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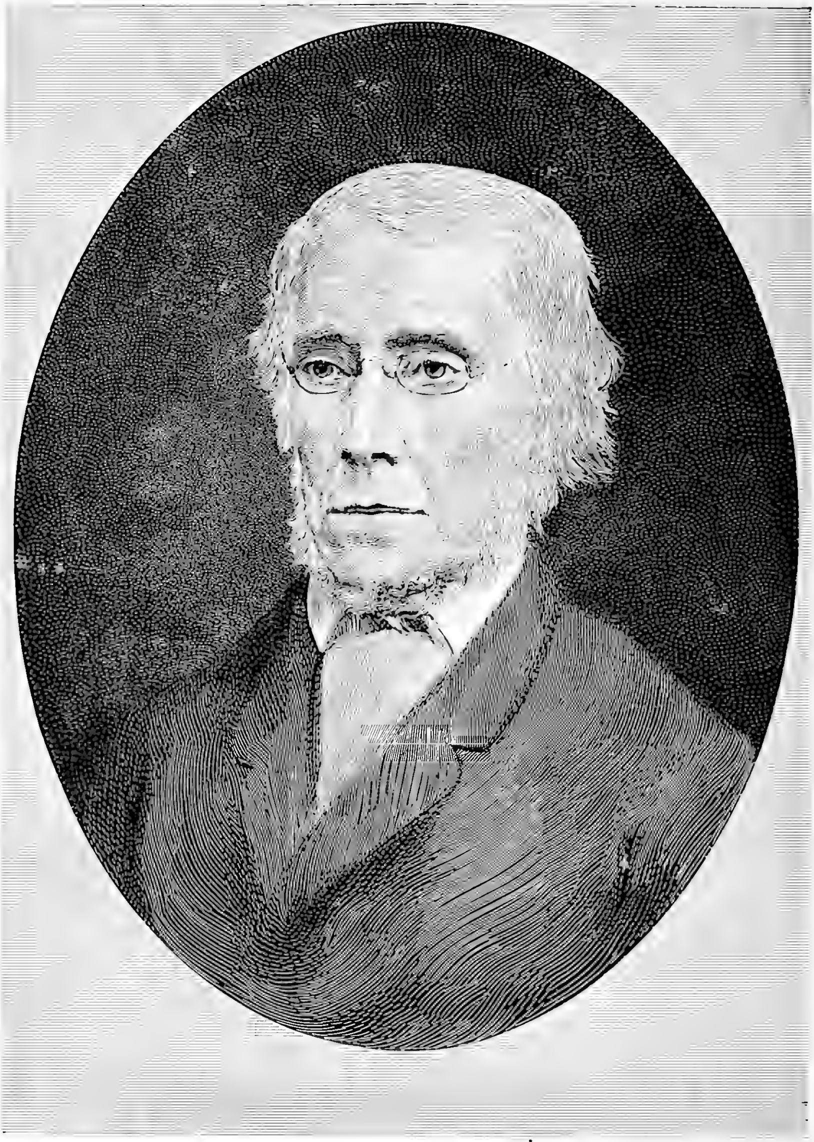

T. A. Conrad

1803—1877

BULLETINS

OF

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Vol. 23

*

No. 77

Timothy Abbott Conrad, with Particular Reference to his Work in Alabama One Hundred Years Ago

By Harry Edgar Wheeler

September 2, 1935

Paleontological Research Institution
Ithaca, New York

Gilbert Dennison Harris

TO GILBERT DENNISON HARRIS

(PROFSSOR EMERITUS OF PALEONTOLOGY AND STRATIGRAPHIC GEOLOGY, CORNELL UNIVERSITY)

WHO HAS BEEN, FOR NEARLY HALF A CENTURY, ONE OF THE PRINCIPAL WORKERS AND AUTHORITIES IN THE FIELD OF AMERICAN TERTIARY GEOLOGY; AND WHO HAS, BY HIS PAINSTAKING RESEARCH, LIBERALITY, AND VOLUMINOUS PUBLICATIONS, SIGNIFICANTLY ENCOURAGED STUDENTS AND VASTLY ENLARGED OUR KNOWLEDGE OF EOCENE HISTORY.

Affectionately,

THE AUTHOR

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INTRODUCTION

SCOPE OF THE WORK: ACKNOWLEDGMENTS

For many years the author has been a leisure-time student of the fossils of the Tertiary formations, particularly those which are identified as belonging to the Eocene period, and which occur in Alabama. As Prof. Gilbert D. Harris says, Alabama will always be the type locality for this great division of geologic time. The State attracted the attention of the earliest of those investigators with whose studies this period has ever since been associated.

It was through the kindness of Dr. Truman H. Aldrich and Dr. Eugene A. Smith that this realm of fascinating interests was made real to the writer's imagination, and many were the meetings and many the excursions that were arranged in the encouragement of mutual interests.

Not having had the technical training nor the professional connections that the paleontologist requires, the author has contented himself with the making of a collection of fossils, in the gathering and study of which many new facts and some new species have been brought to light; but he has also been interested in the historical side of the study, which interest has led him far afield in matters which the paleontologist does not always have time to follow.

From the cauldron of technical confusion and controversial bitterness the author has undertaken to save some of the nearly obliterated facts concerning the pioneer work of *Timothy Abbott Conrad*. He has tried to piece together the scattered remnants of a life that is not embossed with events of thrilling interests nor characterized by leadership in the political or social affairs of his time, but which nevertheless had the highest respect of his contemporaries in the field of geologic study.

The author reviews his own work with the criticism that he has not produced a story for the reader who wants a full biography; nor yet for the scientist who expects specific help in technical matters. After all our labor to recover data of pertinent interest there remain great gaps — bridged by no recoverable documents — in the life of one of our greatest American paleontologists. In the interest of accuracy he has chosen not to embellish the story with unwarrantable drafts on his own imagination.

The author desires to express his indebtedness to all who have assisted him in following up many clues. Libraries, museums, and private collections have been ransacked for information. The following persons and institutions deserve special mention for many kindnesses and courtesies extended: Mr. Richard M. Abbott, of Bristol, Pennsylvania, Miss Louisa G. Conrad, of Lansdowne, Pennsylvania, and other members of Conrad's family; Elizabeth Kerr Atkinson (Mrs. G. F.), the daughter of Dr. W. C. Kerr, former State Geologist of North Carolina; the late Charles W. Johnson, of the Boston Society of Natural History; Prof. Gilbert D. Harris, of Cornell University; and Mr. Peter A. Brannon, of the Department of Archives and History, Montgomery, Alabama.

The Academy of Natural Sciences, Philadelphia, and especially its Secretary, Dr. James A. G. Rehn, has been very gracious in permitting the author to copy and quote from a sheaf of letters written by Mr. Conrad to Dr. Samuel G. Morton. Dr. Charles C. Adams, Director of the New York State Museum, has made available letters from Mr. Conrad to Dr. James Hall, former Director of the New York State Geological Survey. Mr. Peter A. Brannon has permitted the author to examine copies of letters which passed between Dr. Isaac Lea and Judge Charles Tait, some of which have thrown much light on biographical interests. The originals of these letters are in the Department of Archives and History, Montgomery, Alabama. The officials of the Library of Congress, the Trenton Free Public Library, the Wagner Free Institute of Science, the United States Geological Survey, and the United States National Museum have been ex-

ceedingly kind in ferreting out information that was vital to our story. There are many others who, in one way or another, have been of help. We desire to mention in this connection: Dr. Rudolph Ruedemann, of Albany, New York; Dr. Joseph Hyde Pratt, late State Geologist of North Carolina; Dr. E. N. Lowe, late State Geologist of Mississippi; Mrs. R. T. Ervin, of Camden, Alabama; Mrs. W. E. Deer, of Claiborne, Alabama; Mr. Clem Gazzam, of Birmingham, Alabama; Dr. V. H. Paltsitz, Chief of the American History Division, New York Public Library; Dr. Paul Bartsch, Curator, Department of Mollusks, United States National Museum; Mr. John U. Perkins, of the Smithsonian Institution; Col. Lawrence Martin, Head of the Department of Maps, Library of Congress; Dr. Carl Boyer, Director of the Wagner Free Institute of Science; Mr. Fred. W. Ashley and research assistants in the Library of Congress; Miss Hazel Gray, assistant Librarian, American Museum of Natural History; and Miss Sarah King, of Auburn, Alabama, a great-great-granddaughter of Judge Charles Tait.

The author also desires to express his appreciation to those who have offered constructive criticism of his work, and who have aided him in many research problems, among whom may be mentioned Mrs. Emily Wilcoxson, of Field Museum; and Dr. H. A. Pilsbry, Curator of Mollusks, Academy of Natural Sciences, Philadelphia, Pa.; Mr. Calvin Goodrich, of the University of Michigan; Dr. Roland M. Harper, of the Alabama Geological Survey, who has also read the proof, verified some of the bibliographical references, and furnished the list of plants of Claiborne bluff; and my wife, who has been the untiring and unselfish companion of all these patient investigations.

The publication of this work has been made possible by the encouragement of the Geological Society of America, which has furnished the funds for the republication of Conrad's Geological Map of Alabama; by the generosity of Dr. Howard Kelly, of Baltimore, Maryland, to whom the author is indebted for the illustrations and binding of the text; and by the coöperation of Prof. Gilbert D. Harris, for his unfailing interest in the progress of the work and his assumption of its publication as one of the volumes of the Bulletins of American Paleontology.

The author has tried to correct some of the errors concerning Conrad's personal life and work that have crept into literature. Matters that have been entrusted to maps and charts have been verified in the smallest detail, as far as that was possible. In many cases, especially where controversial situations had to be faced, the author has chosen to present the facts as simply as possible, largely by direct quotation from letters and books, and to evaluate the evidence only when it seemed imperative in the interest of a fair understanding.

The illustrations in this story have been gathered from many sources. Some of the photographs have been made by Mr. Q. B. Schenk; others were taken by the author; while a few have come to him from friends or members of the Conrad family. Other acknowledgements are made in the text and in the table of illustrations.

The writer is indebted to Miss Clara Berentz for constructive work on the charts and maps and for the design used on the binding. The zinc etchings and half tones were made by the Alabama Engraving Company, Birmingham, Alabama; and the reproduction of Conrad's Geological Map was done by Williams and Heintz, Washington, D. C.

CHRONOLOGICAL

1803 Birth, at Trenton, New Jersey, June 21.

1824 First dated poem, republished in *A Geological Vision* in 1871.

1826 Poems, published in the *Souvenir*.

1828 Poems, published in Philadelphia papers.

1830 First scientific paper, published in the Journal of the Academy of Natural Sciences, Philadelphia.

1831 Elected a member of the Academy of Natural Sciences. *Marine Conchology*, Parts 1 and 2.

1832 *Fossil Shells of the Tertiary Formations*, Nos. 1 and 2. *Marine Conchology*, Part 3.

1833 Year in Alabama from February 28 to February, 1834. *Fossil Shells of the Tertiary Formations*, Nos. 3 and 4. Unpublished poem, *Claiborne*.

1834 Honorary member of the Geological Society of Pennsylvania.

Curator, Geological Society, Jefferson Medical College, Philadelphia.

New Fresh Water Shells of the United States.

1835 Curator, Academy of Natural Sciences, from December to December, 1836.

Fossil Shells of the Tertiary Formations, new edition, No. 3, with plates and map.

1836 *Monograph of the Unionidæ of North America.*

1837 Geologist of the New York State Geological Survey.

1838 - 1842 Paleontologist of the New York State Geological Survey.

1838 *Medial Tertiary*, begun.

1838 - 1840 Member Publication Committee, Academy of Natural Sciences, Philadelphia.

1842 Conchologist, Powell's Survey of Tampa Bay, Florida.

1843 - 1845 Member Publication Committee, Academy of Natural Sciences.

1845 Expedition to Mississippi, for Vicksburg Fossils.

1848 *The New Diogenes.*

1851 Application for position in the Smithsonian Institution.

1854 - 1857 Part-time paleontologist, Smithsonian Institution. Work on the paleontology of several government surveys and exploring expeditions.

1865 Member of the American Philosophical Society.

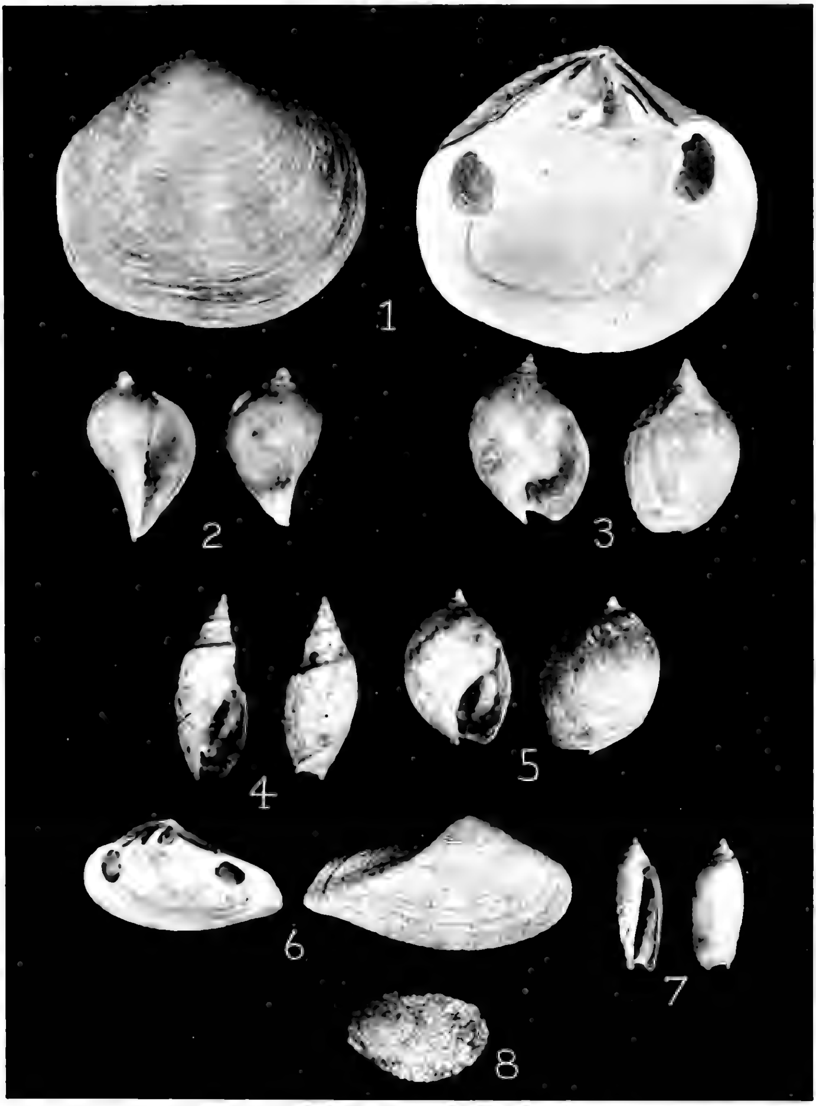
1866 *Check List of the Invertebrate Fossils of North America.*

1870 - 1871 Assistant in Invertebrate Paleontology, North Carolina Geological Survey.

1871 *A Geological Vision and Other Poems.*

1877 Death, Trenton, New Jersey, August 7.

PART ONE
THE HISTORIC BACKGROUND FOR A SCIENTIFIC STORY



FIRST FOSSILS DESCRIBED FROM CLAIBORNE

1. Crassatella alta, 2. Turbinella pyruloides, 3. Ancillaria altile, 4. Ancillaria scamba, 5. Ancillaria subglobosa, 6. Crassatella protexta, 7. Ancillaria staminea, 8. Ostra radians, synonym of *Ostrea sellæformis, juv.*

Photo by Q. B. Schenk

PART I

THE HISTORIC BACKGROUND FOR A SCIENTIFIC STORY

In the year 1832, in Philadelphia, the City of Brotherly Love, a diffident young man published in pamphlet form the first two numbers of a little book which was destined to make something more than a commotion in the scientific world. The name of the man was *Timothy Abbott Conrad;* the name of the book was *The Fossil Shells of the Tertiary Formations.*

Since both the man and the book belong to an eventful period of American geology, and students of history and geology are almost sure to cross their trails, it may be interesting to set in order some intimate and little-known facts concerning them.

The year 1832 is chronologically pivotal. It marks the beginning of serious work on the Tertiary paleontology of North America. Though Mr. Conrad was not yet thirty years old, his reputation as a conchologist was already established. In 1831 he had published a small volume, the *Marine Conchology,* illustrated (in its completed form) with seventeen plates, hand-colored by his sister, which work secured for him a recommendation for membership in the Philadelphia Academy of Natural Sciences. On the return of Dr. Gates,* of New York, from a

* This Dr. Gates may be identified—though not with absolute certainty—as Dr. Hezekiah Gates, a native of New England, who resided in Whitesboro (New York?) and who was practising physician and apothecary for many years in Mobile, Alabama. Dr. Charles Mohr (*Plant Life of Alabama*) says that he was the first botanist to collect the flora of the coast region of Alabama. In 1829 he was elected a member of the Lyceum of Natural History of New York, the present Academy of Sciences, but the records do not show for what reasons. In his journeyings north and south he may have collected fossils as well as plants. If he visited Claiborne he was probably the guest of Judge Tait and would certainly have been introduced to the bluff, doubly interesting for its flora and its fossils. Asa Gray dedicated to him the genus *Gatesia* which name unfortunately had to be abandoned since it was already preoccupied.

rather extensive visit to the Tertiary localities on the Atlantic seaboard and at Claiborne, Alabama, Mr. Conrad was given the task of describing the new species which he had collected. Dr. Dall does not hesitate to say[1] that at this time (1832) Conrad was the foremost authority on the Tertiary geology of North America. The modest numbers of his *Fossil Shells,* in which these descriptions appeared, were beautifully illustrated, both the original drawings and the engravings being prepared by the author. Of the species figured, nine were from Claiborne, one of which, however, was identified as *Venericardia planicosta* Lamarck, though it was assigned to the genus *Cardita.*[2]

A DISTINGUISHED STATESMAN AND PATRON OF SCIENCE

The credit for introducing Claiborne to the scientific world belongs to a planter and statesman. Charles Tait, a native of Louisa County, Virginia, had represented the State of Georgia in the United States Senate from 1809 to 1819. Tendering his resignation in 1819, he offered his citizenship to the newly constituted State of Alabama. He had been officially interested in the affairs of the Territory while still in Washington, and had also acquired lands in what came to be known as Monroe County. Before he came to Alabama, however, he spent a long vacation in Philadelphia, gratifying his desire to visit the Academy of Natural Sciences and to meet some of its distinguished members. Among these, all of whom were to play some part in the several acts of our story, were Dr. Isaac Lea, the millionaire publisher and conchologist[3]; Dr. Samuel G. Morton, author of the *Synopsis of Organic Remains;* and Mr. Charles A. Poulson, another wealthy scientist, whose library was rich in source materials and whose molluscan collections were said to be the most extensive at that time in America.

1 Bull. Phil. Soc., Washington, 12, p. 216, Jan. 1893.

2 Since these particular shells are the first ever described from this historic locality, whose beds have since yielded not less than four hundred distinct species, it may be well to list them here: *Crassatella alta, Crassatella protexta, Turbinella pyruloides, Ancillaria altile, Ancillaria subglobosa, Ancillaria scambia, Ancil. staminea, Ostrea sellæformis* and *Ostrea radians.* The two last-named species came from a bed underneath the ferruginous sand, *radians* being subsequently considered by Conrad a juvenile form of *sellæformis.*

3 Many years ago I learned from Dr. Truman H. Aldrich, himself a mining engineer and a pioneer in the development of the coal fields of Alabama, that Dr. Lea had laid the foundation of his fortune by the acquisition of large tracts of coal lands in western Pennsylvania.

Claiborne Fossils

1. Crassatella alta, 2, 2a. Pyrula penita, 3. Dentalium thalloide, 4. Pectunculus stamineus, 5. Grateloupia hydana, 6. Cassis nupera, 7. Oliva alabamensis.

Photo by Q. B. Schenk

If we wonder how it came about that a man of Senator Tait's social standing and political leadership chose to throw in his lot with immigrants who had yet to patent their homesteads in territory very recently acquired from the Indians, we need merely to remember that his only son James had already settled in Alabama and had written glowing letters of the opportunities the new State offered.

James Tait had been a private in the Georgia militia, commanded by Gen. John Floyd, which troops figured prominently in the Creek War in Alabama. In 1813 General Ferdinand Leigh Claiborne, Mississippi's brilliant hero of the Indian Wars, was ordered to fortify the high bluff on the Alabama River, previously known as John Weatherford's Plantation,[4] but later as Alabama Heights. The fort, which is described by Monette[5], was little more than a stockade defended by three block houses and a half-moon battery. It was named Fort Claiborne in honor of its builder. No battle was ever fought there, though it was an important base of supplies for the troops engaged in the conflict with the Creeks at Eccanachaca, or "Holy Ground," the swamp-surrounded stronghold of William Weatherford, which was about 110 miles northeast of Fort Claiborne, in a great bend of the Alabama River, south of Selma and east of Cahawba.

Young Tait and his comrades of Floyd's Georgia Militia were so attracted by the opportunities which Alabama would offer them that they determined to settle in this fair and promising region on the expiration of their military contracts. Carrying this purpose into effect soon after the Battle of New Orleans, young Tait entered land (in 1817) near the present village of Camden, later christened the "Dry Forks Plantation". Claiborne, which was to become the capital of the county formed in 1815 by the Mississippi Territorial Legislature and named in honor of James Monroe, was only thirty miles away. At that time James Monroe

[4] The plantation proper was on the opposite side of the river. The fact that Weatherford claimed the lands on the left bank of the river upon the bluff on which the fort and town of Claiborne were built, accounts for the poorly constructed buildings first erected in the town. For graphic pictures of the tragic events of this period, see Pickett, *History of Alabama*, 1851. Note especially his account of the Battles of Burnt Corn, and "Holy Ground"; and his description of the most terrible of all Indian massacres, that of Fort Mims, on August 30, 1813.

[5] *History of the Discovery and Settlement of the Valley of the Mississippi*, John Wesley Monette, Vol. II, p. 414, 1848.

