealis*, Totten. Fragments of a shell were found at Greenport which in all probability belongs to this species.

Range—Long Island? Newport to Nova Scotia.

Solenidæ.

52. *Solecurtus gibbus*, F. & H. Coney Island (Ferguson). South beach at Rockaway and near Fire Island Light.

Range—St John's R., Fla. to C. Cod.

53. *Solecurtus bidens*, F. & H. Greenport; one or two dead specimens.

Range—Florida? S. Carolina to C. Cod.

54. *Machæra costata*, Gould. Coney Island, Rockaway, and East-hampton. Rare.

Range—N. Jersey to Labrador, Ochotsk?

55. *Solen ensis*, Linn. Not very abundant.

Range—Florida to Labrador; N. Scandinavia to the Mediterranean.

Anatinidæ.

56. *Anatina papyracea*, Say. Gardiner's Bay, in three to five fathoms muddy sand. Rare.

Range—Greenport to Anticosti Id.

57. *Cochlodesma Leanum*, Mighels. Rare. Dredged in three fathoms sand in bays.

Range—N. Carolina to G. of St. Lawrence.

58. *Thracia Conradi*, Couth. One valve supposed to belong to this species was dredged in ten fathoms at Greenport.

Range—Greenport? Rhode Island to the G. of St. Lawrence.

59. *Thracia truncata*, Mighels. Off the coast in thirty-eight fathoms. (U. S. Coast Survey, *fide* Stimpson.)

Range—Long Island to Greenland.

60. *Lyonsia hyalina*, Conrad. Not uncommon in bays; dredged at Greenport in six fathoms.

Range—Tampa B. to Eastport.

61. *Pandora trilineata*, Say. Rather rare in bays; dredged in from two to six fathoms; common in more exposed situations, such as the northern shore of Montauk Pt., but not on ocean beaches.

Range—Florida to G. of St. Lawrence.

Corbulidæ.

62. *Corbula contracta*, Say. Greenport. Though not uncommon, and though the valves are often found united, we have never obtained this species alive. We have not met with any evidence that this species is found in the living state north of Cape Hatteras.

Range—S. Carolina to C. Cod.

Myadæ.

63. *Mya arenaria*, Linn. Common everywhere.

Range—S. Carolina to Greenland; Ochotsk, Nova Zembla to British Channel.

Gastrochænidæ.

64. *Petricola pholadiformis*, Lam. Rare.

Range—G. of Mexico to G. of St. Lawrence.

65. *Petricola dactylus*, Say. Rather rare.

Range—Georgia to C. Cod.

66. *Saxicava arctica*, Desh. Greenport, Montauk, and Little Gull Island.

Range—Georgia to Behring's Straits; Nova Zembla to Madeira.

67. *Pholas costata*, Linn. A fragment was dredged at Huntington.

Range—Vera Cruz to New Bedford.

68. *Pholas truncata*, Say. Rockaway.

Range—S. Carolina to New Bedford.

69. *Pholas crispata*, Linn. Large single valves are frequently found on the shores (De Kay, Ferguson).

Range—Charleston to G. of St. Lawrence; Norway to British Channel.

70. *Teredo dilatata*, St. Greenport, on the piles of a pier. Rare.

Range—S. Carolina to Nova Scotia. G. of St. Lawrence?

GASTEROPODA.

Nudibranchiata.

71. *Æolis vermiferus*, Smith. Half an inch long. Back grayish white, thickly spotted with greenish gray, with a deep orange-colored spot between the oral tentacles, a second long and narrow one, wider in the middle, extending from the dorsal tentacles to the first clusters of papillæ, and a third between the first and second clusters, having the form of an isosceles triangle with hollowed sides, whose base line, of a deeper orange, was on the median line of the back, and the apex was situated on the side, half-way between the upper and lower surfaces. Under the tentacles, on the left side, another orange line existed. The anterior half of the lower surface was white, the posterior half light salmon-color, showing through the foot. Foot long, narrow, white, nearly transparent, pointed behind, and horned in front. Tentacles four, the oral the longest. Eight clusters of papillæ, with four or five in each cluster, transparent white, filled with dark-gray, apparently fœcal matter; very irregular in diameter and length. The name I propose alludes to the worm-like appearance of these bunches of grey papillæ.

A careful examination of the descriptions and figures of the Nudibranchiata of our coast, contained in the new edition of Gould's Invertebrata of Massachusetts, seems to furnish no ground for identifying this species with any of them. Greenport. One specimen was found at low-water mark.

Chitonidæ.

72. *Chiton apiculatus*, Say. Huntington, Greenport, and Gardiner's Island. Common on stony bottoms; one to ten fathoms.

Range—S. Carolina to C. Cod.

73. *Chiton albus*, Linn. New York Harbor (Budd, *fide* De Kay).

Range—New York, C. Cod, Greenland, Finmark to Scotland.

Patellidæ.

74. *Tectura testudinalis*, Gray. Glencove (Ferguson), Huntington, Greenport, and Little Gull Island. Rare at Huntington.

Range—Long Island to Greenland, Scotland.

75. *Tectura alveus*, St. One dead specimen was dredged in mud in Lloyd's Harbor.

Range—Long Island to Maine.

Calyptræidæ.