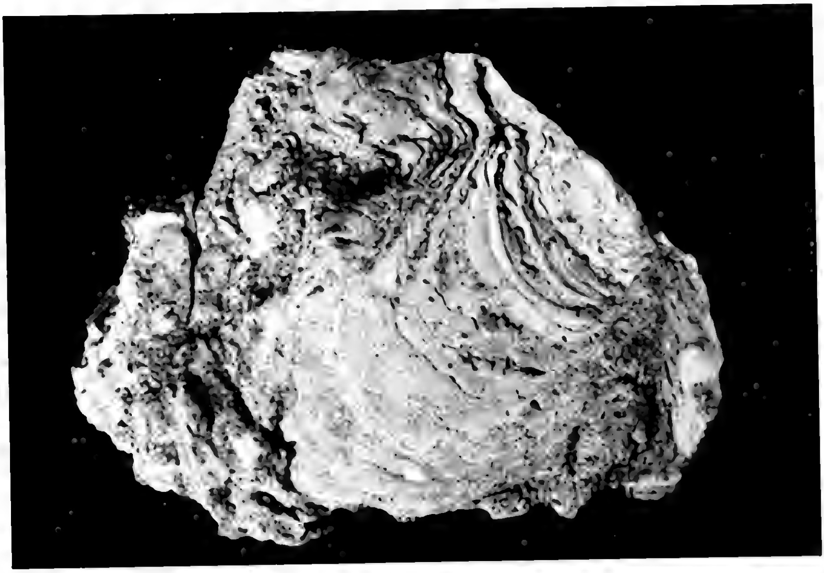
was Secretary of State, but he afterwards became President. As originally formed, Monroe County stretched over nearly half the present area of the State; but by 1819 its boundaries were the same as those of today.

The Territorial Capital of Alabama was St. Stephens, thirty miles due west of Claiborne, situated on a bluff, not of the Alabama River, but of the Tombigbee. St. Stephens was the Capital only for the interval between 1817, when Mississippi qualified for statehood, and 1819, when Alabama hemmed her patchwork of undivided counties and numerous Indian land grants and joined her older sister as a member of the Union. The old Federal Road crossed the Alabama River at John Weatherford's ferry (Ft. Claiborne), thus connecting Milledgeville and St. Stephens, respectively the capitals of the State of Georgia and the Territory of Alabama.

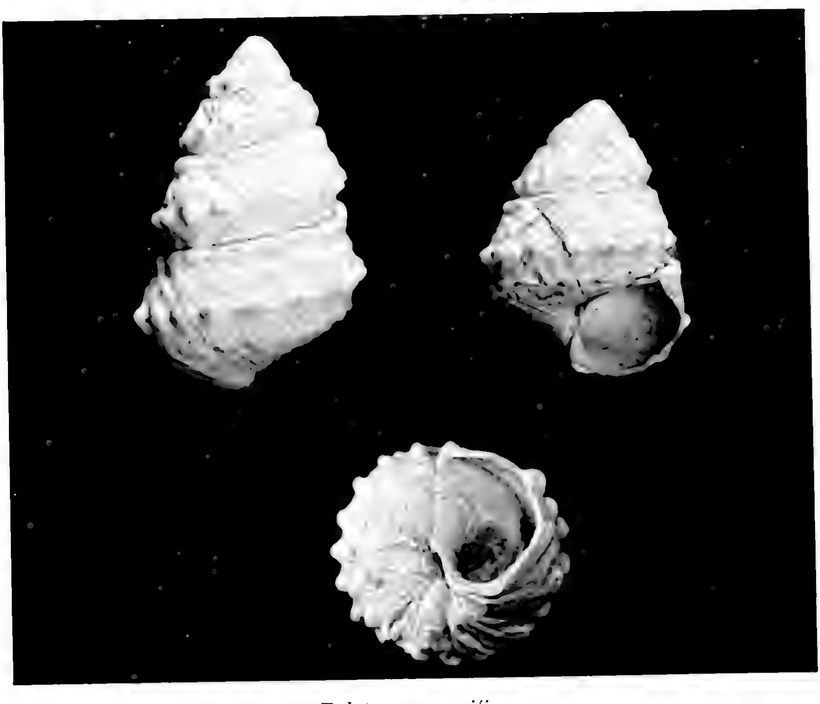
So in 1819, soon after the admission of Alabama to statehood, the distinguished Senator from Georgia moved himself and all his worldly goods to Claiborne, entering for himself near Claiborne in a great bend of the Alabama River a plot of many acres, not far from the "Dry Forks" plantation of his son, in Wilcox County.

But men of Tait's calibre are not easily absorbed by the material interests of a remote and undeveloped country. No sooner had the constitutional convention, which met at Huntsville, definitely located the first capital at Cahawba[6] than President Monroe appointed him the first Federal Judge of the State. Until 1826, when he resigned his office to look after the interests of his plantation, Judge Tait maintained an official residence in the rapidly growing metropolis of Claiborne.

6 Cahawba, at the time, was merely a selected "site". Within a few months over fields of cotton, rose a city of great promise and importance, but one destined to sink into oblivion within the short period of sixty years. In 1830 Cahawba's real estate could not have been bought for fifteen million dollars; but in 1894 one of the last surviving examples of antebellum architecture, the famous Perine mansion, costing one hundred thousand dollars, was torn down and its bricks were used to build a negro school. At that time the estate of Captain "Cliff" Kirkpatrick, exceeding twelve hundred acres, included all that was once a city of culture and the seat of government. See "A Forgotten Capital" in *Illustrated American*, March 7, 1896.



Ostrea sellæformis
Claiborne, Alabama



Tulotoma magnifica
Specimens photographed from shell heaps near old Fort Williams, Coosa River, Ala.
Photos by O. B. Schenk

In his new environment Judge Tait did more than serve the stream of immigrants that passed through this gateway to their homestead claims; he contributed largely to the cultural and scientific development of his day. Social affairs and political activities, which gave his town prestige, were of minor concern to him. Even his plantation, which demanded constant attention, did not prevent his giving expression to a desire to see something of the world beyond the pioneer's horizon; for in 1832 he made a six-months' tour of the (then) western states, on which he was accompanied by his family.

Judge Tait had come from a cultural environment, and he ran true to form in his new frontier situation. In his library were books on geology, ornithology, natural history and science, biography, history, and other subjects. Many of these books were ordered through the firm of Carey, Lea and Co., of Philadelphia. Tait had taught school in Georgia. Previous to that, he had been a member of the faculty of Cokesbury College, in Baltimore, Maryland, the first Methodist college in America. He had, at Claiborne, college-bred men for his neighbors, his own son being a graduate of Harvard University. He kept up a correspondence with John C. Calhoun throughout life. Henry Clay was his first cousin. His political career was so clean and his ability so respected, that in 1828 President Adams offered him the post of Minister to the Court of St. James, an honor which he declined.

CLAIBORNE: ITS PROMINENCE IN ALABAMA HISTORY

At the time, then, that our story begins, six years after Judge Tait had retired to private life, Claiborne had become one of the most important towns of the State. It had a population at one time estimated to be no less than twenty-five hundred, though this figure probably included a number of Monroe County residents identified with its business and social interests. In the year 1819 Judge Thomas Stocks, after a visit to Claiborne, stated that only one other town in the State had a larger population. Mr. Justus Wyman, who was a merchant's clerk in Claiborne in the same year, kept a rather careful and explicit diary,[7] in which he

[7] Published with editorial notes, in *Publications of the Alabama Historical Society*, Vol. III, pp. 107-127, pages quoted, 110, 115, 117.

says:

> The census of Sept. 1818 [showed that the population of the State] was rising of 60,000 including slaves and free people of color. (This census was necessary to ascertain whether Alabama could meet the population prerequisite for statehood, which was 60,000; or under certain conditions might be less than that number.)*
>
> Mobile [he continues], is the oldest town in Alabama, and amongst the first settled by the French in the Louisiana territory . . . The whole number of inhabitants at the present time (March 1819) may be estimated at nearly 2,000. . . .
>
> Fort Claiborne . . . stands on a high bluff of land called the Alabama Heights, about 180 feet above the level of the river. The first settlement commenced in this town toward the close of the year 1816; since that time it has increased with a rapidity scarcely paralleled. The whole number of inhabitants which one year ago did not exceed 800, is now rising of 2,000.

Among the builders of "Claiborne Town" was the Hon. James Dellet, a brilliant young lawyer, born in Philadelphia and of Irish ancestry, whose palatial home, designed by a Connecticut Yankee, replaced in 1835 the so-called "mansion" which he had first erected. But it was not in Dellet's house that the citizens of Claiborne and Monroe County held the reception for General LaFayette who honored their "city" by a visit on April 5, 1825. Judge Tait was on the reception committee but Dellet was master of ceremonies. August Levasseur,[8] the distinguished Frenchman's chronicler, remembered well the eloquence of the lawyer and the social superiority of the wilderness village, though he forgot that LaFayette dedicated the new Masonic Lodge — the third established in the State — speaking from a stand built for the occasion. Perhaps Levasseur was not a Mason. We, too, may wonder, if we stop to think about it, that a community that

* See Peters *Public Statutes at Large of the U. S. of Amer.*, 1: 53, f.n. Art. 5, 1845.

8 Levasseur *Lafayette in America*, Vol. II, p. 85, 1829. An elaborate program, including a grand ball in the evening, had been planned, but the steamer had been much delayed and LaFayette was compelled to shorten his stay in Claiborne in order to meet his engagements in Mobile and New Orleans. Levasseur says: "From Cahawba we descended the river to Claiborne, a small fort on the Alabama. The general was induced by the entreaties of the inhabitants to remain a few hours which were passed in the midst of the most touching demonstrations of friendship. M. Dellet, who had been appointed by his fellow citizens to express their sentiments, acquitted himself with an eloquence we were astonished to meet in a spot, which, but a short time before, only resounded with the savage cry of the Indian hunter."

Charles Tait
1768—1835

had not yet effaced the lines of its wilderness character could produce so many citizens superior to its natural advantages. Befor Claiborne was twenty-five years old, it had furnished three of the ten Governors who in that length of time had been called to serve the interests of the State.

Judge Tait had something to do with the election of two of these Governors; for John Murphy was his neighbor and friend, and John Gayle was married in Claiborne, though he had a home elsewhere in the County. John Murphy and John Gayle were both classmates of James Dellet in South Carolina College, James ranking above both of the Johns in scholarship. Murphy, the fourth Governor of the State, was elected in 1825, and re-elected in 1827; Gayle, the seventh Governor, was elected in 1831. It was during Gayle's administration that the first railroad in the State — forty-six miles long, connecting Tuscumbia and Decatur — was completed, and the *second* cotton mill[9] was erected, this being in Madison County. Arthur P. Bagby, the tenth Governor of the State (1837-41), came to Claiborne in 1819, and was, like Tait, a lawyer and a native of Louisa County, Virginia.

But while younger men were setting their caps for political recognition, or cultivating their social and commercial opportunities, the real statesman among them was delving into the mysterious beds of shells which an impatient river had uncovered in the bluff on which the fort and town had been built. Here were records of events of which the aborigines had no traditions, and which would be of the least concern to the settlers, young or old. Geologic agencies that had elevated these great marine deposits had been considerate, for the sands were not solidified nor were all the fossils comminuted. Apparently they were piled up on the floors of ancient estuaries and bays, long afterwards

[9] The old Bell Cotton Mill, built in 1832, and situated in the three forks of Flint River, in Madison County, is still standing, and some of its machinery is yet in place. The *first* cotton mill in the State, known as Haughton's Mills, was built in 1818 and 1819, and was located *near* the three forks of Flint. On August 30, 1819, it had "in complete operation two large double throstles with preparations, which are making thread of a superior quality." Justus Wyman's *Diary*, in *Proceedings Alabama Historical Society*, Vol. III, p. 126, 1899. Notes by Thomas McAdory Owen.

to be lifted up by forces that had a million years at their disposal.

No wonder that the Judge with his fascination for scientific study occupied himself in sifting out from this quarry shells, corals, and bones — fossils which no scientist had ever named or even seen. The *strange* fact is that it was not until 1829 that he brought to the notice of his friends in the Philadelphia Academy of Sciences the nature of his discovery. The *stranger* fact is that Dr. Isaac Lea, ever keen for opportunities to multiply by name the population of molluscan families, should have let the precious fossils in that first box — to say nothing of the yearly quotas that he professed to have received from Judge Tait — lie untouched and nameless on his table! To be sure he was pretty well occupied with the parcels of fresh-water shells that kept coming in from various parts of the United States, and perhaps he forgot about the fossils in the midst of active preparations for a long absence abroad. But no sooner had he returned from Europe and awakened to the significance of Mr. Conrad's work in Alabama, than the situation bristled with possibilities. Willy-nilly, he became a competitor in a field which heretofore he had not entered.

It is fair to say, then, that to a distinguished jurist belongs the honor of discovering one of Nature's most richly furnished storerooms — a storeroom so packed with the remains of Eocene activities that though each successive student might add new facts to our knowledge of that early age, no one of them might presume to think that he had catalogued all its secrets.

On the trail blazed by these pioneer students of Tertiary formations came a troop of geologists and paleontologists, each of them finding some new point of interest or separating some new form of life from those already described. In 1846 came the great English geologist, Charles Lyell, whose profound and constantly increasing knowledge of European Tertiary deposits made necessary several revisions of his *Principles of Geology*. And in succeeding decades, even though Claiborne continued to lose its political and commercial leadership, it has never lost its charm

The Dellet "Mansion,"
Claiborne, Alabama

Photo by the Author, Nov. 11, 1932

for students of these primordial records, and never will. In the procession we can recognize the faces of Angelo Heilprin, R. P. Whitfield, Antoine De Gregorio, William M. Gabb, William B. Clark, Alexander Winchell, William H. Dall, Otto Meyer, Michael Tuomey, Gilbert D. Harris, and Eugene A. Smith; and spanning the earliest and latest periods of study is the work of that princely paleontologist, Dr. Truman H. Aldrich,[10] who visited Mr. Conrad in Philadelphia and who lived to see the centenary of his *Fossil Shells*, and who in the very year of which we speak, at the age of eighty-four, was still describing new species from the inexhaustible ferruginous sands of Claiborne.

[10]Dr. Aldrich died in Birmingham, Alabama, on April 28, 1932. As an interesting sidelight to this story, it may be mentioned that "Colonel" Aldrich, as he was familiarly called, was the grandson of Colonel Samuel Augustus Barker, whom Washington appointed Aide-de-camp and Interpreter to General LaFayette. When LaFayette made his triumphal tour through the Atlantic States in 1824 and 1825, Colonel Barker was still living; and the General, who had his first lessons in English under him, composed the following acrostic in his honor:

S *age of the East! Where wisdom rears her head,*
A *ugustus, taught in virtue's path to tread,*
M *id thousands of his race elected stands,*
U *nanimous to legislative bands;*
E *ndowed with every art to frame just laws,*
L *earns to hate vice, to virtue gives applause.*

A *ugustus, Oh, thy name that's ever dear*
U *nrivaled stands to crown each passing year!*
G *reat are the virtues that exalt thy mind,*
U *nenvied merit marks thy worth refined.*
S *incerely rigid for your country's right,*
T *o save her liberty you deigned to fight;*
U *ndaunted courage graced your manly brow,*
S *ecured such honors as the gods endow.*

B *right is the page, the record of thy days*
A *ttracts my muse to rehearse thy praise,*
R *ejoice then, patriots, statesmen, all rejoice!*
K *indle his praise with one general voice!*
E *mblazon out his deeds, his virtues prize,*
R *eiterate his praises to the skies.*

P. S. The Colonel will readily apologize for the inaccuracies of an unskillful muse and be convinced the high estimation of his amiable character could alone actuate the author of the foregoing.

M. DE LAFAYETTE

Hall and Stairway, Dellet House
Claiborne, Alabama

Photo by the Author, June, 1932

PART TWO

EIGHTEEN THIRTY-THREE

Upper: Masonic Lodge, Perdue Hill, Ala. Removed from Claiborne, in 1884.
Photo by the Author, June, 1932

Lower: Old Warehouse at the top of the Bluff, Claiborne, Ala.
Photo by Q. B. Schenk, Nov. 11, 1932

PART II

EIGHTEEN THIRTY-THREE

EXIT — THE ALABAMAS; ENTER — THE CONRADS

Recent evidence points to the fact that the word *Alabama,* perpetuating the name of the Alabamas, an alien tribe of Indians absorbed by the Lower Creek Confederacy, does not mean, as is commonly supposed, *Here we rest.* There was no rest for the Alabamas after the coming of DeSoto in 1513, and there was no rest for the Spaniards when they crossed the territory of the great Black Warrior, Tuskaloosa, whose capital is supposed to have been on the site of the present Mobile, and at one time claimed by the Alabamas.

In the language of the Alabamas the word *Alabehe-amo* means literally *The people that gather mulberries,* and from this combination the name Alabama is derived[11]. The hereditary home of the Alabamas was between the Coosa and the Tallapoosa Rivers, and along the course of the Alabama River below the junction of its tributaries. Mulberry Creek and Mulberry River appear on the Tanner map in the very heart of their holdings. The distinctive festival of the tribe was timed to the ripening of the mulberries, which were the first of their native fruits. Tradition has it that these people planted mulberry trees in their villages, and that Milfort, their aged chief at the time the French evacuated the country on its acquisition by the English in 1763, made the journey to Mobile in a canoe constructed of mulberry wood.

Just eighty years before the treaty of 1763, which gave Alabama to the English, there emigrated from Crefeld, Germany, to Germantown, Pennsylvania, a certain Thones Kunders, one of the thirteen founders of the city, which historic site is now within the city limits of Philadelphia. The Kunders house, the walls of which until recently were still standing at 5109 Main Street, is

[11]Dabney White, *The Last of the Alabamas,* Arrow Points, Vol. 19:27-31, March 1932.

the only house that can be positively identified as one of the dwellings built by these original thirteen families. Thones Kunders was an ancestor of Sir Samuel Cunard, the founder of the Cunard Steamship Line, whose branch of the family, because of its royalist sympathies, emigrated to Nova Scotia during the American Revolution.

The first Society of Friends organized in America met in the home of Thones Kunders; and more than a century later his great great grandson, Solomon White Conrad (1779-1831), the father of Timothy Abbott Conrad, was for a time the minister of the congregation. During Thones Kunders' lifetime, in 1690, the first paper mill in America was built in Germantown; and more than a century later Solomon White Conrad was identified with the printing business, being the founder of the publishing firm of Conrad and Roberts. Solomon Conrad kept open house for a group of friends whose common interest was the study of natural history, Thomas Say and Lardner Vanuxem being regular visitors. In 1829 he was elected Professor of Botany* in the University of Pennsylvania. His salutatory address moved his audience by its comprehensive erudition and charming eloquence. No wonder, then, that his oldest son, Timothy Abbott, who was born at his maternal grandmother's home near Trenton, New Jersey, on June 21, 1803, inherited such a passion for science that as a boy he was president of a juvenile scientific society.

In his childhood Timothy attended private schools, but neither he nor any of his nine brothers and sisters seem to have secured a college education. Timothy took readily to languages and made himself familiar with Latin, Greek, and French. He and one of his sisters, Susan, had a remarkable talent for drawing, but it is not known whether either of them enjoyed the advantage of a teacher. In his father's printing shop Timothy learned to set type and mastered the art of engraving on stone. It has been impossible to verify the statement made by his nephew, Dr.

* *Corema Conradi*, a rare plant of the New Jersey pine-barrens, and *Conradiana canescens* which grows along the Gulf coast, were named for him. (R.M.H.)

TRUMAN HEMINWAY ALDRICH
1848-1932

THE HOUSE OF THONES KUNDERS
Germantown, Pennsylvania

Photo taken about 1904

Charles C. Abbott, that Timothy made the drawings of shells and other marine forms which appear on some of the plates in Audubon's *Birds of America.*

Just seventy years after the treaty of 1763, or exactly a century and a half from the emigration of his great great grandfather from Germany, Timothy rode or walked across the ancient holdings of the Alabamas, execrating the roads which were often prohibitive even for a stagecoach. But the young shell collector did not plunge into the wilderness to compile the traditions of the Indians; he was in search of records antedating the oldest of aboriginal traditions, records of the earth before it was fit for human habitation.

The prospect for field work was far more congenial to young Timothy than was that of managing the printing shop upon his father's death in 1831. He lacked the faculty for administrative work and had little taste for commercial responsibilities. He was by nature and inclination a scientist. All that he lacked was collegiate training and the rigid discipline of a teacher, like Louis Agassiz.

Conrad's urge for the out-of-doors was responsibile for his expulsion from the Church. When he was a boy, a committee of Friends called upon him to remonstrate against his frequent Sunday walks and his non-attendance at Church. Failing to secure his promise that he would no longer violate the sanctity of the Sabbath in the way he had been doing, these guardians of human conscience dropped his name from the Church roll. The devout Naturalist never sought reinstatement in the Society. To this early humiliation may be traced the genesis of his solitary disposition as well as his cynical attitude of life and his detestation of dogmatism in any form. Ignorant and foolish prejudice against scientific investigation often felt the keen edge of his pen.

The first number of his *Fossil Shells,* which appeared on October 1, 1832, called the attention of geologists to the importance of developing serious work on the Tertiary formations of North America. The second number of this work, published in December of the same year, announced Mr. Conrad's intention of visiting localities in the South, which, up to this time, had been but superficially examined[12].

To outfit this expedition—Conrad had no resources of his own, not even a field worker's salary—subscriptions were solicited among the members of the Academy. Conrad seems to have considered these subscriptions as loans which were to be repaid by collections of fossils secured on the trip. He expected to cover the cost of his publications by the sale of earlier numbers, and by the sale of a number of sets of Claiborne fossils at $15 a set, this item being duly advertised on one of the covers of his *Fossil Shells.* But from these prospects little seems to have been realized.

THE LONG ROAD TO A PALEONTOLOGICAL PARADISE

In December, 1832, Conrad was on the high seas in a full-rigged schooner, bound for the Carolina coast. He wrote to Dr. Samuel G. Morton on shipboard, but since the rats ate up the letter in the night neither the Doctor nor we will ever know in what ecstacies or complaints the poetic paleontologist indulged. When the vessel hugged the shore in eight fathoms of water, the eager collector was dredging for shells, even though the weather was extremely cold. These marine forms were rare enough in the Atlantic, but abundant in the mouth of Cape Fear River.

Conrad's port was Wilmington, North Carolina, a city which so disappointed his expectation that the few specimens he collected there did not compensate for his disgust. From here he embarked in a steamer for Smithville, North Carolina, which he described as "a pleasant little village, on a sand bank, but destitute of interest". However, he posted a letter to Dr. Morton there before he turned his attention to collecting. He says (1834):

> Tired of so unproductive a field, I entered the stage for Georgetown, (S.C.), and was put down at a house within audience of the Atlantic, from whence, for a distance of twelve miles, the stage road lies upon the sand of the sea-shore where the ruts are daily obliterated by the tide and the wind-driven sand. This

[12]This announcement also stated his purpose to complete the work begun, which was to extend through twelve numbers, to be illustrated with a hundred plates, and to describe upwards to three hundred species of fossils. Conrad must have been familiar enough with the prospects which the strata at Claiborne offered to make such an assertion. It was probably based on the collections made by Dr. Gates, as well as on the information that Judge Tait had furnished to his Philadelphia correspondents.

HISTORIC BEECH ON CROSSWICKS CREEK
Abbottville, New Jersey

distance I determined to traverse on foot, and accordingly started early in the morning with bag and box to store away such marine productions as I might pick up while passing along the shell-paved beach. The day was warm, and an easterly wind brought in a mist from the ocean, as drenching as a shower of rain.