76. *Calyptræa striata*, Say. One dead specimen was picked up on the northern shore of Gardiner's Bay. Rare at Montauk.

Range—New Jersey to Grand Manan.

77. *Crepidula fornicata*, Lam. Abundant everywhere.

Range—Tampa Bay to G. of St. Lawrence. Mouth of Rio Grande (Schott).

78. *Crepidula unguiformis*, Lam. Abundant everywhere.

Range—Panama; Caribbean Sea, to G. of St. Lawrence.

79. *Crepidula convexa*, Say. Common.

Range—Georgia to Nova Scotia.

Paludinidæ.

80. *Paludina decisa*, Say. Valley Stream, near Jamaica (Ferguson), Riverhead. Common.

81. *Amnicola porata*, Gld. Riverhead. Common.

Littorinidæ.

82. *Littorina rudis*, Gld. Abundant everywhere.

Range—Staten Island to Greenland; Nova Zembla to North of Spain.

83. *Littorina littoralis*, F. & H. Abundant everywhere.

Range—Staten Island to Greenland; the Mediterranean.

var. *Peconica*, Smith. Greenport.

84. *Littorina irrorata*, Gray. Huntington. A few dead specimens were found in the grass above high-water mark. Rockaway.

Range—Tampa Bay to Long Island.

85. *Lacuna vincta*, Turton. Not uncommon.

Range—Staten Island to Greenland, British Channel.

86. *Rissoa minuta*, St. Abundant in sheltered situations in bays, and also in salt-water ponds. Great differences exist between the shells grouped under this name, and several species probably exist. Specimens from Napeague Bay, at the western extremity of Montauk Pt., are much longer and slenderer than usual. Specimens from Greenport are also marked by Stimpson as new.

Range—Staten Island to Gulf of St. Lawrence.

87. *Rissoa aculeus*, St. One specimen on Little Gull Island.

Range—Gull Island to Eastport.

88. *Rissoa* (*Cingula*) *lævis*, De Kay. Bushwick Inlet (De Kay). We have not been able to identify this species.

89. *Rissoa Stimpsoni*, Smith. Shell thin, rather dark brown. Divergence about 24°. Whorls seven, very convex, separated by a very deep suture, and distinctly wrinkled by the lines of growth. Apex obtuse. Aperture oval, nearly one-third the length of the shell. Length, 0.23 inches, of which the first whorl occupies rather more than one-half.

FIG. 2.

Rissoa Stimpsoni.

Two specimens at Greenport.

90. *Assiminea?* A small mollusc, doubtfully referred to this genus, occurred on a pier at Huntington. The specimens are not now accessible.

91. *Skenea* ——, Smith. Greenport. About one-twenty-fifth of an inch in length. Only one or two specimens were found, and in a state that will hardly admit of a satisfactory description.

Turritellidæ.

92. *Cæcum pulchellum*, St. Greenport.

Range—Greenport to New Bedford.

93. *Cæcum Cooperi*, Smith.

The shell belongs to the section "*Elephantulum*" of the genus *Cæcum*, as divided by Carpenter. It has about twenty-four somewhat rounded longitudinal ribs or lirae, crossed by numerous rings, rather obscure about the middle of the shell, but very distinct at the two extremities, where the longitudinal ribs become indistinct. There is a slight constriction near the mouth of the shell, which swells out again beyond it. Plug mucronate, with the apex inclining to the left, when looking at the back of the shell. The lateral profile is concave, rising rapidly towards the back. Operculum concave. Length, 0.13 inch; width in middle, .035 inch. The shell is white, not very thin, and moderately curved. In possessing both longitudinal ribs and rings this species resembles *Cæcum* (*Elephantulum*) *plicatum* of Carpenter, from the West Indies, which, however, is smaller, and appears from the description to have a much longer plug, symmetrically placed on the end of the shell. It does not appear to agree with the description of *C. imbricatum*, Carp., with which Mr. Carpenter, unable, however, to make a direct comparison, thought it might be identical.

FIG. 3.

Cæcum Cooperi.

Two specimens were dredged in four or five fathoms sand in the northern part of Gardiner's Bay.

94. *Cerithium Sayi*, Menke. Abundant in all bays.

Range—N. Carolina to Nova Scotia.

95. *Cerithium Greenii*, C. B. Adams. Canarsie, Huntington, and Greenport. Rare.

Range—Bermuda; S. Carolina to Boston.

96. *Cerithium nigrocinctum*, C. B. Adams. Canarsie, Huntington, and Greenport. Rare. Low water to ten fathoms.

Range—S. Carolina to Buzzard's Bay.

Vermetidæ.

97. *Vermetus radicula*, St. One dead specimen at Greenport.

Range—Florida to Buzzard's Bay.

Scalariadæ.

98. *Scalaria lineata*, Say. Gowanus, Yellowhook, Glencove (Ferguson), Huntington, and Greenport. Rare.

Range—Georgia to Buzzard's Bay.

99. *Scalaria Humphreysii*, Kiener (*clathrus*). One dead specimen at Greenport.

Range—Georgia to Long Island.

100. *Eulima oleacea*, Kurtz & Stimpson. Eight or ten dead specimens in ten fathoms at Greenport.

Range—S. Carolina to Greenport.