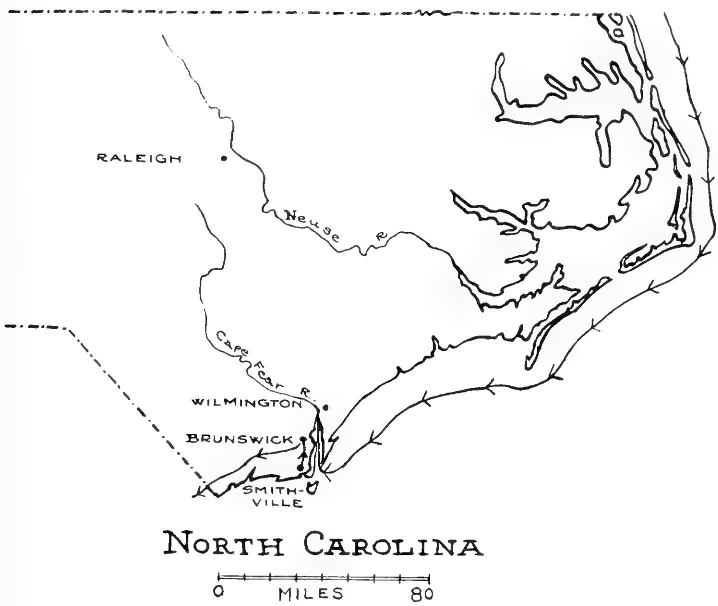


Figure 1. Conrad's route through North Carolina, 1832

Conrad's account of his experience in this region is both spontaneous and picturesque :

The sea beach of the Carolina coast which I have alluded to, is described by Bartram in his usual graphic style. With the first signs of a road which led off from it I proceeded through the forest, hardly expecting that so obscure a path should lead to a habitation of man; but a cabin at length was found where from one of its pallid inmates I procured a vague direction to the nearest inn, which I was never destined to find. Indeed, it would require the clue of Ariadne to direct one through the labyrinths of this sterile uniformity of scene. The pedestrian, who traverses the low sandy region of the seaboard, meets with few objects of interest sufficient to reward his toil. If, when tired of wandering through the deep sand, he strikes into the woods, he will find the brown slippery pine leaves an indifferent exchange for the highway. This most uninteresting country, however, enjoys a winter climate as lovely as a northern October, when the air is unvexed by storms. The pine forest is here and there varied in the low, moist, richer portions of soil, by a growth of oak, hickory, and a variety of less conspicuous trees, nearly everyone of which wears a beard of Spanish moss which a Turk might envy, and on almost every limb, stripped of its panoply of leaves, the mistletoe, as if in

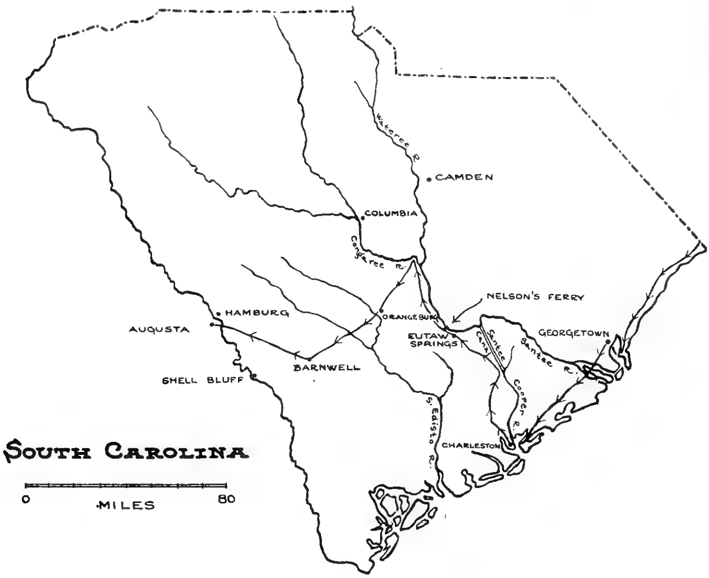


Figure 2. Conrad's route through South Carolina, 1833

pity, hangs its emerald and perennial mantle. The swamps resound with the singular cry of the ivory-billed wood-pecker, and the pileated wood-peckers, with their crimson crests flashing like meteors, are seen chasing each other in frolic pastime around the grey trunk of the dismantled tree . . .

As a specimen of the kind of traveling which a passenger in the mail line may sometimes enjoy, I will here observe, that I was one day doomed to ride in a ricketty jig, one shaft of which had been broken, but was lashed together by a piece of rope; the horse was stone blind, and the road newly cut through the woods, elegantly veined with roots, and ragged with the charred stumps of trees. 'Well,' observed the driver, who was a perfect Jehu in his profession, 'we will try to clear the trees, but I cannot answer for the stumps.' Away we started in a zigzag course, now bolting directly toward a tree on the side of the road, then a jerk of the reins, shooting us over to its opposite neighbor; a Scylla and Charybdis navigation; how we escaped the stumps it is in vain to inquire, but in this manner we safely reached the ferry, where a boat was in waiting to convey us to Georgetown, a village situated

VOL. 1. **NO. 1.**

FOSSIL SHELLS

OF

THE TERTIARY FORMATIONS

OF

NORTH AMERICA,

ILLUSTRATED BY FIGURES DRAWN ON STONE, FROM NATURE.

BY T. A. CONRAD,
Member of the Acad. Nat. Sc. of Philada.

CONTENTS.

PHILADELPHIA:
Sold by JUDAH DOBSON, No. 108, Chestnut St.
October 1, 1832.

Cover of *Fossil Shells of the Tertiary Formations*, Vol. I, No. 1

among extensive rice farms which border the tide waters of Pedee river, and generate miasmata sufficient to kill the roses on the cheek of childhood, and to give the poor girls that aspect of disease which ought only to accompany the decline of age, for it is chilling to mark so dark a cloud in the bright heaven of youthful enjoyments[13].

From Georgetown, Conrad evidently followed the road down the Carolina coast to Charleston. He must, then, have turned

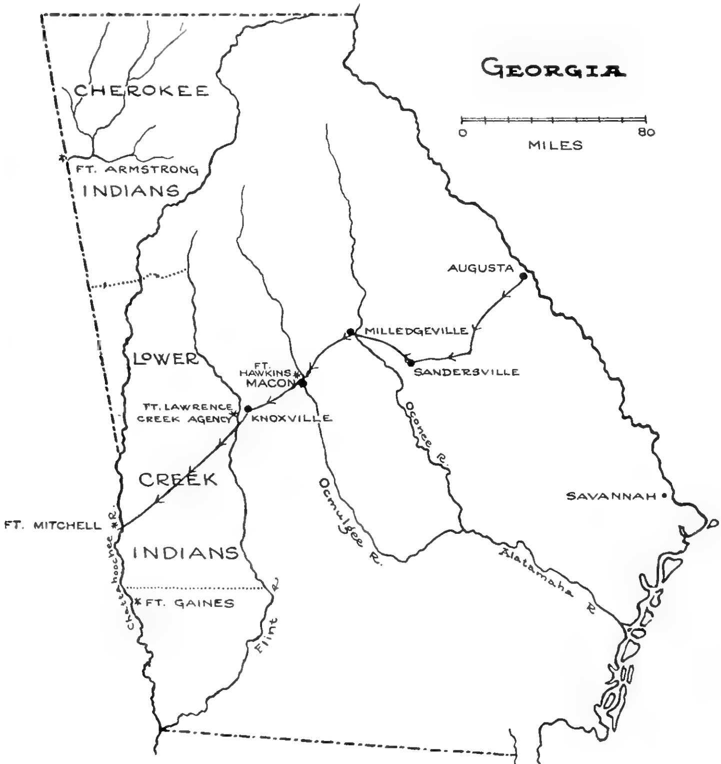


Figure 3. Conrad's route through Georgia, 1833

inland, for Dr. Morton wrote:

Mr. Conrad has also discovered an extensive basin of the calcare-

[13] *Advocate of Science and Annals of Natural History*, Vol. 1:158-162, 1834.

ous deposits between Charleston and Eutaw Springs, in South Carolina[14].

Here we would lose sight of the unhappy traveler were it not for a letter, dated March 3, 1833, which Conrad addressed to Dr. Morton soon after he reached Claiborne. In this letter he says that he had spent almost the whole of February near the Santee Canal in South Carolina[15]. After counting his money and finding that he did not have enough to buy a horse and to meet other necessary expenses, he gave up his proposed "jaunt through the lower part of Georgia," which he believed to be "rich in organic remains":

> Consequently, [he says] I have hurried to Alabama by the stage route to Montgomery, sometimes on foot, and at other times on the stage; but of all roads in the Union, this interests me least; and is tantalizing because it runs through a primitive country but a few miles north of a *terra incognita* of Secondary and Tertiary formations; but I must husband my slender resources, and I hope at least to make (the) shells of Alabama defray whatever expenses I may incur.

He was successful in collecting Unios from the Savannah River at Augusta, Georgia, getting specimens that the muskrats had dragged up on the banks; but he was not successful in his efforts to collect from the Chattahoochee, at Columbus, as the river was rising.

> I travelled along on foot, [he says] thro' the Indian nation, and indeed I travelled from Knoxville in Georgia to Mon gomery, Alabama, over roads so horrible that they are obliged to run a common wagon in place of the stage, and charge you ten cents a mile for the privilege of jolting you to death, and burying you in the mud.

Somewhere along the way Conrad lost his dredge, and his resources dwindled to $30.00. Writing to Dr. Morton he revealed his predicament:

> Dr. B. Smith offered to supply me if I was in want of money, and if he would send me 25 dols. and Mr. Lea and Mr. Poulson the

14Amer. Jour. Sci., Vol. 24: 132, 1833.

15The accompanying map undertakes to trace as definitely as possible the route that Conrad took and the places that he visited. The facts have been gathered from various articles, a study of travel possibilities as shown on the maps of that day, and especially from letters which have recently come to light.

ISSAC LEA
1792—1886

Engraved by H. W. Smith, 1860

> same, I would guarantee each a collection of shells . . more than double the amount to each.

Since Sandersville was on his route from Augusta to Milledgeville, and he later described shells from there, we may presume that Conrad collected there in the headwaters of the near-by streams. We know that he collected successively in the Oconee, Ocmulgee, and Flint Rivers. Several times in his writings he mentioned Milledgeville, the capital of Georgia, and collecting in the Oconee River. In *New Fresh Water Shells* Conrad commented on the fact that the Ocmulgee, which he crossed at Macon, west of Milledgeville, was the last of the rivers flowing into the Atlantic, and that Flint River, thirty miles farther west. was the first flowing into the Gulf. He further explained that he found, as one would expect, that the molluscan fauna of the two systems was very different.

At Montgomery, Alabama, Conrad took the steamboat for Claiborne, passing Cahawba in the night. The next day, when the boat stopped at Prairie Bluff to load cotton, he seized the opportunity to gather what fossils he could from the Secondary (Cretaceous) formations there. He was thrilled to find that some of them were evidently new.

> I passed in the night to C(laiborne), where I am now in the hospitable mansion of my revered friend, Judge Tait. He took me by the hand in the kindest manner; said I must consider his house my home, and tells me I cannot do justice to Alabama if I do not remain with him *one or two years,* and Mrs. Tait says the same.

HAPPY DAYS WITH HOSPITABLE FRIENDS AND TERTIARY FOSSILS

It may be well here to note how cordially Mr. Conrad was held in Dr. Lea's estimation at this time, and how graciously he was recommended to Judge Tait. We quote from Lea's letter to the Judge dated January 17, 1833:

> I addressed a few hasty lines to you some weeks since by my friend Mr. Conrad who visits the Southern States with an intention of examining their natural products and their geological formations. He is anyway entitled to your kind attention as an ardent student of nature, & I feel assured you will do anything in your power to promote his views.

There is extant a letter from Judge Tait to Dr. Morton, dated October 16, 1832, which is quite appropos:

> It gives me pleasure . . to learn that my correspondence with

> Mr. I. Lea has attracted the attention of the Academy to this portion of the country. If, in the course of events *an agent of the Academy should be sent to this region for the purpose of geological investigation*, or researches of any kind connected with the objects of your Institution—I shall feel it a duty, as well as a pleasure, to afford him any facility in my power, in forwarding his views. To such a one I tender a home in my house as long as he may think it proper to use it as such.

When Judge Tait informed Dr. Lea on March 12 of Mr. Conrad's arrival, Dr. Lea replied on April 29:

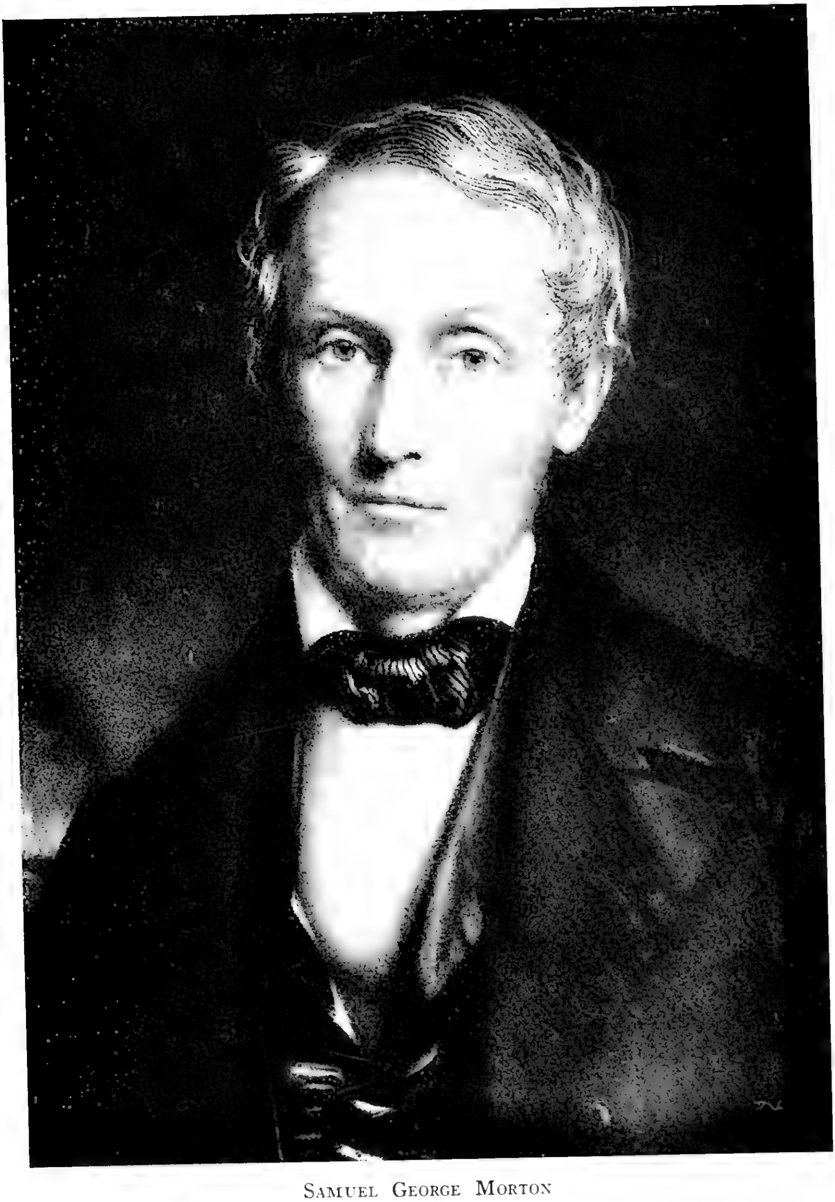
> I am glad our friend Mr. Conrad has arrived safely under your hospitable roof. Your kind attentions to him will ever I am sure be appreciated by him and you have the thanks of the friends of Science here for your constant and active endeavors to promote the knowledge of Nat. Hist. of the State you reside in.
>
> Dr. Morton having communicated to me the desire of Mr. C. to remain longer in the South, made a proposal to me to advance him money. I am desirous of placing $50.00 in his hands & have to beg of you the favor if *entirely* & *perfectly* convenient to do so for me . . .
>
> I am sincerely rejoiced that you have in Mr. Conrad an intelligent geologist who will do the geology of the State justice in whatever he may publish respecting it—He will be able from personal examination of the deposits to do the matter far better than I could. . . As my object has and ever will be, I hope, the promotion of truth I must willingly yield to Mr. C. who has studied the deposits much more perfectly than I have done.

In the same letter he expresses great solicitude for his friend in connection with his work in collecting the molluscan faunas of Southern rivers:

> Mr. C. must not, however, expose himself too much. His health is of the first importance to him & his friends would indeed regret that imprudent exposure should deprive Science of that advantage which his labour will produce.

After a few weeks in Judge Tait's hospitable home, happily at work on the bluff, which did not disappoint his expectations, Conrad improved rapidly in health. The frail young man, who had scruples about eating meat, was now feasting on fried chicken, corn muffins, hot biscuits, and buttermilk. Mrs. Tait was ever solicitous about his health, and for her Conrad cherished the affection of a son. Daily he and the Judge drank each other's health in a bumper of rare Madeira.

Ever and anon, in prose or poetry, and in his letters to friends, Conrad's enthusiasm for his new home leaped forth in classic garmenture, discolored only by his physical ailments or subdued by the torture of an unreplenished pocketbook.



Samuel George Morton
1799—1851

Engraved by Buttre, 1877

> You see, [he wrote to Dr. Morton] I have stumbled on the land of promise, a perfect Eldorado of fossils; where I shall collect with as much enthusiasm as Proserpine the flowers of Erna; if the cholera or fever does not gather me to my fathers as 'gloomy Dis' bore off the unhappy maid.

His paleontological work was interrupted long enough at least to compose this hitherto unpublished poem on Claiborne, which was found in a letter to Dr. Morton, dated April 20, 1833.

CLAIBORNE

Sweet clime where summer blossoms ever swell,
Or seldom languish when the north wind sighs,
Here hearts as warm as in thy summer dwell,
Pure as thine air and cloudless as thy skies.

Home of the pilgrim who has sought in vain,
Hygeia in our icy hills erstwhile
She have I met upon thy sunny plain,
And woed and won at least a transient smile.

That smile hath served to light the beacon fire
On Hope's eternal altar in the breast;
Like those bright vesper hues when storms expire,
Prophetic of a morrow calm and blest.

Claiborne! 'tis here that Hope has winged the hours,
She and her sister health, celestial maids !
Long shall my fancy seek thy dewey bowers,
Or haunt with friends thy woodland colonades.

'Tis there the mock-bird pours his varied song;
Thy sylvan love the fairy Orpheus learns;
Emblem of youth ! no note can charm him long,
'Tis sad or merry, soft or wild, by turns.

Thine air is more than Gilead's balm to me
At dewey morn or sapphire tinctured ever,
Thy cliffs are clothed with many a gorgeous tree,
Tempering the hot breath of thy Summer heaven.

Sweet village 'tis to thee a wanderer owes
Friends, who respect a pilgrim to that shrine
Which over earth new life and beauty throws,
And gilds the rugged chambers of the mind!

Thou great magician Science, who cannot tell
The love of other worlds, thy wand advance,
And lo ! in earth what mute historians dwell,
That give to Truth the halo of Romance.

Cuvier, like Prospero, hath peopled earth
With forms restored from ages which have been

A populous world, ere human joys had birth,
Ere lovely woman came to light the scene!

'Tis such enchantment hallows all thy bowers,
And thy wild cliffs, a paradise to me,
And long shall Memory treasure up those hours,
When young Hygeia smiled, and I could joyous be.

Even after he had returned to Philadelphia, Conrad's enthusiasm for the scene of his recent labors found expression in an article entitled *Claiborne*, published in the *Advocate of Science and Annals of Natural History*[16]. This is his description of the ascent from the ferry landing by the Federal road to the village:

> To the student of natural science, or to the lover in general of the glories of external nature, I know few places that can offer so many attractions as the village of Claiborne . . . From the landing place on the river you ascend by a winding road, having a wall of rocks on your left, and on your right a profound ravine, where in spring you may gaze down upon a wilderness of blossoms which decorate the humble plants, the more conspicuous shrubbery, or the giant trees. . . The umbrella tree here waves its enormous leaves, and expands its gigantic blossoms; the *Magnolia grandiflora* spreads over its humbler relative a dark and glossy canopy of perennial foliage. As you reach the summit of the hill, you remark that it is fringed with low pines, many of which seem to spring from the solid rock, and to 'twine their roots in perpendicular places'. Fragments of various strata skirt the margin of the river, and above, several springs gush from the surfaces of the calcareous rock, in which they carve their smooth and winding channels, and leap over the intervening chasm.

It is interesting to place here for comparison the description given by Sir Charles Lyell of the precipitous ascent at the steamboat landing at Claiborne, which is about a quarter of a mile down the river from the ferry landing.

> In the course of the night we were informed that the Amaranth had reached Claiborne. Here we found a flight of wooden steps, like a ladder, leading up the nearly perpendicular bluff, which was 150 feet high. By the side of these steps was a framework of wood, forming the inclined plane down which the cotton bales were lowered by ropes. Captain Bragdon politely gave his arm to my wife, and two negroes proceded us with blazing torches of pine-wood, throwing their light on the bright shining leaves of several splendid magnolias which covered the steep. We were followed by a long line of negroes each carrying some article of

[16]Vol. I, No. 1, p. 26, August 1834.

Thomas Say
1787—1834

From a Woodcut by Longacre and Herring, 1839 our baggage. Having ascended the steps[17], we came to a fine terrace, covered with grass, the first green sward we had seen for many weeks, and found there a small, quiet inn, where we resolved to spend some days, to make a full collection of the fossil shells, so well known to geologists as abounding in the strata of this cliff. About 400 species, belonging to the Eocene formation, derived from this classic ground, have been already named[18].

Lyell's description of a glorious Alabama sunset on a balmy *winter* day also deserves our appreciation:

At this season, January 29th, the thermometer stood at 80 degrees Fahrenheit in the shade, and the air was as balmy as on an English summer day. The green sward was covered with an elegant flower, the Houstonia serpyllifolia, different from H. cerulea, so common in New England meadows . . . In the evening we enjoyed a sight of one of those glorious sunsets, the beauty of which in these latitudes is so striking, when the sky and clouds are lighted up with streaks of brilliant red, yellow, and green, which, if a painter should represent faithfully, might seem so exaggerated and gaudy as would the colours of an American forest in autumn, compared with European woods[19].

MOBILE, ST. STEPHENS, ERIE

During the third week in April, 1833, Conrad made his first trip to Mobile, taking advantage of the fact that Judge Tait was going along. They attended first of all to the shipping of boxes of fossils to Philadelphia. At least one of these boxes was intended for Dr. Lea—the one that Conrad collected at such risk to himself and his negro helper as described farther on. Judge Tait introduced Conrad to Col. Walton, of Pensacola, with the result that he received an invitation to explore several Florida localities recommended to him, among which were Santa Rosa Island, St. Marks, and Key West.

Conrad also met at this time Mr. John B. Toulmin, a wealthy Mobile cotton broker, who probably entertained both the Judge and the shell collector. Ever afterwards Toulmin's home was Conrad's whenever he was in Mobile. Through the influence of these two friends, Conrad was given passes on all the river steamboats owned by Captain Audley H. Gazzam and his brother, Charles W. Gazzam, an honor which he valued very highly.

[17]The number of these steps was 365; in 1908 the author counted them several times, and found that the number had not changed.

[18]Lyell, *A Second Visit to the United States*, 1849, vol. 2, p. 53. Lyell was mistaken in thinking that so many species had been named at the time of his visit, though there are probably more than that number now.

[19]*Ibid*, 55. What he took for *Houstonia serpyllifolia* is doubtless *H. rotundifolia* (R.M.H.)

> Mr. A. H. Gazzam, of Mobile, sent me a flattering letter, offering me, as a missionary in the cause of science, a free passage in his steamboats on the waters of the Alabama, a privilege which has never been extended for a similar purpose to an individual in any other State in the Union[20].

Dr. Lea insisted that he was entitled to the honor of perfecting this arrangement! Yet Conrad wrote to Judge Tait:

> You say truly, sir, that Mr. Gazzam deserves praise; the passport which he gave me is written in a style highly creditable to his understanding and his heart; he is a patriot of the noblest order, willing to sacrifice pecuniary profit to the advancement of his country's science; and I shall do justice when I return to Philadelphia to his enlightened and disinterested zeal. And in justice to Mr. Hazard, I shall not forget that he offered me a passage in the 'Tom'.

Conrad accepted an invitation to visit Mobile Point on the Gulf about the last of April. He went there on a tow boat, the matter being arranged by Mr. Toulmin. The Captain of the tug obligingly carried him all the way to the theatre of his operations and introduced him to the family of Dr. Roberts. He was sick all the time he was there, being unable to walk out on the beach more than a few times. In the absence of the doctor Mrs. Roberts gave him medicines, but she would accept no compensation for any of her services. He was greatly revived by the sea breezes on his return trip to Mobile, which was made in a revenue cutter, and attributed his recovery partly to the liberal consumption of oranges. He wrote to Judge Tait:

> If my ambitions were only equal to the opportunities I enjoy, Alabama would find a natural historian worthy to portray her interesting features and her inexhaustible stores of science.

Judge Tait left Mobile the day before Conrad got back, but Conrad informed him by letter that he had met Dr. Robert W. Withers (1798-1854) who resided in Erie and that he expected to go there as his guest, leaving the next night, May 7. To Dr. Morton, in a letter dated May 8, Conrad confessed that he hesitated because he had no tidings of his clothes. He waited until the latter part of the week before taking the steamboat for Erie, instructing Judge Tait to forward the expected box of clothes either to Mobile or to Erie. As a matter of fact it did not reach him until about the middle of August, after his return from the

[20]*New Fresh Water Shells of the United States*, p. 23.

long excursion to north Alabama. He was actually so shabby when he returned to Claiborne that Judge Tait was mortified at his appearance.

Concerning his plans for work Conrad wrote to Dr. Morton on May 8, as follows:

> I shall probably spend a month or two in traversing the Prairie Country, as Dr. W. has offered me a horse, a kind and opportune offer which will greatly facilitate my inquiries. I have become acquainted with a gentleman of Tuscaloosa, a relative of Mrs. Toulmin's, and this will be my passport in that vicinity. Time hangs very heavy on my hands here although I have everything I could ask for but employment; no residence could be more agreeable than Mr. Toulmin's.

Mr. Toulmin must have taken a keen interest in Conrad's work and he must have had great faith in his scientific ability; for he offered to send him to France, probably on one of the transports in which he was interested. Conrad wrote to Dr. Morton that he would have a "stateroom and every convenience", and begged him to see if he could not raise a hundred dollars, besides the fifty already promised. He assured the Academy that he would refund the loan in fossils yet to be collected, saying:

> You have my consent to take every unique and perfect fossil for the Academy . . . I'll go to Paris; for such an opportunity does not occur every day. The vessel will sail in December.

Alas! December found Conrad rounding up his collections in preparation for his return trip to Philadelphia, and nothing ever came of his dream of collecting in person the far-famed fossils of the *Calcaire Grossier* of the Paris Basin.

As we have seen, Dr. Withers and Mr. Conrad did not leave Mobile on May 7, as they had planned; but they seem to have left about the 11th of May. Mr. Toulmin had given him $25.00 toward "collecting fossils for the Academy, or at least I construed it thus". He got off the steamboat at St. Stephens and spent about three weeks in this region, sometimes the guest of a Mr. Gould, whose residence has not been located. So that it was about the first of June before Conrad finally reached Erie.

His experiences in the "prairie country" about Erie furnished rich and interesting revelations. His mischievous spirit seized on the wealth of his discoveries as a means of teasing his sedate superior in Philadelphia, but Dr. Morton later handled the matter seriously enough in his review of the Cretaceous deposits of North America. In a letter to Judge Tait, dated June 7, Conrad wrote:

> I am now satisfied that the whole region in Mississippi, thro' which the Tombeckbee flows is Morton's 'ferruginous sand'. I frequently hear of the fossils which prevail all over the prairie of the Choctaw country: I have the pleasure to inform you that the Erie Bluff is full of interesting remains, among which I found the *Pecten quinquecostatus,* (a magnificent specimen) a shell which in Europe characterizes more than any other fossil, the chalk formation; I have also found at Dr. Withers' two species of that rare and desirable genus, *Hammites,* hitherto only found in Alabama, and which is highly characteristic of the cretaceous strata; and I must not omit another genus equally important, and which is here found for the first time, *Inoceramus.*
>
> You see, dear sir, what brilliant discoveries I am making and how I shall dazzle the eyes of Dr. Morton; indeed I don't think it prudent to let this great light of knowledge dawn on him too suddenly, for fear it might injure his mortal eye, but I tell him only half the truth at a time, and thus fit him for a more sober and rational enjoyment of the whole.

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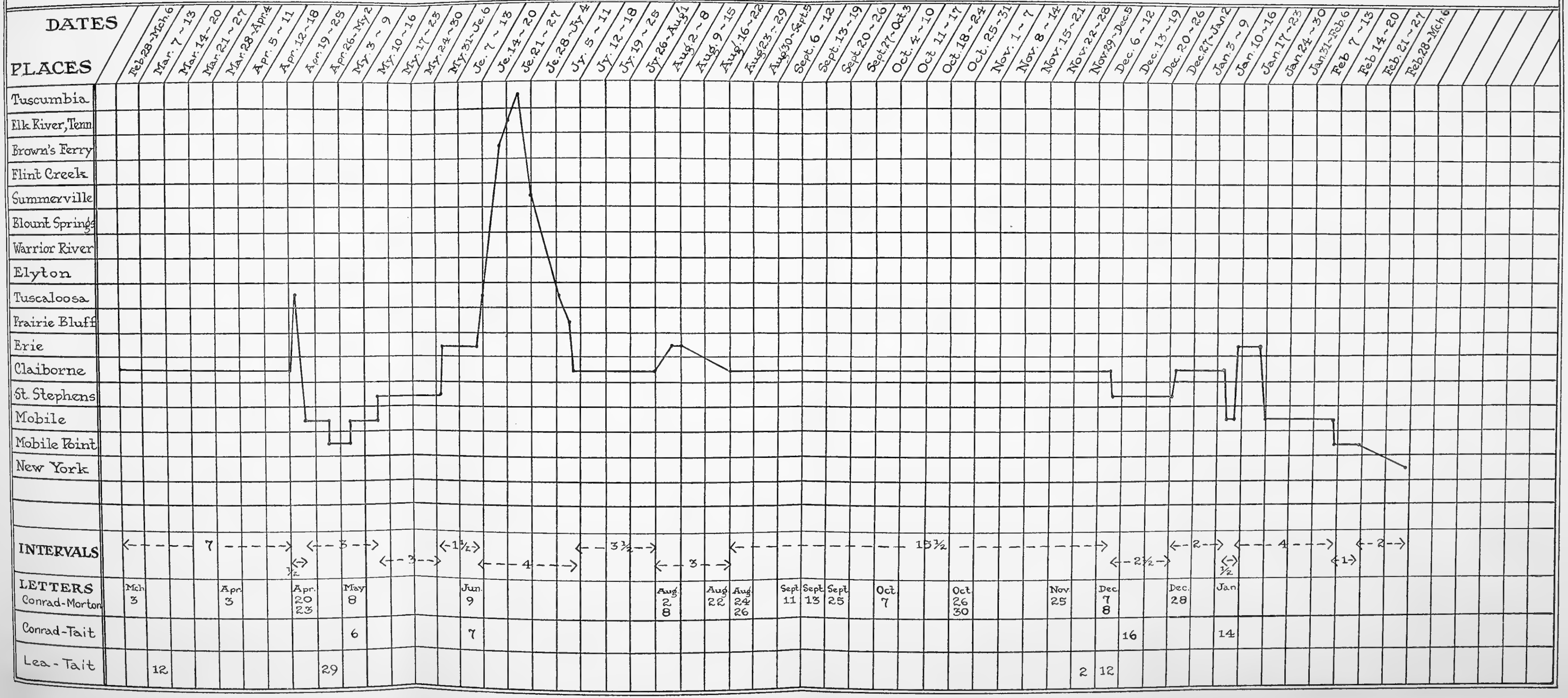
CONRAD'S RESIDENCE AND JOURNEYS IN ALABAMA 1833 ~ 34



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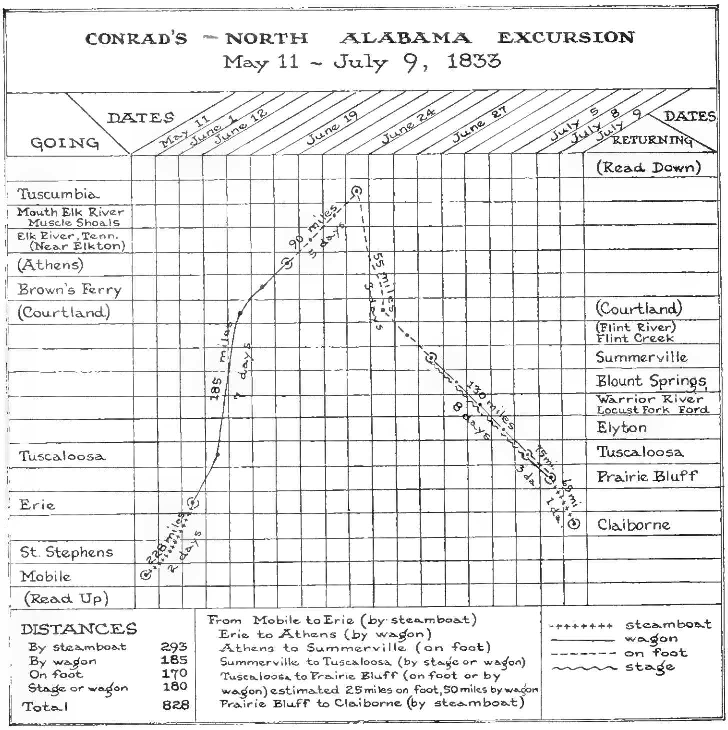
PART THREE

THE EXPEDITION TO NORTH ALABAMA

Figure 4


CONRAD'S — NORTH ALABAMA EXCURSION
May 11 – July 9, 1833
DATES
GOING
May 11
June 1
June 12
June 19
June 24
June 27
July 5
July 8
July 9
DATES
RETURNING
(Read Down)
Tuscumbia
Mouth Elk River
Muscle Shoals
Elk River, Tenn.
(Near Elkton)
(Athens)
Brown's Ferry
(Courtland)
Tuscaloosa
Erie
St. Stephens
Mobile
(Read Up)
(Courtland)
(Flint River)
Flint Creek
Summerville
Blount Springs
Warrior River
Locust Fork Ford
Elyton
Tuscaloosa
Prairie Bluff
Claiborne
228 miles
2 days
185 miles
7 days
90 miles
5 days
55 miles
3 days
130 miles
8 days
75 mi.
3 ds.
69 mi.
1 da.
DISTANCES
By steamboat 293
By wagon 185
On foot 170
Stage or wagon 180
Total 828
From Mobile to Erie (by steamboat)
Erie to Athens (by wagon)
Athens to Summerville (on foot)
Summerville to Tuscaloosa (by stage or wagon)
Tuscaloosa to Prairie Bluff (on foot or by wagon) estimated 25 miles on foot, 50 miles by wagon
Prairie Bluff to Claiborne (by steamboat)
steamboat
wagon
on foot
stage

PART III

THE EXPEDITION TO NORTH ALABAMA

PEN PICTURES OF A PIONEER PERIOD

Alabama must have offered many delightful experiences to the early settlers. The formative periods of a country's life bristle with unknown factors which prompt the attention of inquisitive minds. If there are any trails used by earlier occupants of the newly settled country, where do they go? The uncleared forest abounds with game and is peopled with birds of strange plumage or curious habits. Some of the trees and many of the shrubs and flowers are altogether new to the pioneer. And when the trained naturalist comes along, he finds even more objects that thrill his soul and push his quill.

We turn instinctively to travelers like William Bartram, Thomas Nuttall, Philip Gosse, and Charles Lyell for truthful, as well as picturesque, accounts of the country through which they passed, and for the preservation of invaluable records. The immigrants that crowded into the country on the expulsion of the Red Man lacked appreciation for the Ivory-billed Woodpeckers, the Carolina Paroquets, and the long-leaved Magnolias, which won the admiration of the naturalist.

Here are two glimpses of the flora and fauna of Alabama in 1838 from the pen of Philip Henry Gosse, the English schoolmaster, who taught the little school at Pleasant Hill, not so far away from Claiborne:

> There are the Magnolias, or Laurels, as they are called here, two species of which at least are common, if not a third. These are the Big Laurel (*M. grandiflora*), and the Umbrella Laurel (*M. tripetala*), and perhaps the Cucumber-tree (*M. cordata*). The first of these is among our largest forest-trees, straight as a ship's mast, with a fine pyramidal head of massy foliage, whose evergreen verdure maintains its colour and its gloss undimmed by the storms of autumn, and the frost of winter. The fleshy conical fruits, four inches in length, are now ripening their numerous cells, from which project pulpy red seeds, depending by long filaments.

The Umbrella-tree is so called from its leaves, which are of extraordinary appearance; they are eighteen or twenty inches long, and six or eight broad; and being often disposed in a radiating manner at the end of a stout shoot, they expand a surface of three feet in diameter. The tree itself does not aspire to the magnitude of its sister, being scarcely more than a shrub. Its large conical fruit is of a dark rose-colour. The Magnolias, in their smooth grey bark and pillar-like outline of the trunk, bear a resemblance to the beech,—that queen of the forests[21].

In the course of a ride to Selma, a little town a few miles distant, I had the pleasure of seeing a flock of Parrots (*Psittacus Carolinensis*). The bird is not at all common in these parts, and indeed is was the first occasion on which I had ever seen one of this beautiful tribe in a state of wild nature. There were eighty or a hundred in one compact flock, and as they swept past me, screaming as they went, I fancied that they looked like an immense shawl of green satin, on which an irregular pattern was worked in scarlet and gold and azure. The sun's rays were brilliantly reflected from the gorgeous surface, which rapidly sped past, like a splendid vision.

Wilson tells us that the Carolina Parrot feeds greedily on the seeds of the cocklebur, and that its rarity or abundance in any locality is partly dependent on the presence of this plant. If this be so, the beautiful parroquet ought to be common, for there is no lack of the vile weed in question[22].

Charles Lyell gives us a sketch of the bluff at St. Stephens, which belongs here:

On the way back from Tuscaloosa to Mobile, I had a good opportunity of examining the geological structure of the country, seeing various sections, first of the cretaceous, and then lower down of the tertiary strata . . .

When I arrived at the last-mentioned rock, or the white calcareous bluff of St. Stephens, it was quite dark, but Captain Lavargy, who commanded the vessel, was determined I should not be disappointed. He therefore said he would stop and take in a supply of wood at the place, and gave me a boat, with two negroes amply provided with torches of pine-wood, which gave so much light that I was able to explore the cliff from one end to the other, and to collect many fossils. The bluff was more than a hundred feet high, and in parts formed of an aggregate of corals resembling nummulites, but called by A. D'Orbigny, orbitoides . . .

When I looked down from the top of the precipice at St. Stephens, the scene which presented itself was most picturesque. Near us was the great steamboat, throwing off a dense column of white vapour, and an active body of negroes throwing logs on board by torch-light. One of my companions had clambered with me, torch in hand, to the top of the bluff; the other was amusing himself in the boat below by holding another blazing torch under large festoons of Spanish moss, which hung from the boughs of a huge plane tree. These mossy streamers had at length been so dried up by the heat, that they took fire, and added to the brilliant illumination. My fellow-passengers were asleep during

[21] *Letters from Alabama*, pp. 289, 290.
[22] *Ibid*, pp. 298-299.

Claiborne Bluff in Summer, showing landing and bottom of incline.
Photo by T. I. Wright, June, 1932

this transaction, but congratulated me the next morning on having had the command of the vessel during the night[23].

William Bartram, in his quaint way, gives us many little etchings of aboriginal life in Alabama, of which the following is an example:

> The trader obliged me with his company on a visit to the Alabama, an Indian town at the confluence of the two fine rivers, the Tallapoose and Coosau, which here resign their names to the great Alabama, where are to be seen traces of the ancient French fortress, Thoulouse; here are yet lying, half buried in the earth, a few pieces of ordnance, four and six pounders. I observed, in a very thriving condition, two or three very large apple trees, planted here by the French. This is, perhaps, one of the most eligible situations for a city in the world; a level plain between the conflux of two majestic rivers, which are of equal magnitude in appearance, each navigable for vessels and perriauguas at least five hundred miles above it, and spreading their numerous branches over the most fertile and delightful regions, many hundred miles before we reach their sources in the Apalachen mountains . . .
>
> Stayed all night at Alabama, where we had a grand entertainment at the public square, with music and dancing, and returned next day to Mucclasse; where being informed of a company of traders about setting off from Tuckabatche for Augusta, I made a visit to the town to know the truth of it, but on my arrival there they were gone; but being informed of another caravan who were ready to start from the Attassee town in two or three weeks time, I returned to Mucclasse in order to prepare for my departure[24].

The political changes and material prospects of a country in the stage of transition from colonial dependency to independent nationality are the liveliest topics in every village, no matter how remote it may be from the state or national capitals. When Sir Charles Lyell visited Claiborne in 1846, the tavern talk had mostly to do with the prospect of another war with England, and with the estimation of the political strength of the leaders of rival parties. Newspapers were few, but there was plenty of news. Every man who went to the postoffice, or had business

[23]Lyell *A Second Visit to the United States*, 2:75, 77, 1849.

[24]Bartram *Travels Through North and South Carolina, Georgia, East and West Florida*, etc., 2nd London Ed., pp. 445, 446, 1794. This "Alabama" is not to be confused with another, and later, town, by the same name, which Bartram also visited. The earlier Alabama town was near the present Montgomery. Both were built by the same people. Bartram says: "Two miles above Manchac we put into shore at Alabama: this Indian village is delightfully situated on several swelling green hills, gradually ascending from the verge of the river: the people are a remnant of the ancient Alabama nation, who inhabited the east arm of the great Mobile river, which bears their name to this day, now possessed by the Creeks or Muscogulges, who conquered the former." *Ibid*, p. 427.

with his neighbor, carried more columns of news than the papers could publish.

MAPS, ROADS, AND RIVERS

When we examine the maps of Alabama that were made about the time of Conrad's visit, we find that a large area within the boundaries of the State was still virtually possessed by the Indians. Many Cherokee, Creek, and Choctaw names were still in common use, while few names of physical or cultural features now familiar to us were known to the makers of maps.

Vast tracts of land along the eastern borders of the State, and the great hunting preserves of the Indians on the western side in which no Indian village had ever been built, were recognized as belonging to the new commonwealth only by reason of Indian land cessions still in process of perfecting. Some of these grants had been made by the Creeks and some by the Cherokees; and still other plots had been acquired in one way or another, some by actual purchase. The maps that undertook to chart these acquisitions look like a kaleidoscopic patchwork.

In 1830 Tanner[24a] published his so-called Post Route map of Alabama. It has great significance for us, because in a revised edition, it was the map actually used by Conrad. On it the county lines are faintly traced, and more roads are drawn than we would suppose to have existed at such an early period. Many of these, however, were little more than Indian trails; and some were roads blazed by pioneers, which needed the hard usage of civilization to make them really serviceable. Some of the new roads had been built by the Government to facilitate its wars with the Indians.

Conrad complained of the inaccuracies of the Tanner map, discovering for himself that Blount Springs, for example, was between the two forks of the Warrior River, and not to the north of them. However, Conrad used Tanner's map in the 1835 edition of his *Fossil Shells*, designating on it the geological divisions of

[24a]For a recent appreciation of Tanner's cartographic work see W. L. G. Joerg, Annals Assoc. Am. Geogrs., 25:46, 1935.

Claiborne Bluff in Winter, just above the Lower Landing.
Photo by Q. B. Schenk, December 22, 1934

the State. These divisions are hand-colored, the legend being printed across the top margin of the map, with the color key for each division. *This is the first geological map of the State, as far as the writer has been able to learn.*

It is interesting to note that while this map shows no indication of the great iron ore deposits in central Alabama, it does definitely mark Tuscaloosa as a coal-producing area. There are but four localities designated as Eocene: Claiborne; St. Stephens; a spot in Wilcox County, south of Blacksville; and a short section along the left bank of the Chattahoochee River, north and south of Fort Gaines. We wonder how Conrad missed some other Eocene localities not far from Claiborne, which by reason of the fact that they were also established "landings" might have been easily discovered. We refer, for example, to Bell's Landing, Gregg's Landing, and Matthews' Landing, all of which are between Claiborne and Prairie Bluff, on the Alabama River.

Referring again to Tanner's map, we find that one of the chief roads of north Alabama was the old Byler road, extending from Tuscaloosa to the Tennessee River, near the site of the present-day Leighton, which is northwest of Moulton and south of Mussel Shoals. Conrad must have traveled this road in going to the Tennessee Valley; and parts of this same road are in use today. The road going south from Huntsville divided at Blountsville into three forks. The main branch continued in an almost straight line through old Elyton to Tuscaloosa. Conrad traveled the Blount Springs road and the lower section of this Huntsville-Tuscaloosa highway in returning from the Tennessee Valley. Another fork turned directly southward from Blountsville, swinging to the west through the Cahawba River Valley and thence on to Selma and to Cahawba, the State's first capitol. The third fork of the road made its way in a southeasterly direction out of Blountsville down the Coosa River valley to Montgomery, there joining the Federal road to Mobile.

There were roads in South Alabama that figure in our story. One was the old Federal road (just mentioned), which connected Milledegeville, the capital of Georgia, with St. Stephens, the territorial capital of Alabama; which road, as we have seen, crossed over the Alabama River at Weatherford's ferry (Claiborne). South from Tuscaloosa came another road which divided near Bear Creek into two forks, the western swinging over to St. Stephens, and the eastern down through Claiborne to the old Federal road from Mobile to Montgomery, the junction being some thirty miles south of Weatherford's ferry.