101. *Stylifer* ——. Stimpson informs us that some years ago he obtained a species of *Stylifer* attached to the spines of a star-fish in New York Harbor. We are not aware that it has ever been described.

102. *Chemnitzia interrupta*, St. East River (De Kay), Huntington, and Greenport. Common. Mud and sand, one to five fathoms.

Range—S. Carolina to Boston.

103. *Chemnitzia producta*, St. Lloyd's Harbor and Greenport. Rare.

Range—Long Island to Buzzard's Bay.

104. *Chemnitzia fusca*, St. East River (De Kay); Greenport. Rare.

Range—New York to Boston.

105. *Chemnitzia bisuturalis*, St. Glencove (Ferguson); Huntington and Greenport. Rather rare.

Range—S. Carolina? Staten Island to Massachusetts Bay.

106. *Chemnitzia trifida*, St. Common.

Range—Staten Island to Massachusetts Bay.

107. *Chemnitzia impressa*, Kurtz. East River (De Kay).

Range—S. Carolina to Connecticut.

108. *Chemnitzia seminuda*, St. Newtown Creek (De Kay), Huntington, and Greenport. At Greenport in two fathoms mud. Abundant.

Range—South Carolina. "Massachusetts Bay northwards" (Stimpson).

Naticidæ.

109. *Natica heros*, Say. Common everywhere; large and strong in exposed situations.

Range—Georgia to G. of St. Lawrence.

110. *Natica triseriata*, Say. Common everywhere.

Range—Staten Island to G. of St. Lawrence.

111. *Natica immaculata*, Totten. Napeague Point, outside of Gardiner's Bay. Dead specimens only.

Range—Long Island to G. of St. Lawrence.

112. *Natica duplicata*, Say. Common everywhere, more especially on ocean beaches.

Range—Mouth of Rio Grande (Schott), Florida to Massachusetts Bay. Two species are probably included under this name.

113. *Natica pusilla*, Say.

"Shell thin, suboval, cinerous or rufous, with sometimes one or two obsolete, dilated, revolving bands; columella callous; callus pressed laterally into the umbilicus, whitish; umbilicus nearly closed and consisting only of an arquated, linear, vertical aperture.

FIG. 1.

Natica pusilla.

Length about a quarter of an inch." Say.

"Shell resembling in shape *N. immaculata*, minute, one-quarter inch in length, thick and strong, yellowish brown (except around the umbilicus, where it is white), and beautifully marked with longitudinal zigzag lines of mahogany color. Umbilicus closed by an abundant white callus, leaving a narrow sulcus; there is also much callus deposited on the pillar lip, especially where it joins the outer lip. Operculum calcareous like that of *N. clausa*." Stimpson.

As there has been considerable doubt concerning this species, both Say's and Stimpson's descriptions are here reproduced. The shell here intended is the same as that found on the coasts of N. and S. Carolina by Kurtz, and at New Bedford, Mass., by Stimpson and Prime.

The species described and figured as *N. pusilla*, Say, by Gould is not the genuine *pusilla*, Say, it is *N. Grœnlandica*, Möller.

Very rare at Huntington; rare in Gardiner's Bay, in sand from four to five fathoms.

Range—Georgia to Buzzard's Bay.

Velutinidæ.

114. *Sigaretus perspectivus*, Say. Seacoast near Rockaway (De Kay).

Range—Tampa B. to Long Island.

Cancellariadæ.

115. *Cerithiopsis terebellum*, St. Huntington and Greenport. Moderately abundant; two to ten fathoms sand.

Range—Jamaica, W. I. (*fide* C. B. Adams); S. Carolina to Buzzard's Bay.

116. *Cerithiopsis Emersonii*, St. Huntington and Greenport. Moderately abundant; two to ten fathoms sand.

Range—S. Carolina to Buzzard's Bay.

Muricidæ.

117. *Ranella caudata*, Say. Common on sandy and pebbly bottoms; one to ten fathoms.

Range—Tampa Bay to Buzzard's Bay.

118. *Purpura lapillus*, Lamarck. Montauk. Abundant.

Range—Long Island to Greenland; Behring's Straits to North of Spain.

119. *Nassa trivittata*, Say. Common everywhere; in exposed situations larger and more highly colored.

Range—Georgia to G. of St. Lawrence.

120. *Nassa vibex*, Say. Huntington, Northport, and Lloyd's Harbors; on grass in very shallow water. This species has been considered rare on our northern coasts; we, however, have found it quite abundantly, and especially so in Lloyd's Harbor, in which in one day we obtained with the dredge forty specimens or more.

Range—Aspinwall to Cape Cod.

121. *Nassa obsoleta*, Say. Very abundant.

Range—Florida to G. of St. Lawrence.

122. *Buccinum undatum*, Linn. Ft. Hamilton (Ferguson), Montauk, and Little Gull Island; one specimen from the Sound, near Greenport. Fragments of very large specimens were picked up on the beach at East Hampton. Rare. Mr. Stimpson considers our species to be *B. undulatum*, Möller (Canadian Naturalist, Oct. 1865, p. 379).

Range—(of *B. undatum*) New Jersey to Arctic Seas; Ochotsk to British Channel; (of *B. undulatum*, according to Stimpson) New Jersey to Greenland.

123. *Buccinum plicosum*, Menke. Common.