Over most of these roads, at one time or another, and by any means he could afford, Conrad traveled. More often he was on foot; but sometimes he managed to get a lift in some wagon that was not overloaded, and sometimes he made use of the stage when he needed to travel a little faster and had the money to pay his fare. He was often far from friends, unable to pay for his lodging, and sometimes refused the hospitality of the settlers. He had always to humor a stomach that refused to assimilate certain kinds of food. Besides, he suffered much from exposure. According to one account, he craved a comfortable bed at night but seldom had it.

For the sake of science this timid man went through experiences that commend his fortitude and determination. Traveling often alone, and making friends along the way, he gathered facts the significance of which some of his contemporaries did not appreciate and still fewer of the rural inhabitants could understand. The man who first developed and interpreted our Tertiary formations literally tunneled through difficulties that would have staggered the sturdy explorers of later days. But Conrad did not set out to locate intrinsic treasures, nor to build a fortune for himself; he chose rather to lay his humble offering at the feet of science.

ON THE TRAIL OF A SHELL COLLECTOR

While Conrad was the guest of Dr. Withers at Erie he struck up an acquaintance with a gentleman from Virginia, Mr. Atwater[26], who was traveling to Limestone County and whose route

26 Enroute Mr. Atwater amused Conrad much by his theory concerning the origin and nature of fossils. He had identified "petrified rattlesnakes" and many other victims of the Noachian deluge and was sure that this catastrophe had occurred in the fall, since there were so many "petrified nuts" (Pentremites) to evidence it. Commenting on Voltaire's opinion that the Alpine shells had been dropped by pilgrims, Conrad drew a picture of these geological itinerants threading their way along the bottom of the sea, and doubtless sporting with the Saurians of that ancient day.

The Steps and Landing
Alabama River, Claiborne, Alabama

Photo by Q. B. Schenk, November 11, 1932 crossed the Tennessee River at Brown's ferry, at the head of Muscle Shoals[27]. It suited Conrad well to accompany him, particularly because this would make possible the collecting of fresh-water shells in a region full of promise, and because it would entail little expense. It turned out to be a costly excursion. The hospitality, which was so spontaneously granted him in the southern part of the State, was singularly wanting in the northern counties. He contracted fever, he thought from wading in the Warrior River, suffered from running sores and insect bites, and probably was the victim of poison oak or sumac. He had few facilities for the preparation or transportation of his specimens. On this north Alabama trip he walked approximately one hundred and seventy miles, practically one-third of the whole distance covered from Erie to Tuscumbia and back to Claiborne.

Our chart (Figure 4) will show, as best we can now determine, Conrad's route to Muscle[28] Shoals, the principal localities visited, and the approximate dates and means of travel.

From Mobile to Erie Conrad traveled up the Tombigbee and Warrior Rivers 228 miles by steamer. The seven-day trip by wagon with Mr. Atwater probably ended at Athens, the county seat of Limestone County, a point of easy access to Elk River, Tennessee. It is likely that Conrad walked the rather extensive circuit of 145 miles from Athens into Tennessee, down Elk River, all through the Muscle Shoals region, across the river to Tuscumbia, and thence east along the left bank of the Tennessee River to Flint Creek, and beyond to "Summerville". By this time he was probably pretty heavily loaded with specimens, which with con-

27 The original spelling, "Muscle Shoals", instead of the preferred form *Mussel* Shoals, is retained for historic reasons only. This is also done in the case of "Cahawba" and "Tombeckbee", for the same reason. However, the word *Muscle* as applied to a clam, is fairly common, and comparatively recent. See Murray's Dictionary, *in loco*.

28 Based upon the Conrad-Tait correspondence of 1833, Conrad's logical route to Muscle Shoals was by the Byler road, the first state-supported highway, rather than by the Blount Springs road. From a study of the Tanner map (1830), the Byler road was the shortest route to Brown's Ferry, at which point Mr. Atwater crossed the Tennessee. The Blount Springs route indicated no road from Decatur to Brown's Ferry. That Conrad mentioned what happened "on the road *from* Summerville *to* Tuscaloosa (italics ours) indicates that his return trip to Tuscaloosa was made as charted.

stant additions would necessitate the use of wagon or stage for at least eight days on the return trip to Tuscaloosa, a distance of 130 miles from Summerville.[28a]

As Conrad left his collections at Tuscaloosa, we assume that he finished his land journey, about 75 miles, to Prairie Bluff either on foot or by wagon. The last lap of the journey, from Prairie Bluff to Claiborne, 65 miles, was a matter of only a few hours by steamer.

Conrad got some of his best specimens from Elk River, "which", he says, "wears the palm for new, curious, and beautiful shells". He explored this stream from its mouth to at least a short distance in Tennessee, for he later sent to Dr. Morton an original colored drawing of a Unio from "Elk River, Tennessee."[29] The limestone spring at Tuscumbia repaid his visit with new Melanians. More than once in his writings and letters he mentioned Flint Creek in Morgan County, which he called a river, and which flowed into the Tennessee River from the south. We may reckon that he stopped an hour or more at every ford or shoaly crossing of the streams he discovered on this trip. He mentioned specificially "Flint River" and the Locust Fork of the Black Warrior River as excellent collecting grounds.

The whole trip from Erie to north Alabama and back again took Conrad all of four weeks, and that in a season when the weather was uncomfortably hot. But despite all of his privations and sufferings his appreciation for the beauties of nature was not dulled. The whole region which Conrad described in the passage quoted below is now flooded by the great Wilson Dam, completed in 1925; and many forms of molluscan life which were common in Conrad's day and which were not able to adapt themselves to changed conditions have perished. The mud-loving species, however, have probably multiplied.

Here is Conrad's description of the region:

> It is shallow, ornamented with a number of small islands, and its bed is full of the long grass which abounds in various species of *Naiades*. The lover of the grand and beautiful in natural scenery, as well as the student in science, will here find abundant sources of interest. He will be delighted with a noble river, whose beau-

28a Present-day spelling, Somerville.

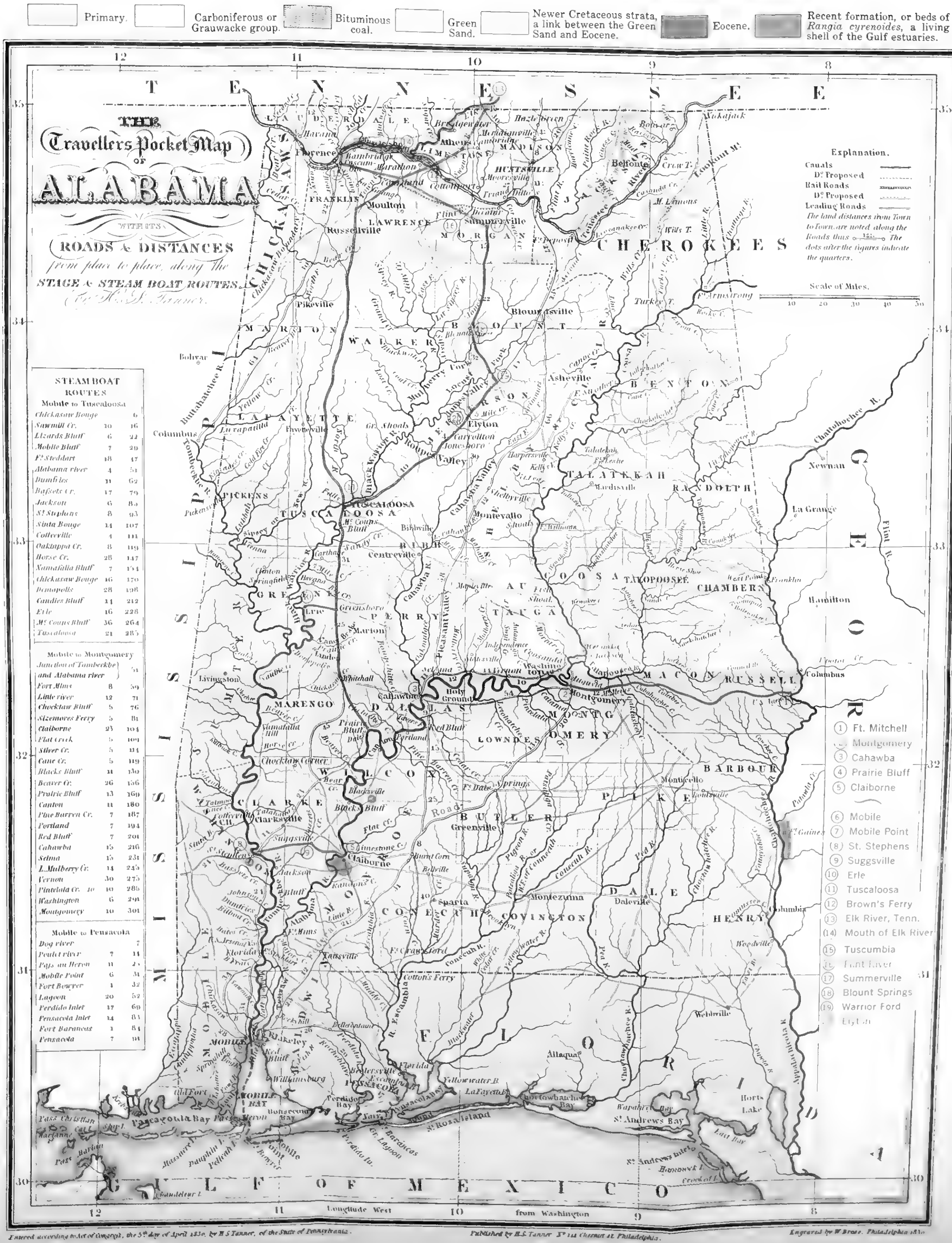
29 Letter to Dr. Morton, postmarked "Claiborne, Aug. 24, 1833".

Charles Lyell
1797—1875

Engraved by G. I. Stodart, 1881

tiful and noble islands are clothed with gigantic trees; whose high and undulating shore on one hand is ornamented with thriving villages, and on the other spreads out an extensive alluvial, rich in all the gifts of Ceres, or rises abruptly from the river a mural escarpment of carboniferous limestone, which reflects its blue and sombre aspect in the crystal waters at its base. Like many other spots, however, remarkable for their loveliness, the subtle messengers of death have chosen it for their abode, infusing the poison of their breath into the serenity of autumn, when the transparency of the air and the purity of the sky, together with the gorgeous scenery, present at first to the unconscious traveler, sensations alone of health and enjoyment.[30]

[30] *New Fresh Water Shells,* p. 13, 1834. Quoted also by Ortmann, Science II, 60:566, Dec. 19, 1924.



Entered according to Act of Congress, the 5th day of April 1830, by H. S. Tanner, of the State of Pennsylvania. Published by H. S. Tanner, Nº 144 Chesnut St. Philadelphia. Engraved by W. Brose. Philadelphia 1830.

PART FOUR

WORKING AND WAITING

PART IV

WORKING AND WAITING

ROUNDING UP AN EVENTFUL YEAR

During the most of July, 1833, Conrad was evidently at Claiborne, but during a good part of August he was elsewhere. By the twenty-second of August he was again in Claiborne, for on that day he posted a letter from Judge Tait's home to Dr. Morton, in which he stated that he had just completed a two weeks' overland trip from Erie. On his return he walked from Erie to Prairie Bluff, being caught on the way in thunder showers and a hurricane.

It was at this time that Miss Mary, the niece of Mrs. Tait, is mentioned in his letters. The Judge and his wife made a hurried trip to one of their plantations[31], leaving the impractical naturalist and the *very* young lady "master and mistress pro tem". Already Conrad had developed a deep affection for this girl, for whom he gathered lovely shells on the Gulf Coast, and whom he seldom failed to remember in his letters to the family. Possibly the attraction was mutual, for Mary was much concerned about Mr. Conrad's lack of skill in the use of a razor. He tried to keep his promise to her not to cut his face, reporting on one of his trips

[31] Besides the Monroe County plantation which Judge Tait owned, he had also a plantation in Wilcox County, which may be located just south of the "v" in Blacksville on Tanner's map. Conrad designates this spot definitely as Eocene, and states that it was on the Judge's property. In the *Introduction* to his *Fossil Shells*, No. 3, 1835, he says:

> In Wilcox County, Alabama, on the plantation of my friend, Judge Tait, the *Eocene* appears in the form of a dark-colored sandstone in which the shells are only traced by the imperfect chalky vestiges, but sufficiently defined to show their relation to the fossils as Claiborne. Pp. 25, 26.

that he was partially successful and that he would "exercise the utmost caution on account of the feelings of both".

A fine drawing of a *Philadelphus* (probably undescribed) which was found in one of his letters to Dr. Morton, may have been inspired by some sentimental incident; for on his return to Philadelphia he sent his thanks to Miss Mary for two pressed specimens of the flower, one of which he kept for himself. The drawing itself was made in Claiborne.

In the library of Mr. Peter A. Brannon there is a letter from Mr. Conrad to Judge Tait, written long after his return to Philadelphia, which comes as near being a confession of his love as one might expect from an older man for an attractive girl who shared his love of nature but who could never mean more than a friend to him.

> And Mary—I remember her a beautiful vision of all that is lovely and attractive; may she meet with a lot in life equal to her merits, and a heart responsive to her own, which will be able to appreciate the treasure.

Conrad's fancy for punning occasionally crept into his correspondence. He reported that he had recently observed a migration of Swallow-tailed Kites, but regretted that he could not "undress them for his friends in Philadelphia". When the young ladies in Mr. Toulmin's home were making preparations for a party "in honor of Lucinda", they set Mr. Conrad to work beating eggs and writing poetry. "I fear", he says, "I made the eggs lighter than the poetry sublime, but *ni'l importe!*"

Following his return from Erie on August 22, Conrad apparently spent the next sixteen weeks at Claiborne. His time was pretty well occupied with his collections; and his letters to Morton, eleven or twelve of which are extant, show great industry in the determination and description of new species, some of which are accompanied by drawings. In his letter of September 11 appears the first intimation that he knew of Dr. Lea's intention to claim for himself the fruits of another's extended studies and costly sacrifices. Although the letters containing many of these descriptions were not mailed until the last of October, they had ample time to reach Dr. Morton before the publication of the fourth number of his *Fossil Shells.* These letters justify Mr.

Conrad's assertion that he wrote every line of his No. 4, even if Dr. Morton had already done much of the work before he received the letters. Of the controversy itself we shall have much to say in another section of this work.

We shall have to pass over the next two or three months of Conrad's stay in Alabama as rapidly as possible, there being little to relate.

On or about December 9 Conrad set out for a visit to his friend, Judge Harris, in St. Stephens, whom he found camping in his kitchen while the rest of his house was undergoing repairs; he therefore stopped with Major Reuben Chamberlain, who ran the only hotel in town[32]. On the way over to St. Stephens—he made the trip on foot—he stopped at Suggsville[33], six miles west of Claiborne, and found it well worth while from a scientific standpoint.

From St. Stephens he had planned to go on to Erie and thence to Tuscaloosa, returning with his north Alabama collections to Mobile; but he postponed this trip on account of the absence of Mr. Toulmin from the city. Just what this had to do with his going he does not explain, but we may infer that he was depending on his friend's arranging his transportation back to New York. He returned, therefore, to Claiborne, where he remained for about two and a half weeks. Sometime in January, 1834, he left Claiborne for good, rather hurriedly it seems, by reason of the fact that his boat had arrived at the landing ahead of her schedule. He had no time to do more than to get his boxes loaded on the steamboat. He felt quite keenly the fact that he did not have time to bid adieu to the friends who for so many months had made their home his own, and so he expressed himself in a letter to the Judge, adding that he proposed to sail for Philadelphia in about a month.

[32] *Reminiscences of Old Saint Stephens,* by Mary Welsh; Proceedings Alabama Historical Society, 3:206-226, 1899.

[33] As has often happened in the case of a field naturalist, his sanity was here in question. A traveler reined up his horse to see whether a pedestrian in the act of raving over the discovery of a large specimen of *Plagiostoma dumosum* was not sick. He was still more incredulous when he received the cheerful but mischievous explanation that the collector was not "sick", only "tired".

Just before the steamboat reached Mobile, it collided with the packet *Herald* in a sharp bend of the river. Conrad sat up half the night in readiness to transfer his precious collections to whichever of the barges remained afloat. Happily no serious damage was done.

On January 14[34] Conrad wrote that he was leaving Mobile the next evening for Erie on the steamboat *Courier*. As this boat was bound for Tuscaloosa, he arranged with a friend, Mr. Starr, to have his boxes shipped from there on the return trip of the packet so that he could spend the intervening time with his friend Dr. Withers, who had married since last he saw him. His north Alabama collections had then been in storage at Tuscaloosa for more than six months. He returned to Mobile about January 21.

THE HOMECOMING OF A TRAVELER

It was not until February 9 that Conrad finally left Mobile for New York, and then the brig in which he sailed was detained by contrary winds for a full week in Mobile Bay. Once on her way, however, the vessel

> skimmed like a frigate bird over the blue undulating sea, with her wings buoyed up by the breath of old Boreas, who was rioting in his escape from the prison cave of Eolus.

A spouting spermaceti whale and a company of porpoises accompanied the brig for a while, and flying fish

> like animated silver, were cresting the blue transparency of their ocean home; beautiful, indeed, was the novel scene around me, but the bitter penalty of trespassing on the domain of old Neptune began to be severely felt. Sea sickness in its worst form was my relentless but admirable physician, and now I am growing fat they tell me, and certainly I am in good health and spirits. The captain of the vessel thought my life in danger, I was so severely affected.

In twelve days from Mobile Point he reached Sandy Hook, and shortly afterwards New York. The letter from which we have just quoted is addressed to Judge Tait, and it dated April 10, 1834; it also pictures his homecoming:

> I have my boxes safely deposited in my bed room, the floor of which is carpeted with muscles and fossils not greatly to the edification of my mother and sisters. The ladies will not recognize

[34] This letter was posted to Black's Bluff, Monroe County, and is the only one of the letters to Judge Tait so addressed. Black's Bluff is known to have been the plantation postoffice of the Judge.

> a fine fossil as the most beautiful and valuable object in nature, and I am reluctantly compelled to differ in opinion from them.

The ladies were soon relieved, however, for Conrad was elected an honorary member of the Geological Society of Jefferson (Medical) College of Philadelphia, and was made Curator of the Museum *without pay*. He was installed in the room where the collections were housed, which Conrad declared to be the finest that he had ever seen devoted to the interests of science. "I propose making this my den," said he, "where I can pore over my fossils, like a hyena over his bones."

In two letters written after Conrad's return, April 10 and July 19, we get a few of the references ever made to his family. In one he bore the gratitude of his mother to his Claiborne friends for their kindness to him; in the other he spoke of the sweltering temperature of 100°F., declaring that he had never suffered from the heat at Claiborne but that he had nearly suffocated in Philadelphia.

> We have had a very sick family this summer, he wrote, three cases of dysentery. One is my little afflicted brother who lies beyond hope of recovery; his screams have affected me so much while writing the letter that it must serve as an excuse for its incoherent style. (This was Joseph, the youngest of the children, who died that year.)

Shortly after Conrad's return to Philadelphia he had several conferences with Prof. Rogers, who invited him to be an associate on some collecting trips to Virginia the following winter. Prof. Rogers had been engaged to speak in the principal towns, but Mr. Conrad would not agree to share in any of this responsibility. It is known that he had a rather weak voice, which made him reluctant to talk in public; but with intimate friends he was said to be a delightful entertainer. Prof. Rogers was also interested in getting samples of the soils and sands from the various layers of the Claiborne bluff, so much so that Conrad wrote to Judge Tait to secure them if possible. At the same time he expressed his keen interest in the vertebrate fossils sent to him by Mr. Cooper, a lawyer in Claiborne, who seems to have had a plantation in Clarke County. Conrad expressed also a regret that he had not paid more attention to the localities in Clarke County, especially the plantation of Judge A. B. Creagh, where so many of the Zeuglodon remains were found.

He assured Judge Tait that he would send him a set of Lyell's *Principles of Geology,* and with it some of his own publications, packing with them some beautiful shells, which we may feel sure were intended for Mary.

From the correspondence of this period we cull an incident which is presented only for the humor it contains.

It seems that Mr. Conrad had another tilt with Dr. Lea, having requested the return of some of his South Carolina specimens. Dr. Lea seized the opportunity to remind Mr. Conrad that he was out fifty or seventy-five cents for postage on the package. He offered Conrad a chance to square the account by returning the amount due in new species that he (Conrad) had described. Not relishing the suggestion that he should furnish Dr. Lea's cabinet with a suite of co-types *all for 75c,* Conrad promptly sent the Doctor the whole amount in cash. Whereupon Dr. Lea immediately refunded twenty-five cents of this with the statement that his memory might have been at fault and that Conrad probably owed him only fifty cents. Now Mr. Conrad, whose forgetfulness was sometimes a virtue, remembered distinctly that for the past several years Dr. Lea had been in his debt for $1.25; but he decided now to close this account, after the manner of the resourceful Dr. Sidney Lincecum, by tearing up the note so that he could say: "I owe no man anything, and no man owes me anything; so I am free to go when and where I please".

PART FIVE

THE PASSING YEARS

PART V

THE PASSING YEARS

It will be difficult to present a connected story of Conrad's life following his year in the South; for we have only meager records of his professional engagements, and his technical papers seldom yield any biographical notes.

As far as we have been able to learn, only seven persons[35] are living at the time of this writing who remember Conrad, and his contemporaries have left few traditions or anecdotes relating to his personal affairs. Conrad was very careless about his belongings, and not less so about his scientific records[36]. He kept no diary, and whatever field notes he may have made were not preserved. There are apparently no letters extant which were written to him by his many correspondents and friends. His reclusiveness in later years, his apparent ill health, and his idiosyncrasies did not multiply the type of friendships and social contacts that would have enriched our story. All that we can promise to do is to piece together the scattered facts gathered here and there from his family and from his writings, and to draw from them such conclusions as are fairly warrantable.

From 1834 to 1846 Conrad's engagements and literary labors make a period of real activity. The ensuing thirty years (1847-

35 Elizabeth Kerr Atkinson, Asheville, North Carolina; Miss Louise G. Conrad, Lansdowne, Pennsylvania; Miss Louisa Hewitt, Trenton, New Jersey; Miss Helen Moyer, New York City; Miss Julia Boggs Abbott, Bristol, Pennsylvania; Mrs. Alfred Black, California; and Prof. Collier Cobb, Chapel Hill, North Carolina. Miss Helen Moyer is a daughter of Lucy Conrad Moyer, one of Timothy's younger sisters; Miss Julia Boggs Abbott is a granddaughter of Timothy's favorite sister, Susan, and a sister of Richard M. Abbott. (Prof. Cobb died Nov. 28, 1934—Ed.)

36 Mrs. Frances Baker, a granddaughter of Solomon Conrad, writes that her Uncle Tim lived with her family during the winter, the house being on Arch Street, near Twenty-first, Philadelphia. She remembers her father saying that Timothy received many certificates of honorary membership in foreign learned societies, but that he would merely glance at them, and then tear them up. When he was asked by a member of the family what he had done with a letter which he had received from a crowned head in Europe, he replied shortly, "Answered it".

1877) might well be called the *Silent Years;* for besides his contributions to scientific journals, and occasional field trips or short-term engagements, only sketchy records are at hand.

The last few years of his life were spent in seclusion in Trenton in the home of his brother-in-law, Timothy Abbott, the husband of his favorite sister, Susan.

THE PERIOD OF ACTIVE PRODUCTION: 1834-1846

How long Conrad continued to enjoy the courtesy of a "den in Jefferson College we do not know. He probably had a room in his mother's house in Philadelphia, the family still occupying the old home in Christ's Church Alley, a most respectable neighborhood in those days. Later the family moved to Zane Street near Fifth. Timothy seems to have been always welcome among his kinsfolk; evidently he gave them little trouble, as he was generally engrossed in his studies and work.

Evidently 1834 was to be, for Conrad, a busy year. He had already organized his collections, glueing the type specimens on cards for the Academy. He felt so proud of this work that he wished that Judge Tait might see the Claiborne fossils in their "improved condition". He wrote to the Judge:

> I am infinitely obliged to Mrs. Tait and you for the pains you have taken to secure the box of fossils for me, and I can assure you that they will form a highly prized portion of the collections of the Academy.

He was already at work on his *New Fresh Water Shells,* which appeared in 1834. He visited his friend, Prof. Lardner Vanuxem, whose collections held material that enabled him to connect up the Eocene deposits of the Coastal Plain all the way from Maryland to Alabama. After resigning his chair in South Carolina College, Prof. Vanuxem did not lose his interest in science, but he found in the active physical responsibilities of his sixty-acre farm health and freedom worth more to him than a five-thousand dollar salary. As for Mr. Conrad there was not at this time either farm or other employment. He wrote Judge Tait:[37]

> I have no prospect of getting into business, and consequently I am greatly dispirited; idleness and poverty I should think would make the earth a purgatory to the best natured man in the world, and I am not the best natured, I am sure.

[37] Letter, July 19, 1834.

In the same letter, addressed to Judge Tait, he says:

> Next week Mr. Gibbons expects to publish the 1st no. of his new series of the "Advocate of Science" in octavo form; it will contain woodcuts and I have in it an article entitled "Claiborne".

(See p. 32.)

The editor and publisher of this journal, which never got beyond nine numbers of the first volume, was a member of the Academy of Natural Sciences and a good friend of Conrad. He printed some of Conrad's papers, and Conrad placed the collections of Claiborne fossils which he wanted to turn into money into his hands as agent.

For the *Advocate of Science* Conrad wrote four articles, including the one on Claiborne. From these we have been able to glean a few biographical items, and fill in some gaps concerning his work in North Carolina at the time he was on his way to Alabama. All of these contributions lack literary merit, for Conrad was not gifted in the organization of his materials for descriptive writing. The journal, however, contains interesting notices of his writings published during 1834 and the year following. In the January (1835) number, for example, there is a notice of the publication of the new No. 3 of his *Fossil Shells*, which was put on sale at the office of the *Advocate*, as well as the printing shop of Judah Dobson. This particular number of the *Fossil Shells* was devoted to a review of the Claiborne *Pelecypoda* which appeared in the first Number 3, together with new material. The *Advocate* reported that this number was presented to the Philadelphia Academy on March 10.

In 1834 Conrad described a shell which at that time was very abundant on the calcareous rocks in the Alabama River below Claiborne. He named it *Paludina magnifica*[37a]. This species was also described by Lea first under the name *Paludina bimonilifera* and later under the name *P. angulata*[37b], the specimens of *bimonilifera* coming to him from Judge Tait; the habitat of *angulata* being given as "Coosa River, Alabama, Dr. Brumby". Conrad searched for the shell in vain on the rocks at St. Stephens.

[37a] *New Fresh Water Shells*, pp. 48, 49, Plate 8, fig. 4. The genus to which it is now assigned is *Tulotoma*.

[37b] *Trans. Amer. Phil. Soc.*, 5: 58, Plate 19, fig. 17, 1837; *Ditto* 9:22, 1844.

Although this shell is no longer living either in the Alabama River, or in the Coosa River, or in the Warrior River, it must have been a prolific inhabitant of all these streams in ages past. Many shell heaps and kitchen middens of the aborigines on all these water courses attest its popularity as an article of food. The specimens photographed are from the immense shell heaps on the Coosa River near old Fort William, the *Tulotomas* constituting more than 85 per cent of the shell contents examined.

The kitchen middens at old Carthage on the Warrior River, the present Mound Park, have yielded numerous specimens of these *Tulotomas,* but so far as known no living specimens have ever been collected from the Warrior or Tombigbee Rivers. On Decemer 22, 1934, the author found Conrad's species abundant in a shell heap on the Alabama River opposite Claiborne. Unless the Indians literally ate up the whole family, it is difficult to assign a reason for the extinction of a mollusk so robust and so abundant. It has not been collected alive, as far as known, since Herbert H. Smith found it in the Coosa River at Peckerwood Shoals, Weduska Shoals, and Fort William Shoals in 1910. This was prior to the development of power dams which flooded these habitats.

On the death of Thomas Say in December, 1834, Conrad was nominated by the Academy of Natural Sciences to prepare a biographical sketch for the next meeting, but he declined the honor. He did, however, agree to carry on Say's work on the *American Conchology,* six numbers of which had already been completed. In the January (1835) number of the *Advocate of Science,* there was a notice of the "first number of Say's *American Conchology* continued by T. A. Conrad", in which the statement was made that the plates were already engraved and colored for the following species: *Unio lineolatus,* Rafinesque; *Donax variabilis* and *D. fossor,* Say: *Arca zebra,* Swainson; and *Venus alveata,* Conrad. This *seventh* part of Say's important work was not actually issued until 1838. It is so rare that the author has been able to locate no other copies of it besides the two which are owned by the Philadelphia Academy of Natural Sciences and bound up with the other parts of Say's *American Conchology.* Dr. Pilsbry writes me (January 25, 1935):

> It comprises 14 (unnumbered) pages of text, beginning with

Philip Henry Gosse
1810—1888

Donax fossor, and plates 61 to 68. The covers are not dated and do not mention Conrad's name. His contributions consisted of several short notes signed "Ed." or "Editor," and one description, *Tellina tenuis*, of which he says "I have copied the above from Turton's Bivalves of the British Islands, believing our shell to be the *tenuis* of authors. Mr. Say, unfortunately, has left no description of this species, which was sent him by Professor Ravenel of Charleston, who found it on the shore of Sullivan's Island.—Ed."

Binney's republication of this contribution was based on the copies in the Academy where he was at work in 1858.

In February, 1835, Conrad was elected a member of the Academy's standing committee on ornithology; and in March of that year he was elected one of the three honorary Curators of the Academy. During 1834 and 1835 it appears that Conrad published as books and contributions to scientific journals as many as seventeen titles. In addition his *Monograph on the Unionidæ* was begun during the latter year.

Early in the year 1839, a young man by the name of Philip Henry Gosse came to Philadelphia, and having met Conrad determined to seek his fortune in Alabama. Gosse was destined to become one of the world's distinguished zoölogists. In his biography, written by his son, Sir Edmund Gosse, we read that "it was suggested to him by one of the savants of Philadelphia that he would find a useful field for his energy in the State of Alabama; and this gentleman—Mr. Timothy A. Conrad, the conchologist—was so kind as to give him an introduction to a friend of his at Claiborne, which afterwards proved useful". Whoever this friend was it could not have been Judge Tait, for he died in 1835.

About the middle of May, Gosse took passage at Mobile on one of the "fine high-pressure steamers which thronged the Mobile wharves, fifty years ago". The steamboat was the *Farmer*, and one of its passengers was the Hon. Chief Justice Reuben Saffold, who had for many years been a member of the Territorial Legislature of Mississippi. It happened that the jurist was then on the lookout for a competent schoolmaster for the children of his neighborhood, including his own. On reading Conrad's unsealed letter, he instantly offered Mr. Gosse the position. So it happened that the teacher who afterwards wrote a charming little volume entitled *Letters from Alabama* passed up Claiborne, but stopped at King's Landing, the nearest point to "Bell Voir", the home of

Judge Saffold. One who cares to follow the trail will find some intimate stories of early Alabama in the little book above referred to, as well as a sketch, supposed to be of Claiborne bluff, and perhaps the first picture of it ever made.

In 1838 Conrad brought out the first part of his *Fossils of the Tertiary Formations,* which, as the introduction stated, was devoted to the *Medial* (or, as we say now, the *Miocene*) division of the Tertiary period. The materials for this work had been gathered at various localities in Maryland, Virginia, North and South Carolina, by James T. Hodge, Conrad, and others. At this time Conrad was employed as paleontologist of the New York State Geological Survey; but this book, in its several parts, was published by Judah Dobson, who must have lost heavily on the several books and pamphlets which he financed for Conrad.

Of the cover of the *first* part of the "Medial" Tertiary, there were three editions. The part itself covered pages 1-32, plates 1-17. The cover first prepared was entirely blank save for the title. On April 16, 1839, a new cover appeared, on the third page of which *nine new species* were described. The third edition of the cover, dated March, 1840, contained in addition, on the second page, a description of *Arca elevata.* Some of these covers, either with one or both surcharges, were used as covers for the *second* part of the work.

Part Two of the *Medial Tertiary* was issued on May 7, 1840, continuing pages 33-56, plates 18-29; but in some copies the cover was dated September, 1841.

Part Three, containing pages 57-60, plates 30-44, was issued in January, 1845, the date being determined by Conrad's own autograph. Plate 33 was apparently never issued.

Part Four, containing pages 61-86, with an Index, and pages 87-89, plates 45-49, was issued about March, or April, 1861, this being ascertained from a notation made by William M. Gabb in his own copy of the book.

Apparently this important work, spanning a period of twenty-three years in writing, evidences either loss of interest or financial difficulties. The remarkable thing is that the publication *was completed at all,* and especially that it was assembled in uniform style, barring the several variations in plates and covers.

When the New York State Geological Survey was organized in 1837, the State was divided for convenience into four districts, and a geologist placed in charge of each. Mr. Conrad was given the Third District; Lardner Vanuxem, Ebenezer Emmons, and W. W. Mather were placed in charge of the other three. At the end of the first season Conrad was made paleontologist of the whole Survey; while James Hall, who had been assistant in one district, succeeded him as geologist, though there was a shift in the district assignments. Conrad was with the Survey in the capacity of geologist and paleontologist for five years, during which time he received a salary of $1,500 a year, a sum that was for him a princely compensation. His savings during these years were probably the basis of investments which later made him financially independent. His will, made the year before his death, discloses the fact that he left to his sister Lucy his house in Trenton which was valued at $10,000; to a favorite and deserving niece, Mary G. Abbott, an indeterminate number of railroad shares and other securities; but to his well-to-do brother Solomon and nephew Walter nearly 200 shares of valuable and productive railroad stocks. It seems that Conrad often discussed investment opportunities with his brother-in-law, Timothy Abbott, and gained sufficient confidence in his ability to buy and sell to make him quite successful.

Dr. Dall may have had sufficient reasons for saying that Conrad's heirs sold his valuable collection of manuscripts for waste paper, but since they were acquired by Dr. Charles Conrad Abbott, his nephew and himself a most painstaking collector, that would not seem reasonable. Some years later Dr. Abbott's house was burned, and his own library and whatever he had of Conrad's was lost.

The following account of the organization of the Paleontological Department of the New York Geological Survey appeared in the *American Journal of Science,* in July 1839:

> This department has been organized since the former report. Mr. Conrad was detached from the third district for the purpose of fulfilling this duty which is very important to science. Although it may not seem so conspicuous in the report as some other department, Mr. Conrad, whose high qualifications for this duty are well known, has made a leading objective to identify as far as possible the fossil shells of the State of New York with those of Europe, in so far as to obtain their geological equivalents.

Dr. Clarke has given us a fascinating account of the birth of the American Association for the Advancement of Science. Mr. Conrad was one of the seven or eight persons who were invited to the home of Dr. Ebenezer Emmons in Albany, New York, in 1838, where plans were made for the organization of the Association of American Geologists. The actual organization was perfected in 1840. During succeeding years the Association expanded to include scientific groups other than geologists, and in 1847 so many of these groups were recognized that the name of the organization was charged to the *Association for the Advancement of Science,* by which name it has been known ever since[38].

In addition to his official reports, Conrad published a review of the fossils collected by James T. Hodge, in 1840, on an extensive trip through the eastern portion of the Southern Atlantic States. All of these fossils proved to be of Tertiary age, and of the 134 species identified thirty-two were new to science.

In 1842 James Hall became paleontologist of the Survey when Conrad had "thrown up his hands in dismay" as the four geologists turned in on him their accumulations of fossils for his determination. Thus "the survey was over," but the fossils were mostly untouched. Hall now undertook to publish all the fossils of the New York formation in one year, as usual, with his "religious refugium, *Deo volente*".[39] Realizing the necessity for assistance, he invited Conrad to be responsible for the *Pelecypoda,* an invitation which was declined.

During 1842 Conrad published in the Proceedings of the National Institution for the Promotion of Science a paper entitled *Observations on a portion of the Atlantic Tertiary Region, with a Description of New Species or Organic Remains.* This is one of the most complete studies he ever wrote. It shows the keenness of his analytical mind and the breadth of his understanding, as well as his thorough acquaintance with the literature of the formations under consideration. In this paper Conrad says:

> From all the various localities of this formation I have obtained about two hundred and thirty-nine species of shells and corals;

[38] Clarke, John M., *Life of James Hall,* pp. 100-103.

[39] *Ibid,* p. 137. See also Hall's note on Conrad's resignation "without communicating any report to the Governor", in Pop. Sci. Monthly, 22: 815, April, 1883.

> among these I find thirty-six species which are now existing on the coast of the United States. The number of recent, compared with extinct, forms will therefore bring this formation within the limits of the miocene period. My only doubt, heretofore, has been that it could be referred to the era of the Bordeaux deposits; but since Mr. Lyell has suggested that the latter may be an older portion of the miocene than the crag of England, which I have always regarded as identical in age with our medial tertiary, I have no longer any objection to refer the formation in question to the miocene period. I claim to have made this discovery solely by my own investigations.

In the same paper there is an important historical note which we give in Mr. Conrad's own words:

> In conclusion, two important deposits of the upper tertiary will be noticed. One on the Potomac, near its junction with the Chesapeake bay, and the other on Neuse River, North Carolina. The first of these was described by me in 1830, in the Journal of the Academy of Natural Sciences, of Philadelphia, in which paper appeared the first attempt to classify and describe any of the tertiary formations of North America.

The last paragraphs of this paper, exclusive of the description of the new species, summarize the conclusions which he had reached, and which were fully accepted by contemporary geologists. He also announced the plans for the continuation of his studies:

> I have alluded in this essay to the fact that the eocene and miocene are not connected by a single species common to both. It is equally remarkable that very few are common to the miocene and the newer deposits, and they, with one exception, are recent species. The conclusions derived from my investigations are, that the American tertiaries are of the eras of the eocene, miocene, and postpliocene, and that the newer pliocene is either wanting, or has not yet been observed.
>
> In concluding this brief sketch of a portion of the tertiary region, I will take occasion to remark, that it is my intention when I have fulfilled my obligations to the State of New York, in publishing the organic remains in connection with its geological survey, to investigate the Atlantic tertiaries more thoroughly, and to submit the results of my labors to the National Institution.

In the description of new shells which followed, Conrad published a new figure of his *Ostrea sellæformis,* which he originally described from Claiborne. He took this opportunity to put into the synonymy his own *Ostrea radians,* and Lea's *Ostrea semilunata* and *O. divaricata.*

During the winter of 1842, through an arrangement with the National Institution for the Promotion of Science, Conrad joined the Government expedition, led by Major Powell, that was sent to survey Tampa Bay, Florida. During these three months on the Gulf Coast, his particular mission was to secure Miocene shells for the cabinet of the Institution. He found that of the 347 species of Miocene shells then known, fourteen percent were still living.

Conrad commenced his investigations at Savannah, Georgia. When the steamer was forced to stop for repairs in the St. John's River, he embraced the opportunity to collect shells at Hasard. After making short visits to Key Basine, Indian Key, and Key West, the explorers proceeded to Tampa Bay, in the vicinity of which Conrad found many localities that yielded material of great importance to his mission.

The results of these studies were published as a *Catalogue* in the American Journal of Science for 1846[40]. At the end of this list of Miocene fossils were descriptions of "Upper Eocene" fossils from the limestone of Tampa Bay.

In the spring of 1845 Conrad spent two weeks in the vicinity of Vicksburg Mississippi. He was very probably the guest of his friend Dr. W. D. Moore, whom he says he loved more than most men, and whose death in 1864 affected him very deeply. Concerning this trip the most diligent inquiry has failed to discover what was his route and method of travel and under whose auspices it was made. In 1848 Conrad brought out his paper entitled *Observations on the Eocene formation, and descriptions of one hundred and five new fossils of that period, from the vicinity of Vicksburg, Mississippi; with an Appendix.* There is nothing in this article to show that he made any effort at this time to study the Eocene deposits at Jackson, Red Bluff, or other Mississippi localities.

The results of Conrad's further studies of Mississippi fossils, based on materials sent to him by Dr. Moore, were published several years later. The figures were published in Wailes' Report on the *Agriculture and Geology of Mississippi*, for 1854, with a list of the fossils of Tertiary age; and the descriptions were published the following year (1855) in the Proceedings of the Acad-

40 Vol. 52, pp. 393-398; and 399-400, nine illustrations.

DESCRIPTION

OF THE

HYDRARGOS SILLIMANII:

(KOCH,)

A GIGANTIC FOSSIL REPTILE, OR

SEA SERPENT:

LATELY DISCOVERED BY THE AUTHOR, IN THE STATE OF ALABAMA,

MARCH, 1845.

TOGETHER WITH SOME GEOLOGICAL OBSERVATIONS MADE ON DIFFERENT FORMATIONS OF THE ROCKS, DURING A GEOLOGICAL TOUR THROUGH THE EASTERN, WESTERN, AND SOUTHERN PARTS OF THE UNITED STATES, IN THE YEARS 1844—1845.

BY DOCTOR ALBERT C. KOCH.

Corresponding Member of the Societies of Halle, and of Dresden, &c.

The Bones of this monstrous Serpent, measure 114 feet in length, and weigh seven thousand five hundred pounds.

New-York:
1845.

Title Page of Dr. Koch's Pamphlet describing *Hydrargos Sillimanii,* First Edition, 1845 emy of Natural Sciences[41].

In the autumn of 1844 Conrad had a visit from Israel Slade, graduate of the Rensselaer Academy, who bore a letter from James Hall, his successor as paleontologist of the New York State Survey. Slade was in charge of a small commercial expedition to collect fossils and minerals for the firm of Hall and Slade, one of chief objectives of which was to make a collection of fossils at Claiborne, Alabama. While in that region, in the spring of 1845, he bumped into the notorious "Doctor" Koch, who soon was to astonish the people of New York with the extradorinary sea-serpent, 114 feet long, which he constructed out of the bones of several *Zeuglodons* collected near Claiborne. Slade declared that he himself discovered these specimens on Judge Creagh's plantation, in Clarke County, but that the wily Dr. Koch bribed his men to let him have the bones.

Koch first named his creation *Hydrargos sillimanii,* much to the chargin of the learned Dr. Silliman; but later in the same year he re-christened it *Hydrarchos Harlani.* Dr. Harlan, in 1832, had described a vertebra of the same animal, calling it *Basilosaurus,* by which name the cetacean still goes[41a]. Later, upon examination of a complete skeleton of this warm-blooded animal, Prof. Owen named it *Zeuglodon cetoides,* a more appropriate name than that of Harlan.

The monstrosity constructed of skeleton remains of the Zeuglodon collected at widely different localities created a great sensation. However, the real animal in its true reconstruction is wonder enough, for it is indeed the most interesting of all the marine vertebrate creatures of Tertiary times. Dr. Gibbes said

[41] Vol. 7:257-263. Compare list of fossils, prepared by Prof. Moore in Hilgard, *Agriculture and Geology of Mississippi* 1860, p. 132; and note references on p. 84, foot note.

[41a] A partial list of the papers on this interesting subject is here given for they have both historical as well as scientific value:

Harlan, Trans. Amer. Phil. Soc., 4, 1832.
Owen, Trans. Geol. Soc., London, 6, 1839.
Conrad Amer. Jour. Sci., 38: 381, 382, 1840.
Editorial, Amer. Jour. Sci., 49:218, 1845.
Gibbes, R. W., Jour. Acad. Nat. Sci., 1: 5-15, 1847.
Tuomey, Michael, Jour. Acad. Nat. Sci., 1: 16-17; Proc. Acad. Nat. Sci., Feb. 1847.
Lyell, Charles, Proc. Boston Soc. Nat. Hist., 2: 65-68, 1848.
Lyell, Charles, Amer. Jr. Sci., 4: 186-191, 1847.

that Dr. Koch knew before he published his description that *Zeuglodon* and *"Hydrarchos"* were the same. In his *Second Visit* to the *United States* Lyell makes some interesting remarks on the subject:

> Professor Jeffries Wyman was the first who clearly pointed out that the bones, of which the fictitious skeleton called Hydrarchos was made up, must have belonged to different individuals. They were in different stages of ossification, he said, some adult, others immature, a state of things never combined in one and the same individual. Mr. Owen had previously maintained that the animal was not reptilian, but cetacean, because each tooth was furnished with double roots, implanted in corresponding double sockets.

Conrad wrote a brief paper on the subject calling attention to the fact that he had familiarized himself with the Zeglodon beds. He is credited as being the first geologist to locate correctly[42] the geological position of these remains; namely, below the nummulitic limestone and above the Claibornian stage of the Eocene. Lyell, in 1846, confirmed this diagnosis when he visited the localities in person[43].

THE PERIOD OF MISCELLANEOUS INTERESTS: 1847 - 1877

In 1848 Conrad published anonymously a modest volume of poems, entitled *The New Diogenes, a Cynical Poem,* which later he sought to suppress. This work will be reviewed when we consider his poetical writings.

From 1849 to 1861, when Conrad brought out the final number of his *Medial Tertiary,* he published each year, with the exception of 1851 and 1859, from one to nine papers, including continuations of projects already begun, or forty-nine contributions in all. From 1862 to 1877, despite his reputed inactivity or indifference, he continued to publish contributions in several scientific journals, from one to eleven each year, with the exception of 1873 and 1876, or seventy-two papers in all!

From the letter books of Professor Joseph Henry, former Secretary of the Smithsonian Institution, have been gleaned some facts concerning Conrad's services to the Government. It seems that Dr. Spencer F. Baird kept these files at his home, and so fortunately they escaped the disastrous fire of 1865 which destroyed the official records of the Institution.