Range—Georgia to Casco Bay.

124. *Pyrula canaliculata*, Brug. Common everywhere, more especially in exposed situations.

Range—Tampa Bay to Cape Cod.

125. *Pyrula carica*, Brug. Common. Very rare in exposed situations.

Range—Florida to Cape Cod.

126. *Columbella lunata*, Sowb. Common in sheltered localities. In mud and sand, from one to ten fathoms.

Range—Georgia to Cape Cod.

127. *Columbella Gouldiana*, Ag. Agassiz in litt. (*fide* Stimpson).

Fig. 5.

Columbella Gouldiana.

Stimpson remarks of this species: "Scarcely to be distinguished from *C. lunata.* It is larger, has a more produced rostrum when young; and its coloring consists of narrow, waved, longitudinal reddish-brown lines,—it being seldom, if ever, banded. The animal differs also somewhat in coloring from that of *C. lunata.*" In the Check List it is placed among "Doubtful Species." The specimens from Greenport, referred to this species, are much longer and slenderer than those of *C. lunata*, and have one or two additional whorls. The more produced rostrum ascribed to it would scarcely be remarked. No banded specimens were observed. Lloyd's Harbor and Greenport. Rare.

Range—Long Island to Mass. Bay.

128. *Columbella avara*, Say. Moderately abundant. Low-water to 10 fathoms.

Range—Tampa Bay to Mass. Bay. Maine?

129. *Mangelia pyramidalis*, St. Off coast of L. I., in 46 f. (Stimpson, Shells of New England, p. 49).

Range—Long Island to Greenland.

Conidæ.

130. *Pleurotoma cerinum*, K. and St. Huntington and Greenport. Low-water to three fathoms. Rare.

Range—S. Carolina to N. Bedford.

131. *Pleurotoma plicatum*, C. B. Ad. New York Harbor (De Kay); Huntington and Greenport. Less rare than *P. cerinum.* Low-water to two fathoms.

Range—S. Carolina to Buzzard's Bay. "Banks (Willis).

TECTIBRANCHIATA.

Bullidæ.

132. *Bulla oryza*, Tott. Huntington. Low-water to one fathom mud. Rare.

Range—S. Carolina to Buzzard's Bay. Maine?

133. *Bulla canaliculata*, Say. New York Harbor (De Kay); Huntington, Greenport, and Little Gull Island. Low-water to four or five fathoms mud. Moderately abundant.

Range—Tampa Bay to Mass. Bay.

134. *Bulla solitaria*, Say. East River (De Kay); Yellow Hook (Ferguson); Huntington and Greenport. Mud from one to two fathoms. Rare.

Range—S. Carolina to Mass. Bay.

Tornatellidæ.

135. *Actæon punctostriata*, St. Wallabout Bay (De Kay); Huntington and Greenport. Low-water mark, mud. Rare.

Range—S. Carolina to Buzzard's Bay.

Melampidæ.

136. *Melampus corneus*, St. Common everywhere.

137. *Melampus denticulatus*, St. Yellow Hook (Ferguson); Huntington. Very rare. Stimpson suggests that this may be an imported species.

138. *Carychium exiguum*, Gould. Centerport and Huntington. Very rare.

PNEUMOBRANCHIATA.

Limnæadæ.

139. *Ancylus fuscus*, C. B. Ad. Huntington, East Marion, and Greenport. Rare. More elevated specimens, probably belonging to another species, occur at the last two localities.

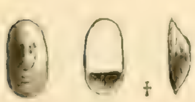
140. *Gundlachia Stimpsoniana*, Smith. Nov. sp.

The full-grown shell is ovate in form, consisting of two distinct parts. The smaller of these, which is the entire young shell described below, is attached very obliquely, and to the right, to the posterior end of the larger one. This "larger shell" is thin, very translucent, and of a whitish or very pale horn-color. It is more expanded to the left than to the right, the right side, however, being quite convex in its outline, while the left side is comparatively straight: roundedly truncate before, and very obliquely truncate behind, the left angle projecting. The striæ of growth are prominent. The "smaller shell" is anteriorly continuous with the dorsum of the "larger shell," generally in such a manner that its upper surface is entirely exterior to that of the "larger shell;" but in one specimen the anterior fourth is covered by a thin plate of new shell, giving it the appearance of penetrating the "larger shell" to that extent. Posteriorly it projects over the margin of the "larger shell" to a variable but very small distance. Its dimensions, form, and markings are described below, but when constituting a part of the full-grown shell its color is generally darker, and the markings less distinct than in the young shell. The interior of the full-grown shell is whitish, and somewhat pearly. The smaller shell is not simply soldered to it by the edges, but a plate of new shell is carried over the septum, the opening into the "smaller shell," however, not being diminished by it. The relative proportions of the septum and of this opening vary very much both in the young and the adult shells, some young shells, although of unusually large size, having only *from one-eighth to one-fourth* of the base covered by the septum, while one specimen, in which the "larger shell" was about two-thirds developed, had a septum *covering less than a quarter* of the aperture. All these forms of the young and old shells were found at the same time (June, 1869) and in the same localities.

The full-grown shell is $5\frac{1}{4}$ millimetres long; $3\frac{1}{4}$ m. wide, and $1\frac{1}{2}$ m. high.