42 Am. Journ. Sci., 52: 209, March 1846.
43 Am. Jour. Sci., 54: 186-191, 1847.

The earliest of these letters is dated January 15, 1852, and was written to Professor Baird by Joseph Leidy. In it Dr. Leidy states that Conrad desired him "to ask you if the Smithsonian will give him $100 to make excavations on the Neuse River, in North Carolina, where he says he is quite certain there are numerous fossil bones, which, if obtained, would go to the Smithsonian, and if none are found he will agree to make a fine collection of the Tertiary fossil invertebrates of his State".

On the back of the letter there is this endorsement:

"I think Conrad's proposition may be accepted. J. Henry".

Like many other prospects for field work, this seems never to have materialized.

On July 3, 1853, Conrad wrote to Mr. Baird, who was then trying to secure his services, that he might be appointed Paleontologist of New Jersey, and, if so, he would have to decline other work save on the Unios from Louisiana, Arkansas, and Texas, which he much desired. But nothing seems to have come of this New Jersey prospect.

Intermittently, between 1853 and 1857, Conrad was engaged by the Smithsonian Institution to work up the fossils collected on various Government surveys and expeditions. There seem to have been some twelve or more papers or reports prepared under these auspices. One of them was the report on the paleontology of the Naval Astronomical Expedition to the Southern Hemisphere under the leadership of Lieutenant Gillis. The report was published in 1855, but nearly two years of patient urging preceded the rapidly written work which Conrad finally submitted.

Conrad's letter to Baird, dated June 14, 1853, is characteristic. He reluctantly declined to undertake the examination of the Chilean fossils, pleading that his health was so debilitated that he was contemplating a trip to Georgia in September to "make a struggle for life". Four days later Baird sent him a note, in which he said: "How soon will you be ready to take hold of Gilliss' fossils from Chile? There are three or four large boxes of them, about six times as great a mass as the Mexican Boundary". Then, on June 22, Baird wrote again—having by that time read Conrad's desponding letter—and while he was mildly sympathetic, he urged vigorously his completion of work already in hand and his acceptance of the Chilean work as well. "I trust you will reconsider about the Chilean fossils. I do not know who in this country can do them, but yourself". As late as October 21 Baird was still pursuing Conrad about the matter. Then, on Christmas Day 1853 (unless by incorrect dating is meant, 1854) Conrad reports that he has completed the work and suggests that he would be glad to have any more *paid* work, especially the paleontology of other expeditions, or at least the United States Unios or fossils "to keep me on the trail". His study of the Chilean fauna led him to believe that a vast area of interior Chile could be identified as of Tertiary age:

> The Cretaceous fossils are very few in number and all published species except a Belemnite. The tertiary is extremely interesting from the fact that Darwin believed no such formation to occur in S. A. except in patches in a few coast localities. There is a modern sea beach traced 50 miles from the Pacific and very likely it runs to the Andes. If so, there is reason to suppose that it may have a vast extent N. and S. This would be bad for Darwin who fortifies his position with a theory of Lyell's.

On January 3, (1854?), Conrad received some fossils from Alabama, which his friend Michael Tuomey, the first State Geologist of Alabama, had sent to the Smithsonian. Conrad hesitated to do anything with them without definite instructions from Baird, fearing that Tuomey might not like his describing any new species. In the same letter he proposes a Catalogue of the Eocene invertebrates with synonyms and references. This "Check List" was published in 1866.

Conrad's compensation for the several papers prepared covering the paleontology of the Charles Wilkes expedition, generally known as the Pacific R. R. Expedition to California, and the Mexican Boundary report, ranged between $10 and $50, the latter sum being paid him for the work on the South American fossils. He submitted his bills with reluctance, amounting almost to an apology. On March 21, 1854, he acknowledged the receipt of a draft for $50:

> If you think 50 dollars too much make what deduction you think proper. I do not wish by too low a charge to make a comparison unfavorable to the claim of colaborers in the Government work.

There is a curious letter dated November 5, 1854, in a postscript to which Conrad says:

> I heard in Albany that Hall had asked Dr. Beck to prevent me from occupying any situation in the Smithsonian, by traducing me, in a letter probably to Dr. Henry. You know I never applied for a permanent situation, nor would I accept one if qualified for it, and I would like Dr. Beck to know that, if you ever have the opportunity to broach the subject to him. Hall is the most grasping man next to Emmons I ever knew and with so many irons in the fire the Paleontol. of N. Y. goes on slow. His new plates are excellent, and his cabinet, if it could ever be arranged, would be a magnificent study.

But Conrad had forgotten that nearly four years previous (January 13, 1851) he had made a modest but none the less definite request to Dr. Henry for a position as field paleontologist, this being inspired by the recommendation of Louis Agassiz in the fourth Annual Report of the Board of Regents that a collection of tertiary and recent shells be made an objective of the Institution. Conrad says:

> As I have paid more attention to the subject perhaps than any other person I would gladly perform the work, if it should not be given to some abler naturalist. I would describe all the new species for the Journal and give also all the geological information I could collect.
>
> In fact, I have long wished to devote the remainder of my life to the special work for which I am better fitted than for anything else. Nothing but poverty has held me back. However, I shall soon be in somewhat better circumstances in all probability, and therefore I would undertake the work for my travelling expenses only, and I so well know the kindness of the Southern people that the expense would be small. I would, therefore, willingly undertake the task for 100 dollars a year, and allow two years in the collecting of specimens and information. I hope you will excuse me for this application, as it is only made in case of no more suitable applicant appearing.

Just what action the Smithsonian took on this matter is not revealed, but certain it is that Conrad did not get the particular field work which he desired. On April 2, 1853, the possibilities of Conrad's coming to Washington were discussed in Baird's letter to Conrad, for the "big room" in the Smithsonian for the display of fossils would soon be finished. In December, 1853, Conrad was offered a room in which to prosecute his studies, and it was at this time that the tide in his financial affairs seems to have turned. His investments began to yield him a sum sufficient to remove the sting of poverty. No later letters were located other than one from Baird to Conrad on May 9, 1863, when he sent him a paper to examine and report on for publication, and a letter three years later (April, 1866) regarding the Invertebrate "Check List" noted above.

During this period Conrad made his home partly in Trenton but often spent the winters in Philadelphia with his brother at 189 North Seventh Street. The long gaps in the Smithsonian letter files suggest that he was for several periods of work actually in Washington, but more often material was sent to him at the Philadelphia Academy or to his home in Trenton.

In 1859, or perhaps 1860, Dr. E. R. Schowalter[44] of Uniontown, Alabama, sent to Mr. Conrad some fossil shells, which he located indefinitely as coming from a region farther north than Professor Tuomey had then explored. These fossils were described by Conrad in the Journal of the Academy of Natural Sciences[45]. They were all from beds to which Conrad, in 1865, gave the name *Lignitic*[46]. Prof. Harris says[47]:

> Up to this time, no stress had been laid on the stratigraphic position of the various Eocene outcrops in America; to know that they were Eocene was all sufficing. In 1855, however, Conrad established three subdivisions in the Alabama and Mississippi deposits of this series[48], naming them in descending order, the Vicksburg, Jackson, and Claiborne groups. In 1865 he instituted another, the Lignitic Formation, wherein he seemingly desired to include beds between the ''Buhrstone'', as described by Tuomey, and the Cretaceous. To this formation he referred the dark colored friable clays of Piscataway Creek and the basal bed of Tuomey's section on Bashia Creek, Clark Co., Alabama; but the ''Marlboro rock'' to use his own expression, belongs to a higher or ''Buhrstone'' horizon[49].

In July, 1863, Conrad reluctantly undertook to rename a collection of Paleozoic shells which he had once worked over while engaged on the New York State Geological Survey. Merrill, in his *One Hundred Years of North American Geology,* page 158, quotes a letter which Conrad wrote at this time to his friend, Dr. Meek:

> I go on Monday to help H. [Dr. James Hall, the Director of the

[44] According to Prof. Herbert Smith the Doctor always spelled his name thus, though is was sometimes spelled without the ''c''. See *Nautilus,* 27:66.

[45] *Description of New Species of Cretaceous and Eocene Fossils of Mississippi and Alabama,* New Series, 4:275-298, Plates 46-47, 1860.

[46] Proc. Acad. Nat. Sci., 17: 70-73; Am. Jour. Sci., 40: 265-268, 1865.

[47] Am. Jour. Sci., 47: 301, 1894.

[48] Proc. Acad. Nat. Sci., 7:257.

[49] The first shells from the Lignitic beds to be described were apparently those published by Conrad in 1853, in the Journal of the Academy of Natural Sciences, vol. 2: 273-276; the shells described in 1865 are the first *referred* to the *Lignitic.* See also Proc. Acad. Nat. Sci., vol. 16; 211-214, 1864. Piscataway Creek, and the Marlboro rock, cited above, are both in Maryland.

Survey] ferret out my skulking species of paleozoic shells. May the recording angel help me. God and I knew them once, and the Almighty may know them still. A man's memory is no part of his soul.

In 1870, Conrad was assistant in Invertebrate Paleontology on the North Carolina Geological Survey, making his home with Dr. W. C. Kerr, the State Geologist. Prof. Cope was engaged at the same time to work up the vertebrate fossils of North Carolina. In 1871 Conrad was again at work in North Carolina. His services were given free for both engagements, each period of work lasting about three months[50]. Dr. Kerr's report on the Geology of North Carolina was offered for publication in 1870, but for lack of funds was not printed until 1875. In this report there are two papers by Conrad[51].

Elizabeth Kerr Atkinson, the youngest daughter of Dr. Kerr, is still living (1932) and well remembers that "Professor" Conrad, as she and Dr. Merrill both style him, came to her father's house in Raleigh in early springtime of 1870. He worked at the Museum and accompanied her father on his field trips to the North Carolina coast. The following letter from Conrad to James D. Dana, which was published in the American Journal of Science[52], gives a glimpse of his activities at this time (1871):

I have been labelling the collection of fossils at Raleigh and am now exploring. I have heard so much of the mixture of the Miocene that I was delighted to see the beds where it occurs. I thought you would like to have a sketch of them. They run between 3 and 5 feet deep and amid a portion of it we found only "green sand" fossils and they are extremely rare. The marl is fine sand mixed with gravel evidently having been rolled on the surface of the earth. In company with Col Yellowby of this place, I was walking over Marl Heap when I picked out of the marl a horse tooth, which I think is Leidy's *E. Fralermus* . . . (*fraternus?*)

Mrs. Atkinson further writes concerning Conrad's relation to the family:

He was such a gentle personage,—very lean and gray; seeming to children vastly old; a great walker however. He loved our Spring and the lanes when Cherokee roses bloomed.

In those days when breakfast—especially in the South—was a banquet, compared to its present proportions, his diet was pre-

50 Merrill *Contributions to a History of American State Geological and Natural History Surveys*, Bul. 109: 380, 382, 1920.

51 *Descriptions of New Genera and Species of Fossil Shells of North Carolina*, pp. 1-25; *Remarks on Some Genera of Shells*, pp. 26-28

52 Am. Jour. Sci., 1: 468. The letter is posted from "Greville", (Greenville), Pitt County, North Carolina.

> pared by my mother: bran, biscuits, and sour milk! I think this was his menu for *all* meals. On this (diet) his work and long walks were maintained to very old age. He was happy with us.
>
> The following year (1871) he wrote to ask if he might return for bloomtime, and did, for several months again.
>
> He sent my brother quite a fine telescope; my sister a Geneva Gold watch and chain; my mother a picture. I was of negligible age. I inherited the watch. (Mrs. Atkinson wrote me that she was still wearing the watch, and preferred it to any she had ever owned.)
>
> On Professor Conrad's return to Philadelphia he published, or had published, a tiny book of poems (a copy of) which he sent to my mother with a charming letter.

His contentment and happiness in the home of those devoted friends is mirrored in his poem *Raleigh,* which is found only in the supplement to the collected volume of poems published in 1871 by his nephew, Dr. Charles C. Abbott:

RALEIGH

I love to walk the stately avenue
Of oak and pine which skirt fair Raleigh's hill,
In the prime days of March, when early dews
An essence from the violet's bloom distil:
When winds are warm, as if from Araby,
And skies as sunny as the sapphire gem;

. . . . . .

My heart is with you while I roam in sadness
In uncongenial wintry scenes of snow,
I seem to tread again your paths in dreams,
Where the swift brook has cut the rock in twain.
Or, 'neath the orange-hedge, my spirit seems
To listen to the mocking bird's refrain,
While the broad mantle of green clover shows
Its ample folds the brown earth's emerald green.

. . . . . .

It is but Nature's prodigality
To scatter blessings every one receives,
And from her hand, so liberal and so free,
A shower of roses buries the green leaves
Where healthy children's cheeks of damask flirt
With gaudy flowers. This Raleigh, is thy pride—
An airy city of the hill, and girt
With floral pageantry serenely dyed.
When lovely April dances, violet-crowned,
And reign sweet regent of the vernal pime,
When rosy influence fills the air around
And in children's faces grows sublime!
And Raleigh, girt within thy scanty lines,
There are kind hearts and friends who draw me to thee;
Who offer welcome to hygeian pines,
And make them pleasant when I wander through them.
These would I fain re-visit, and once more
Tread the green avenue in benignant May,
Or linger by the clear stream's sunny shore,
To dream again the April hours away.

THE CLOSING SCENE

After Conrad's return from North Carolina the second time, there seem to have been no further long excursions. He went back to his retreat in Trenton, New Jersey, and lived there in such simple fashion as to be almost forgotten by his own townsmen. During the last years of his life we find that he contributed to the Proceedings of the Academy of Natural Sciences, Philadelphia, *seven* papers, at least one each year with the exception of 1873 and 1876.

That Conrad left a mass of unfinished projects does not reflect on his ability; it is rather the reaction of physical indisposition and the lack of congenial encouragement on a fertile and ambitious mind. When we consider that the complete bibliography of his writings, including his poetical and popular contirbutions, contains 197 entries, it would seem that he had not been idle or indifferent for any considerable time in his life.

Conrad's death occurred on August 8, 1877, he then being in his seventy-fifth year. He was buried in Trenton. The following notice appeared in the Trenton *Daily State Gazette* on August 11, 1877:

> The death of Mr. Timothy Abbott Conrad, in this city, a few days ago, afforded a striking example of the modest and unobtrusive life of the scholar. Here was a man known and honored among the great and learned of all parts of the world, and although having made his home in this city his whole life, was scarcely known here outside of his own family. . . . His death was the first intimation to most of our citizens that we had so distinguished a man among us. In sending him a letter some time ago, the Emperor of Russia addressed him as Lord Conrad! He was a distinguished member of the Imperial Society of Natural History, of Moscow.

Relics of T. A. Conrad
Upper: Group of shells and corals designed and prepared by Conrad
Lower: Geneva Watch and Chain presented to the daughter of Dr. W. C. Kerr, State Geologist of North Carolina, and inherited by her sister, Elizabeth Kerr Atkinson

PART SIX

THE POETICAL CONCHOLOGIST

THE

NEW DIOGENES.

A CYNICAL POEM.

Is happiness our aim
Why then contentment in a tub is safer
Than piling glory on Ambition's crest
Till it o'ertops Olympus.
N. DIOGENES.

PHILADELPHIA:
PRINTED BY MERRIHEW AND THOMPSON,
No. 7 Carter's Alley.
1848.

Title Page of *The New Diogenes*

PART VI

THE POETICAL CONCHOLOGIST

For Timothy Conrad writing poetry had a peculiar fascination. It would not be straining our imagination to say that he would have preferred to quality as a poet with an urge for science rather than a scientist with a passion for poetry. But the ability to appreciate the classics and the skill to produce verses that survive their copyright are seldom matched in the same individual. In Conrad's case his familiarity with the great poets, ancient and modern, was truly remarkable, but his own compositions were nearly always lacking in merit. He had memorized many long passages from his favorite authors, the recitation of which on his long walks afield proved a blessed corrective of his morbid tendencies.

To the expression of his feelings in verse Conrad turned for relief, and found it; but when his hunger for appreciation was fed with indifference, and sometimes with ridicule, he rushed back to his scientific work, there to find a happier deliverance. Perhaps if Conrad's friends had had some psycho-analytical training, they would have turned his poetical complex to good account. As it was, he suffered the more keenly because his qualifications for research work in science were neutralized in the opinion of a few phlegmatic technicians by his artistic temperament. Conrad yearned to express his inner feelings after the manner of Milton; but too frequently he fell under the spell of Young or Pollock, his *New Diogenes* throughout reflecting the drabness of their spirits.

THE NEW DIOGENES

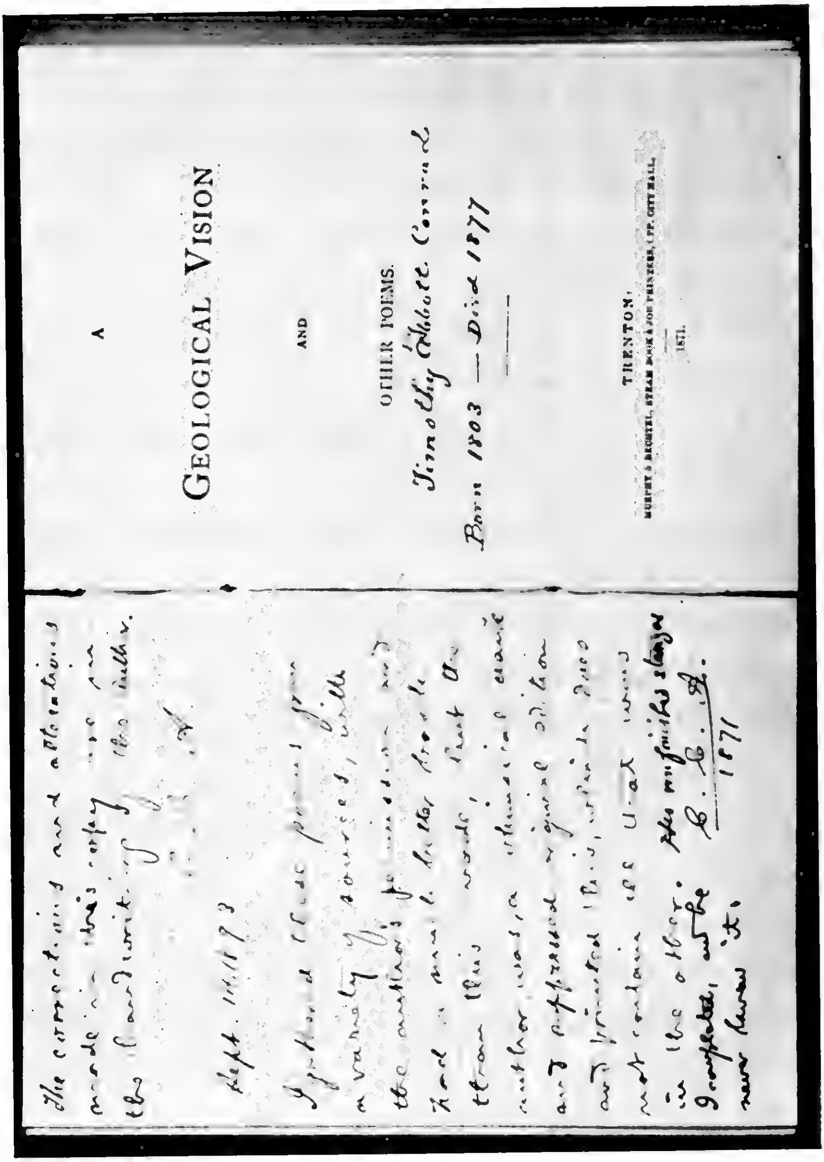
This earliest and longest of Conrad's poetical writings was written when every man's hand seemed to be turned against him. His experience with the New York State Survey had not been any too happy, and there were many periods when he was almost idle as far as scientific work was concerned. Let us not peer too curiously into these cheerless corridors of his life. Let us think rather that these "twenty-five hundred lines of faultfinding" had their value for him, if not for us. The mere task of writing them was a safety-valve; as we say, it served to get some things off his chest. The little book was published in 1848. It was never popular. The edition, even though limited, was never exhausted. Even as a literary relic, the book never developed any instrinsic value. Later on, Conrad, in effect, disowned his own work; rather, he seems to have felt so ashamed of it that in presenting a copy to his intimate friend, John Ford, he wrote in pencil on a slip of paper, which is still preserved in the copy[53].

Don't ever let it out that
I am the author of this book.

The poem itself is in three parts, none of them with title, each divided into cantos. Now and then there rises on the crest of the author's turbulent thought expressions which show the clear thinking of a truer self. At other times the poet writes with the consciousness of his own mental disquietude, finding in *Memory* a curative principle, a deliverance from the follies of youth. He speaks of Science as "Memory's hopeful child". Again he finds in the songs and habits of the birds a proof of the melancholy forces in Nature which hold dominion over his spirit.

Then fall the night—the moon's serenest rays
Inspire the mock-bird's many-voiced lays,
And chase the ruby light with silvery hue,
Which dreaming melancholy loves to view,
While listening to the spirit-soothing rill
The piping frog, the plaintive whip-poor-will;
The zephyr, in the scarce seen bushes sighing,
And the faint thunder-peal, in distance dying—
Sweet contrast to the busy life of day;
Its cheerful music and its proud array.

[53] This copy came into the possession of Prof. Gilbert D. Harris through the late Charles W. Johnson, Curator of Insects in the Boston Society of Natural History, whose wife was the daughter of Mr. Ford.


A

GEOLOGICAL VISION

AND

OTHER POEMS.

Timothy Abbott Conrad

Born 1803 — Died 1877

TRENTON:

MURPHY & BECHTEL, STEAM BOOK & JOB PRINTERS, (UP. CITY HALL.

1871.

Title Page of *A Geological Vision*

What an outreaching of his cramped and tortured soul we find in the closing lines of this poetical diary! We might call it a valetdictory to the world which had offered him so little in the way of joy and blessing:

Farewell the world! Of thee I think no more,
Nor mark the human surges lash thy shores:
They with the passion's wild tornado play,
And no Orion's melody obey.
Earth glides away, as swift as boys o'er ice,
And years are here and vanish in a trice.
The great phantasmagoria dies away,
And pictured space is only for a day.
I wrap my mantle close, prepared to fall,
When the death-angel and the fates shall call,
In other worlds I humbly trust to miss
The crimes, the follies, and the pains of this;
And to remember, in the life above,
Naught of this planet but its angel, LOVE.

A GEOLOGICAL VISION

In 1871, Conrad's nephew, Dr. Charles Conrad Abbott, the distinguished naturalist and author, published a small volume of Conrad's poems under the title *A Geological Vision.* The writer has before him two copies of this collection of verse. They vary in a rather unique way. In one copy, on the fly-leaf, in the handwriting of Dr. Abbott, is the following statement:

The corrections and alterations made in this copy are in the handwriting of the author. C. C. A.
Sept. 14, 1893.

I gathered these poems from a variety of sources, with the author's permission and had a much better book than this made, but the author was a whimsical crank and suppressed original edition and printed this, which does not contain all that was in the other. His unfinished stanzas I completed, and he never knew it.[54] C. C. A.