The young shell is amber-colored, translucent; sides nearly parallel, sometimes slightly contracted in the middle; anterior end rather wider and more obtuse than the posterior, often somewhat obliquely truncated on the left side; posterior end regularly rounded. Apex very obtuse at the posterior third of the length, and much inclined to the right. Concentric lines (of growth?) are perceptible on the upper surface, as well as a number of radiating lines on the anterior end. Septum of lighter color, translucent, displaying distinct lines of growth, covering generally two-thirds or more of the base; the anterior edge straight, and

Fig. 6.



Gundlachia Stimpsoniana (young state).

at right angles to the length of the shell. Edges of aperture slightly thickened, and somewhat whitish.

Length of young shell, 2 millimetres; width, 1 m.; height, $\frac{1}{2}$ m.

The principal differences perceptible between this shell and the *Gundlachia Meekiana* of Stimpson, are:—

1st. The greater size; Stimpson's figure being only three millimetres long, while this is $5\frac{1}{4}$ mill.

2d. In *G. Meekiana* the right side is nearly straight, the truncation of the posterior extremity is but slightly oblique, the right posterior angle projecting; while in *G. Stimpsoniana* the left side is the straightest, the truncation posteriorly, is very oblique, the left angle projecting.

3d. In *G. Meekiana* the "smaller shell" is black, opaque, while in *G. Stimpsoniana* it is amber-colored and very translucent.

4th. Judging by the figure, in *G. Meekiana*, the "smaller shell" appears to project more over the margin of the "large shell" than in *G. Stimpsoniana.*

5th. *G. Meekiana* is higher in proportion. A specimen of *G. Stimpsoniana* five and one-fourth mill. long would be two and one-tenth mill. high, instead of one and one-half mill., if of the same proportions.

I examined several specimens of the animal while living, and was unable, either in the young or the adult, to perceive any essential difference from that of the species of *Ancylus* (*A. fuscus* C. B. Adams) associated with them.

This species occurred in three ponds at Greenport, and in one on Shelter Island, opposite to that place. The specimens were attached to floating sticks and logs, in company with two species of *Ancylus*, and were generally clinging to points very near the surface of the water, and sometimes even a little above it, on spots that were merely damp. The first specimens found, three years ago, were of the young shell only, and similar ones occurred every year since; but it was not until June, 1869, that I found a very few specimens presenting the adult form; and of these only two were completely developed. The collections in previous years were all made at a somewhat later season (July to September), and all the specimens had the base covered by the septum to the extent of two-thirds or three-quarters; while, as before mentioned, specimens in all stages of development occurred in June, though in a *smaller total number* of individuals.

In view of this fact it seems difficult to answer satisfactorily, as yet, the questions proposed by Stimpson in his description of *G. Meekiana* (Proc. Bost. Soc. Nat. Hist., 1863, p. 249) with regard to the period and course of development of our species of *Gundlachia.* It may be remarked, however, that the septum is evidently formed at an early period of the year, and probably not in the winter, as otherwise it is difficult to account for the fact that all those found late in the season had the septum fully developed, while in June adults and half-developed specimens occurred.

About one hundred specimens of the species have hitherto been found.

141. *Limnea columella*, Say. Coldspring, Huntington, East Marion, and Greenport. Common.

142. *Limnea humilis*, Say. Lloyd's Neck, Huntington, Centerport, and Riverhead.

143. *Limnea desidiosa*, Say. Astoria and Huntington.

144. *Physa heterostropha*, Say. Common.

var. *Primeana*, Tryon (Amer. J. Conch., Vol. 1st, p. 227). Huntington.

145. *Physa elongata*, Say. Huntington and Centerport. Rare.

146. *Planorbis trivolvis*, Say. Huntington, rare; Riverhead and Montauk, common.

147. *Planorbis bicarinatus*, Say. Huntington and Centerport. Common.

148. *Planorbis armigerus*, Say. Brooklyn (Ferguson), Greenport, and Shelter Island.

149. *Planorbis exacutus*, Say. Greenport. Rare.

150. *Planorbis parvus*, Say. Common.

151. *Planorbis dilatatus*, Gould. Huntington, Southold, Greenport, and Gardiner's Island. Rare.

Helicidæ.

152. *Helix cellaria*, Müller. Astoria (Binney and Bland).

153. *Helix arborea*, Say. Common.

154. *Helix viridula*, Menke (*electrina*, Gld.). Jamaica (Ferguson) and Lloyd's Neck. Rare.

155. *Helix indentata*, Say. Lloyd's Neck, Huntington, and Gardiner's Island. Rare.

156. *Helix Binneyana*, Morse. Huntington. Rare.

157. *Helix fulva*, Drap. (*chersina*, Say). One or two specimens at Huntington.

158. *Helix lineata*, Say. Fort Hamilton (Ferguson), Oyster Bay, Coldspring, Lloyd's Neck, Huntington, East Marion, and Greenport. Not common.

159. *Limax maximus*, Linn. Williamsburg.

160. *Limax flavus*, Linn. Williamsburg. Common.

161. *Limax agrestis*, Linn. Common.

162. *Limax campestris*, Binney. Less common than *L. agrestis*.

163. *Helix alternata*, Say. Fort Hamilton (Ferguson), Astoria. Shelter and Gardiner's Islands, rare; Lloyd's Neck in one place only, but in great numbers.

var. *Fergusoni*, Bland (Ann. Lyc. N. H., N. Y., vii. 421, 1861).

"Shell small, comparatively smooth, especially at the base; has a shining, somewhat translucent epidermis, which on dead shells becomes opaque. The suture is well impressed, and the outer whorl is not, as usual in this species, obsoletely carinated. The deep-red flammules are disposed with much regularity on a pale horn-colored ground. An average-sized specimen, with five whorls is diam. maj. $15\frac{1}{2}$, min. 14, alt. $6\frac{1}{2}$ mill. The animal does not exude the saffron-colored mucous secretion usually observed in the typical form.

Greenwood Cemetery, near Brooklyn. Rare. (Ferguson.)" Bland.

164. *Helix labyrinthica*, Say. Lloyd's Neck, Huntington, and Greenport. Very rare.

165. *Helix albolabris*, Say. Not very common.

This species on Long Island attains comparatively small size only. A specimen from Huntington measures diam. maj. 21, min. 18, alt. 12 mill.

166. *Helix thyroides*, Say. Common. A sinistral specimen found near Greenwood (*fide* Ferguson).

167. *Helix pulchella*, Müller (*minuta*, Say). Common everywhere near inhabited places.

168. *Helix hortensis*, Müller.

169. *Helix minutissima*, Lea. Coldspring and Huntington. Very rare.

170. *Pupa pentodon*, Say. Common at certain stations.

171. *Pupa fallax*, Say. Coldspring and East Marion. Found only in one locality in each place, but very abundantly.

172. *Pupa contracta*, Say. Lloyd's Neck and Huntington. Very rare.

173. *Pupa corticaria*, Say. Huntington. Rare.

174. *Vertigo milium*, Gld. Everywhere. Plentiful at certain stations.

175. *Vertigo ovata*, Say. Common.

176. *Vertigo simplex*, Gld. Fisher's Island (Linsley), Greenport.

177. *Succinea avara*, Say. Huntington and Greenport. Rare.

Arionidæ.

178. *Arion fuscus*, Müller. (Figured in Binney,* as a small variety of *A. hortensis*, pl. lxv., f. 2.) Astoria, Flushing, and Huntington. At Lloyd's Neck it is found in great numbers in one locality (the same in which the *Helix alternata* was found), but it is not restricted to one place.

Philomycidæ.

179. *Tebennophorus Carolinensis*, Binney. Very common at Lloyd's Neck. Huntington and Islip. Found in great numbers under the bark of chestnut trees.

CEPHALOPODA.

Decapoda.

Loliginidæ.

180. *Loligo illecebrosa*, Lesueur. Huntington. Abundant at Greenport.

Range—Long Island to Newfoundland.

181. *Loligo punctata*, De Kay.

Range—Coast of N. Y. (De Kay).

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* Terrestr. Moll. U. S. Binney, edit. Gould, 1851 and 1857.

182. *Loligo Pealii*, Lesueur. New York (Férussac and D'Orbigny, Hist. Nat. des Ceph. 311, pl. 2, pl. 10, figs. 17–21; *fide* Rept. Invert. Mass., Gould, edit. Binney, 1870.)

TUNICATA.

The TUNICATA, both simple and compound, abound in the waters of Long Island, and descriptions of a large number of species were prepared by Mr. Smith for his paper "On the Mollusca of Peconic and Gardiner's Bays" (Ann. Lyc. N. H., N. Y., Vol. vii., April, 1860). The difficulty, however, of ascertaining which, if any, are identical with described species prevented their publication at that time; and for the same reason we think it best to still defer it. The number of unpublished species noticed is about eighteen, belonging to the genera *Ascidium*, *Cynthia*, *Molgula*, *Botryllus*, *Aplydium*, and *Amoræcium* or its subgenus *Parascidium*. In the Natural History of New York, De Kay describes *Ascidia Manhattensis*, De Kay, but does not expressly say that this species occurs on Long Island, though it is probable that this is the case. The description is so vague a one as not even to fix the generic position of the species. He also mentions *Boltenia reniformis* (Macleay) as found in New York Harbor, but the same remark will apply to this. Alex. Agassiz (Proc. Bost. Soc. Nat. Hist. xi., 17) very fully describes and figures *Salpa Caboti*, Desor, which he states to be common in Long Island Sound, extending its range eastward to Buzzard's Bay and Nantucket. He likewise states that two species of *Appendicularia*, closely allied to *A. furcata* and *A. longicauda* are extremely common in L. I. Sound, extending thence to Massachusetts Bay.

The following dredging lists, prepared by Mr. Smith in 1859, will furnish a clearer idea of the special stations, the association and relative abundance of our species, than can be obtained from the detached notices given of each species. Each list is the result of three or four hauls of the dredge, from fifty to three hundred feet of the bottom being scraped over each time, and *every* shell found is included, so that *average* results are obtained. The accented numbers refer to disunited valves of bivalves. The depths are given in fathoms.

Locality	Greenport Harb.		Greenport Harb.		Gardiner's Bay.		Gardiner's Bay.	
Depth	About 10 fathoms.		4 to 8 fathoms.		6 fathoms.		1 to 4 fathoms.	
Kind of bottom	Sand and broken shells.		Sand and pebbles.		Sticky mud.		Sand and pebbles.	
	Alive.	Dead.	Alive.	Dead.	Alive.	Dead.	Alive.	Dead.
Ranella caudata	1	3	4	1	......	1	59	6
Pyrula carica	1 y.	a few	3 y.	2	......	2 y.	......	2 frag.
Pyrula canaliculata	......	a few	......	......	......	......	3y.	3 y.
Buccinum plicosum	10	a few	......	4	......	......	30	6
Nassa obsoleta	......	a few	......	a few	......	......	......	1
Nassa trivittata	3	10	70	30	4 y.	63 y.	21	34
Columbella avara	......	8	1	3	......	1	36	1
Columbella lunata	13	10	1	10	......	5	56	20
Pleurotoma cerinum	......	......	......	......	5	5	......	......
Pleurotoma plicatum	......	......	......	1	......	......	......	......
Natica heros	1	......	......	......	......	......	......	......
Natica duplicata	......	1	......	......	......	......	......	1
Natica triseriata	......	1	......	......	1	......	3	6
Natica pusilla	......	......	......	......	......	1	......	......
Natica immaculata ?	......	......	......	......	......	1	......	......
Chemnitzia seminuda	......	......	......	......	......	......	56	......
Chemnitzia trifida	......	......	......	4	......	......	......	......
Chemnitzia interrupta	......	......	6	19	3	4	3	7
Cerithium Sayi	......	18	......	10	......	1	......	29
Cerithium nigrocinctum	1	2	......	7	......	......	3	......
Cerithiopsis Emersonii	7	26	4	4	......	......	......	1
Cerithiopsis terebellum	17	11	8	11	......	......	4	2
Coecum pulchellum	......	......	......	2	......	......	......	......
Littorina rudis	......	1	......	1	......	......	......	1
Lacuna vincta	......	......	......	......	......	1	......	3
Crepidula fornicata	many	many	a few	a few	......	......	many	many
Crepidula convexa	many	a few	1	a few	......	......	......	1
Crepidula unguiformis	......	2	5	1	......	......	2	......
Tectura testudinalis	......	......	......	......	......	......	7 y.	2
Chiton apiculatus	29	......	28	......	......	......	18	1
Bulla canaliculata	......	......	......	1	75	90	1	......
Anomia ephippium	many	many	many	many	......	......	many	many
Pecten irradians	......	4′	......	a few′	......	......	......	4′
Mytilus edulis	......	......	......	......	......	1′	......	......
Mytilus modiolus	many	many	......	a few′	......	......	......	......
Arca transversa	10	13	5	a few′	......	......	10	15′
Nucula proxima	15	200	105	60	2900	many	8	7′
Leda limatula	......	......	......	......	165	38,m'y′	......	......
Solemya velum	......	......	1	......	......	......	......	......
Cardita borealis ?	......	......	......	......	......	......	......	1
Cardium Mortoni	......	4′	......	1	......	......	2	5′
Cardium pinnulatum	......	......	......	......	2 y.	2′	......	1′
Astarte lunulata	......	2,43′	......	30′	......	......	......	13′
Venus gemma	......	......	......	4′	......	......	......	......
Venus mercenaria	......	......	......	a few′	......	......	......	......
Cytherea morrhuana ?	......	......	......	......	9	5,1	......	......
Mactra lateralis	......	8′	1 y.	......	3	17′	......	......
Mactra solidissima	5	4′	......	......	......	......	......	......
Kellia planulata	......	......	......	2′	......	......	......	1′
Montacuta elevata	......	......	......	1′	......	......	......	......
Tellina tenera	......	2	45	many′	......	......	......	......
Tellina tenta	......	......	2	a few′	......	......	......	......
Tellina fusca	......	......	2 y.	......	......	......	......	......
Cumingia tellinoides	......	104′	......	6′	......	......	......	1′
Solen ensis	......	a few′	......	many	......	......	......	1 y.
Mya arenaria	......	a few′	......	a few′	......	......	......	......
Corbula contracta	......	25,122′	......	13. many′	......	......	......	6′
Anatina papyracea	......	......	......	......	69	10,4′	......	......
Cochlodesma Leanum	......	6′	......	1′	......	......	......	9′
Lyonsia hyalina	......	......	3	2′	1	3′	1	......
Thracia Conradi ?	......	1	......	......	......	......	......	......
Pandora trilineata	......	3′	4	3′	8	15,18′	......	......
Ascidia or Molgula	12	......	6	......	......	......	......	......

The bark stripped from the piles of a pier at Greenport, together with the abundant growth of *Tubularia larynx* (sometimes a foot long) which covered it, furnished the following species. As a considerable number of piles were stripped, from low-water mark to the depth of two feet, the relative numbers of the different species may probably be taken as correct.

Buccinum plicosum	17	Cerithium Sayi	75
Columbella avara	184	Cerithium nigrocinctum	97
Columbella lunata	4,600	Cerithium Greenii	5
Pleurotoma plicatum	37	Cerithiopsis terebellum	1

The list above was made in summer (August or September). An examination of the same pier in November gave specimens of *Nassa trivittata*, *Nassa obsoleta*, and *Littorina rudis*, in addition to the above, while none were found of *Pleurotoma plicatum* or *Cerithiopsis terebellum*.

INDEX.

[The names of new species are printed in Roman letter; synonyms and species to which reference is made are in *Italics;* names of sub-families, families, or higher divisions, in SMALL CAPITALS.]

ERRATA.

Page 88, 6th line from top, for "dorsalis," read "rufidorsalis."

Page 89, 8th line from bottom, for "Melopiza," read "Melospiza."

Page 120, 16th line from bottom, for "De la Slave," read "De la Llave."

Page 124, 4th line from top, insert before "female," of.

Page 125, 18th line from top, for "*salolæma*," read "*calolæma*."

Page 131, 15th line from bottom, for "Seibl." read "Leibl."

Page 201, 12th line from bottom, for "*Camptosoma*," read "*Camptostoma*."

Page 244, line 8; *spachronites*, read *sphocronites*.

Page 280, 16th line from bottom, for *minuscula*, Say, read *minuscula*, Binney.

Page 302, line 4 from bottom, for "narrow," read "thin."

Page 307, line 17 from top, for "III., 10," read "III., 11."

Page 308, line 10 from top, for "distinguished by its nostrils and caudal as before," read "distinguished from the previous species by its nostrils and caudal."

Page 309, last line but one, insert before "hermaphroditism" "accidental."

Page 343, line 28; for *ancyliformis*, read *neritoides*.

Page 350, strike out *Strebelia*, which proves to be a land shell.

Page 355, insert before "Group Physacea,"

Group B. Shell with an internal lamina.

Genus *Gundlachia*. Pfr. 1849.

Shell ancyliform; apex oblique, non-spiral, posteriorly inclined, basal side two-thirds closed by a flat lamina parallel with the plane of the aperture, soft parts resembling *Ancylus*.

Type *Gundlachia ancyliformis*. Pfr. Cuba.

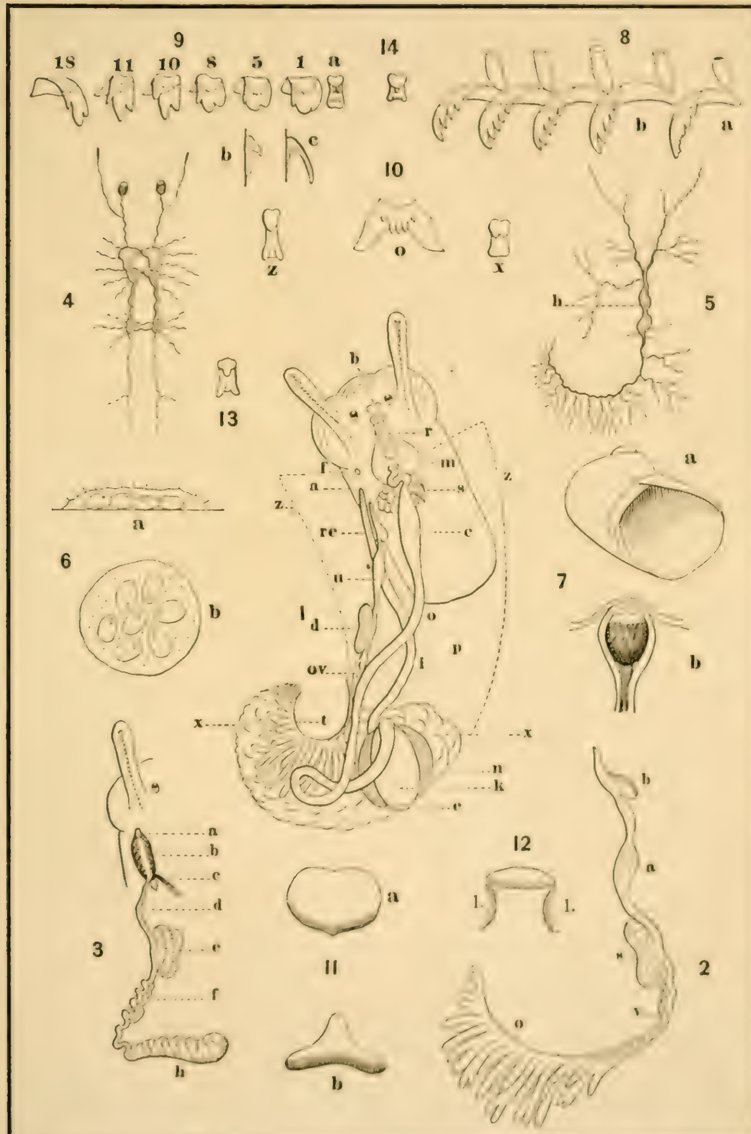
(?) Genus *Latia*. Gray. 1849.

Shell crepiduliform, apex spiral, posterior; aperture with a posterior semi-lunar septum, furnished on the right side with a projecting, slender, free, somewhat twisted lamina. Exterior with a brown spirally striate epidermis. Tentaculæ short, triangular; mantle margin simple; pulmonary aperture on the right side. Foot rounded; teeth unknown.

Type *Latia neritoides*. Gray. New Zealand.

Page 380, 23d line from top; *Mya arenaria*, Say; read *Mya arenaria*, Linn.

Drawn by D. Wiest.



From nature, by W. H. Dall. Jewett & Chandler, Engravers.