1871

This copy of *A Geological Vision,* which Dr. Abbott deplored as being incomplete, really contains five poems less than his original edition. A comparison of the two copies reveals the following similarities and dissimilarities:

The former (shorter) volume, Conrad's own personal copy, was inherited by Dr. Abbott, and later by his son, Mr. Richard Mauleverer Abbott, who still owns it; the latter (longer) vol-

[54] The last sentence of this note, and the date, 1871, are written in a different ink.

ume was an autographed gift to John Ford, through whose daughter, Mrs. C. W. Johnson, it reached Prof. Gilbert D. Harris, who still has it in his library. The former contains thirty-two poems, pages 1-116; the latter contains in addition a supplement of five poems, pages 117-132. The former contains corrections in Conrad's own handwriting, made with a quill pen; the latter contains most of these corrections, which, however, have been printed on a sheet of book paper, cut apart and pasted over the lines that Conrad desired to change. Both volumes were bound in green cloth, the thirty-two poems being first stapled together in pamphlet form, but the supplemental section was not stapled. In each volume the index covers only the thirty-two poems.

The five poems in the supplement, to the publication of which for some reason Conrad objected, are *The Zig-zag Fence; Raleigh; Motion, Heat, and Light; Obscurity;* and *The Muses, the Daughters of Memory.* None of them are dated. Some of them have such merit that we wonder why Conrad should have discriminated against them. Two deserve special mention: *Raleigh,* part of which has been quoted in the previous chapter; and *Motion, Heat, and Light,* in which the poet presents his proofs for the catastrophic theory of the geologic ages, to which at one time he was attached. In this poem he arrays pigeons, butterflies, and dogs against the evolutionary hypothesis, and ridicules any material changes beyond the maturity of the species:

. . . . for the dog
Through all its various forms, will bark forever,
And by its bark refute development
Beyond the fixed boundary of its tribe
By outgrowth of its normal canine sphere.

In this connection it would be interesting to note Conrad's change of front, due to the influence of Lyell, as shown in a letter to Judge Tait, written in 1834:

> Geology has been completely revolutionized of late, by Lyell, and all our poetic dreams of catastrophes, and violent revolutions, so far at least, as relates to newer secondary and tertiary formations, are like the passing visions of Slumber, dismissed from the memory of Ecologists [Geologists?]. Lyell proves that all these changes are referable to causes similar to those now in active operation, but I have no room to give his proofs.

The first poem in *A Geological Vision* opens with the lines:

Great Nature never rests; her features change
Unceasing as the measured flight of time.

Indeed the various aspects of Nature furnished the poet with most of his illustrations and allusions. As he walked through the fields and the forests, the fauna and flora were alike familiar; and in his intimate understanding of these secrets of Nature, he has been well likened to Thoreau.

That the birds held large place in Conrad's interest is evidenced by the space they command in his poems *Spring Birds, Spare That Bird,* and *The Humming Bird.* In *Spring Birds* ten Southern species are named. In his lovely poem The *Peewee* we have an unmistakable allusion to Claiborne and to its scientific treasures:

Once in a kindly winter day,
By Alabama's waters rude,
I saw thee on the mossy spray
That stretched in leafless solitude.

Upon the steep bank's crumbling side
Enriched with many a fossil shell;
And truly, 'twas with joy and pride.
I saw thee in thy precinct dwell.

There is a beautiful prose poem in his story of Claiborne published in the *Advocate of Science,* previously referred to, which was doubtless inspired by the same busy little Pee-wee, and which we make space for here:

Whilst pursuing my researches among the sylvan and vine-clad cliffs and precipices, which constitute the beautiful scenery of the Alabama river at Claiborne, I have often been visited by the Peewee fly-catcher, with his simple but eloquent note. Perching near me on the branch of a small tree, he views me with a degree of fearless curiosity, which would seem to indicate that he recognized an old but half forgotten friend. Sweeping from his perch in pursuit of the insects which sport around he describes a circle in his short flight, and returns to his familiar tree. I fancied he was no stranger, but probably an individual to whose simple melody I had listened with no ordinary pleasure, as I strolled along the romantic margin of the Schuylkill or Wissahickon, on the first fine days of the early spring. I had ever admired the beautiful and appropriate name of *nunciola* or the messenger, applied by Wilson to the familiar bird, who is of all others most truly the harbinger of the vernal season in the north, rejoicing in his return to his native scenes, whilst yet the swallows are lingering in exile, and the snow still remains in the unsunned ravines; whilst those twin daughters of humility, the *Draba* and *Epigœa,* are perhaps the sole plants which gemmed the cold moist earth with their humble blooms, and the red flowering maple the only tree which ventures to put forth its blossoms in mockery of the storms which winter sends back in his angry retreat. Lone bird, thou bringest back to me the light and the glory of the joyous days of my childhood, and now thou are fleeing like myself from the icy embrace of winter, thou seemest like a messenger of glad tidings, just come from my distant home, to visit with songs of rejoicing my solitary terrace on the rock. A few days past perchance, on the margin of the Schuylkill, thou wert listened to by some friend who little imagined that I should ever give audience to the same winged minstrell on the banks of the Alabama.[55]

Conrad's nature interest is further shown in the poem *To Miss ————, with a Group of Shells and Coral,* which indicates a diversion that occupied Conrad's leisure in later years. Whether or not this hobby was the revival of an earlier avocation we do not know. He would arrange in an artistic form a small group of shells with a centerpiece of coral, cover them with a bell glass, and present the whole as a love gift to certain intimate friends. We would fain believe that the one which was accompanied by this particular poem[56] was intended for Miss Mary, the twelve-year old girl in Claiborne, whom he almost worshipped. The closing lines are:

The sea-king crowns no mortal brow with laurels,
But his fair Nereids have arranged a few
Shells 'neath the white arms of the branching corals
And send these treasures of the deep to you.
But as I rose above the tumbling surges,
My heart, resolve and courage almost failed;
For when the shell above its home emerges.
The sea-born colors instantly have paled.
Such as they are, they form an ocean present
Which the bright sea-nymphs beg you to accept;
And as their agent I affirm 'tis pleasant
To know that I my hearty promise kept.

In his lighter mood Conrad painted Nature's picture in the varied aspects of the changing seasons. *October,* whom he addressed as "Thou fairest of the Autumn sisterhood", is dominated by a joyous and buoyant muse; and *Wissahickon in April* contains fulsome eulogies of Spring, and of many of the wild flowers of a northern April. This latter poem is also reminiscent of the joys of his youth.

When our free hearts exultantly went forth
Beating beneath the touch of April joys.

[55] *Advocate of Science,* Vol. I: 28, 29.
[56] A curious thing appears in the printing of this poem. In both copies of the book, all of the poem, with the exception of the first four lines on page 112, has been revised (?), reset in the same type, and pasted on the stub of the original page.

Similarly *Valedictory to Abbottsville, Home, To Twin Aged Oaks,* and *The Beech Tree* breathe tender and beautiful expressions of his childhood.

His longing for home is touchingly phrased in the poem which bears only the title *Stanzas*:

Alas! for him who feels no warm heart beating;
Who hears no music from affection's lips;
Whose gaze no welcoming blush is daily meeting—
This life for him is in a dark eclipse.

His longing for home also creeps out in the poem *Francis Moore, M. D., Late Geologist of Texas.* He seemed to recall one or more visits to "Rockshade Cottage", the Texas (?) home of his friend, but otherwise he has left no proof that he ever visited that State[57].

. . . . . Yet, the clustering trees
O'erlook the roof; —to others it may seem
A tiny Eden, as it did to me
When thou wert there. How desolate now it seems!
I miss the cheerful welcome; and I miss
The tiny feet upon the April grass
Around the door. And sadly do I miss
The wife's kind greeting in the radiant dawn
Of regal May. O fair, departed scene!
As sweet as transient; on my inmost heart
Art thou limned by Memory's art
In colors of the prism.

Sometimes Conrad returned to his theme after an interval of years, either completing it or adding another part to it. *Ambition,* Part One, is dated "1869"; Part Two "Sept. 4th, 1870". *Mars,* Part One, is dated "July 27th, 1846"; Part Two, "Sept. 4th, 1870", the latter date being apparently one of poetical housecleaning.

Conrad made some interesting corrections in the poem *The Lost One.* The footnote, in which he apologizes for using one of Shakespeare's lines, is deleted; and the last lines are revised to read

A seraph's smile shall bid thee welcome hither
Thy spirit freed, attain to endless rest.

Both the first line above and the footnote are retained in the edition that contains the supplemental poems, and the original Shakespearean line is restored—

And flights of angels sing thee to thy rest!

[57] This Dr. Moore is not to be confused with an even dearer friend, Dr. W. D. Moore, sometime Professor of English in the University of Mississippi, elsewhere alluded to in this paper, and a coadjutor of Dr. E. W. Hilgard when he was State Geologist of Mississippi.

Quite in contrast are his poems *Discontent* and *The Watermelon.* In the former—written evidently late in life—Conrad's Muse is sad; but in the latter his spirit is full of rollicking humor. If he had not located his watermelon patch in New Jersey, we might suppose that this was one of the ditties composed in Mobile for Lucinda's party. After paying his respects to apples, bananas, and "Samarcand" fruits; and after eulogizing Georgia peaches, Peruvian "Chirimoyas", Damascus figs, Florida oranges, and Barbary dates, he gives the palm to a *vegetable* fruit, which in the South would certainly surpass in size and flavor any melon that the State of New Jersey could hope to grow. We quote three of the thirteen stanzas:

I make thee, sweet melon, my favorite topic—
Thou chief of the offspring of sun and of dew!
In spite of bananas, the pride of the tropic,
Or famed Chirimoyas the boast of Peru.

Give us cool "Mountain Sweets" from New Jersey, nor ask us
To sigh for the grapes of some orient land—
The peaches of Persia; the figs of Damasus;
Or the idolized fruits of remote Samarcand.

The poet may sing of the Orient spices,
Of Barbary dates in their palmy array—
But the huge rosy melon in cold juicy slices,
Is the Helicon font on a hot summer day.

On a small creek near Trenton which has filled the lowlands with a rich alluvium and is now much overgrown there is a beech tree on which Conrad cut his initials in 1855. But near the old brick house and the site of the ancient mill on Crosswicks creek, at Abbottville, there is a more majestic beech which has counted at least two hundred years on its calendar. It stands on a hill-side, deeply rooted, and well protected. On this tree when Conrad was a care-free boy he cut his initials and the date, 1819, and though the years have greatly broadened the letters, they are still clear and distinct. It is this tree to which Conrad refers in his poem on the *Hummingbird*:

Oft have I seen thee trim thy wing
At rest o'er the Impatiens pale;
Where cat-birds and the brown thrush sing
In Abbottville's wood-cinctured vale.
'Tis there the beech tree's smoothest bark
Records thy boyhood and o'erlooks
In that deep valley's bosom dark.
The meeting of two lucid brooks.

This situation is the picturesque association of virgin woods, hill country, and meadows broken with deep ravines and tangled copses in which the wild birds and animals have ever been at home. This is the territory that furnished Dr. Charles Conrad Abbott with materials from more than a dozen nature books, and which became the mecca of many visiting naturalists and friends. At the present time there is a most promising movement on foot to reclaim the ancient Abbott holdings and convert them into a perpetual wild-life sanctuary—fitting memorial to New Jersey's distinguished Naturalist. To this beautiful retreat have come in the past archeologists questioning the successive civilizations of the Red Man who left full evidences of his occupancy; botanists and ornithologists, who find rare and interesting species here; but mostly students from various schools and colleges, knowing that this particular habitat has no rival in all the State.

PART SEVEN

A COSTLY CONTROVERSY

PART VII

A COSTLY CONTROVERSY

Tantæne animis cælestibus irae
VIRGIL, LIB. I, LINE 11.

"Can heavenly natures nourish hate
So fierce, so blindly passionate?"

How long would it take a steamboat to go from Claiborne to Mobile in 1833? Steamboat statistics during this period have an important bearing on our story.

Between 1820 and 1860 the steamboat was the chief means of travel in Alabama. Justus Wyman, writing in 1819, states[58] that the chief cities of Alabama at that time were Mobile, Blakely, Claiborne, St. Stephens, and Cahawba. All of these have perished with the exception of Mobile. All the river towns, including Claiborne, St. Stephens, and Cahawba, rose with the steamboat, were hailed as coming cities of the State, and likewise fell when steamboat transportation declined. The first steamboat used in Alabama was built at St. Stephens[59], and the last of the Gazzam fleet of river steamers was dismantled about 1888. The rising influence of the railroads hastened the decline of river transportation, which was further crippled during the War between the States.

During Conrad's stay in Alabama the two real competitors of the steamboat were getting under way. The first railroad in the State, extending from Tuscumbia to Decatur, a distance of forty-seven miles, had just been completed, and others had been finished on paper. With the building of better roads there was a

[58] Geographical sketches of Alabama Territory, *Trans. Ala. Hist. Soc.*, Vol. 3: 115, 1899.

[59] Fraser *Early History of Steamboats in Alabama*, in Alabama Historical Studies, Auburn, Alabama, 1907.

rapid development of inland territory, and hence an additional incentive to railroads to capture business.

On some of the maps of the period were listed both steamboat landings with the distances between them, and stage and post routes with information as to stage schedules. For example, the stages that left Montgomery on Mondays, Wednesdays, and Fridays for Milledgeville, Georgia, arrived at their destination three days later. The Tanner map, used so freely by Conrad, furnished only steamboat information.

In the thirties the steamboats had not reached the zenith of their importance. They continued to improve in speed and in the sumptuousness of their equipment, but the transportation of cotton was their big business. In 1846 Sir Charles Lyell traveled on the palatial *Amaranth,* which was richly upholstered and elegantly serviced. The steamboat *Dellet* had a silver service, costing a thousand dollars, which was presented to it by the Dellet family, and is much treasured by its present owners.

It was possible for a steamer traveling downstream to make the trip from Montgomery to Mobile faster than the stage could. But what about the time it took a steamboat to go from Claiborne to Mobile? We are interested in this matter particularly as it affects the mail service of Conrad's day. The *Planter's Almanac,* of 1836, published by Sidney Smith, in Mobile, states that the distance between these two large towns of early Alabama was 113 miles, and that the fare was $4.00. The average rate downstream was twelve miles per hour. Of course, the time schedule depended on the number and length of the "landings", which would vary with the seasons of light or heavy cotton loading. Sometimes there would be races between these great 200-foot steamboats.

In 1822 the "fast-moving" *Osage* made the trip from Mobile to Claiborne—upstream—in twenty-six hours, on which trip she stopped twice to load freight. In 1824 steamers were traveling downstream in floodtime, when there was less danger from snags, at the rate of sixteen miles an hour. All of this discussion of the transportation statistics has little bearing on our story except to show that a sack of mail might have been thrown on a waiting steamer at Claiborne and transferred to an ocean vessel in

Mobile in the year 1833 in less than ten hours, or between sundown and sunup. At that time steamers did not tie up for the night, for the pilots knew every landmark on the shore and determined their course partly by lights reflected on familiar objects on the river banks. Conrad stated that he passed Cahawba in the night and that he first reached Claiborne in the night.

We are more interested in finding out how long it would have taken a letter posted in haste in October by Mr. Conrad in Claiborne to reach Dr. Morton in Philadelphia. Fortunately, we do not have to make any calculations, nor even to accept the suppositions which are in print that it would have taken "three weeks" or "a month at least" for a letter to pass from the northern city to the southern village. The information was of such importance to Dr. Lea that he interviewed the Postmaster at Philadelphia, who informed him that it would require at least twenty days. Curiously enough, Dr. Lea in attempting to prove one thing unwittingly proved another, which was in Conrad's favor. His quotation from a letter written by Judge Tait to him revealed the fact that from fourteen to sixteen days was all that elapsed between the posting of a copy of his *Contributions to Geology* in Philadelphia and the receipt of the book by Judge Tait.[60]

Again, we learn that Conrad made the trip from Mobile to Sandy Hook in twelve days. Mail could have reached Philadelphia in the same time that it could get to New York. If then we add a full day for the steamboat connections from Claiborne carrying mail for that steamer, we can see that Philadelphia and Claiborne were not necessarily much over two weeks apart, if as much as that. Just what all this has to do with the controversy between the two authors in the same field of study will appear at the proper point. It is the story of a controversy that settled nothing between the principals, but wrought great confusion for science.

[60] Judge Tait's letter to Dr. Lea dated December 29, 1833. In this letter the Judge states that ten or twelve days ago he had receivd Dr. Lea's favor of December 3, together with a copy of his book. In the year 1840 passage from New York to New Orleans, over the "New Southern Line", was guaranteed to take (under normal conditions) no more than one week. (See *Alabama Highways, March* 1928.)

A PROMISING COOPERATION

We have seen that when Mr. Conrad started south he had the most cordial endorsements from Dr. Lea. One could not have desired more. The Doctor could have financed the entire expedition and never felt it, while there was honor enough in the results which Conrad conserved to have made them both famous. Here was a basis for constructive coöperation between the conchologist and the paleontologist; for each could have beautifully supplemented the interest and need of the other.

It has been impossible to locate a copy of the original subscription list which made possible the expedition of Mr. Conrad. It certainly was not an expedition organized or financed officially by the Philadelphia Academy of Sciences, though it is evident that the principal subscribers were scientific friends of Conrad connected with the Academy; such as Morton, Poulson, and Pickering. In addition Conrad counted largely on the sale of his *Fossil Shells of the Tertiary Formations* and on the disposition of sets of the shells themselves, which fossils were still to be collected in Alabama and placed in the hands of his agents. Possibly some money was raised in that way, but Conrad hesitated to promise the publication of new numbers of his book until the sales of previously published parts justified the expense involved.[61]

While in Alabama Conrad subsisted on the generosity and hospitality of his friends, many of them made as he went along. At the outset, Judge Tait assured him that his expenses would be inconsiderable; and so they seem to have been. Apparently he had little to pay out for travel; nothing for board and keep at Claiborne, Mobile, St. Stephens, and Erie; and what other incidental expenses he had to meet were largely provided for by Judge Tait and Mr. Toulmin, and a Dr. B. Smith of Philadelphia whose particular connections or interests we have not been able to trace.

It is certain, however, that before Mr. Conrad left Philadelphia there was a very definite understanding that he should have the right to carry on the publication of his *Fossil Shells* and to

[61] Cover of Part Two, *Fossil Shells,* page 4.

describe all the new species which he might discover. In consideration of Dr. Lea's subscription, Conrad was to forward to him all the fresh-water shells that he could collect in the prosecution of his studies.

The letters which have recently come to light, and which have been made available to the writer, clear the matter so definitely that they leave no room for question. We quote from a few of these letters—letters, which if they had been accessible to all concerned long ago, might have prevented the confusion that a hundred years have failed to clear. Conrad's friends seem to have made a faithful effort to reconcile the differences which estranged the jealous Doctor and the peppery-tempered student; but the situation took on the nature of a stubborn contention in which neither party would yield a point. And although both Mr. Conrad and Dr. Lea remained members of the Academy of Natural Sciences to the end of their lives, and continued to submit papers for publication in its Journal and Proceedings, it does not appear that they ever reconciled their differences.

On January 17, 1833, and again on April 29, Dr. Lea wrote to Judge Tait in glowing endorsement of his young friend, Mr. Conrad, and expressed his confidence in his ability. He made full and unequivocal statement that Conrad was authorized to complete the studies already so auspiciously begun on the *Fossil Shells of the Tertiary Formations.*

Because of the pertinent bearing two of these letters have on the controversy, they are here again quoted in part:

Jan. 17, 1833.

I addressed a few hasty lines to you some weeks since by my friend Mr. Conrad who visits the Southern States with an intention of examining their natural products & their geological formations. He is anyway entitled to your kind attention as an ardent student of nature & I feel assured you will do anything in your power to promote his views.

April 29, 1833.

. . . . I am glad our friend Mr. Conrad has arrived safely under your hospitable roof. Your kind attentions to him will ever I am sure be appreciated by him and you have the thanks of the friends of science here for your constant and active endeavors to promote the knowledge of Nat. Hist. of the state you reside in.

Dr. Morton having communicated to me the desire of Mr. C. to remain longer in the South, made a proposal to me to advance him money. I am desirous of placing $50.00 in his hands

> & have to beg of you the favour to do so for me . . . . .
> I am sincerely rejoiced that you have in Mr. Conrad an intelligent geologist who will do the geology of the State justice in whatever he may publish respecting it — He will be able from the personal examination of the deposits to do the matter far better than I could. The examination of hand specimens & the absence of measurements tend to the risque of erroneous conclusions & as my object has & ever will be, I hope, the promotion of science I must willingly yield to Mr. C. who has studied the deposits of the upper formations much more perfectly than I have done.

These were days of cordial confidence and promising coöperation, for Mr. Conrad wrote to Dr. Morton of Dr. Lea's letter to Judge Tait in his behalf, and expressed his appreciation of Dr. Lea's interest in him.

A CLOUDED SKY

Seven weeks after Conrad's arrival in Claiborne—in fact, on April 22, when he made his first trip to Mobile—he shipped to Dr. Lea a box of fossils collected at Judge Tait's request. Of the shipment mentioned, undoubtedly one box went to Dr. Morton. To my mind this early shipment of Claiborne fossils to Dr. Lea is not only a fitting testimony to Conrad's industry, but also a substantial evidence of his confidence in Dr. Lea. He had not the slightest suspicion that Dr. Lea would shortly withdraw his support and retract his statement that he would "willingly yield to Mr. Conrad", etc. In fact, we cannot impugn Dr. Lea's motives on April 29th, or earlier. What happened to change his heart is difficult to ascertain at this distance of time. Perhaps it was some inadvertent provocation on the part of those who were acting as Conrad's agents; perhaps it was the realization that he had relinquished to Conrad much more than he would have done had he known what a rich mine the Claiborne beds of fossils would turn out to be. Possibly his triumphal tour of the scientific centers of Europe had eclipsed his interest in fossils to such an extent that he had not really sensed the wealth of descriptive opportunities packed up in the boxes which Judge Tait had sent him.

Dr. Lea would have us think that he had a deed in fee simple to all the data which the bluff at Claiborne might furnish, and it did not occur to him that Judge Tait had a perfect right to supply other scientists and scientific institutions with the same material if it was desired by them. From a letter written by Judge Tait to Dr. Morton in October 1832, we learn that the Judge was elected a corresponding member of the Academy of Natural Sciences while he was traveling in the West between April and October of that year. In his letter of acceptance the Judge offered to collect for the Academy "a box of organic remains" and "in due time" specimens of fresh-water shells and land shells. It would appear, then, that apart from the materials which were supplied to Dr. Lea through Judge Tait's generosity some went to the Academy.

What probably happened is this: Late in the spring of 1833, Lea must have been impressed with the fact that Judge Tait had too modestly pictured the Claiborne possibilities, no doubt after a more careful examination of the material received from the Judge between 1829 and 1832. By the middle of May, 1833, he should have received the shipment that left Mobile on April 22. Even a cursory examination of the material on hand made it apparent that every shell he touched was new to science. He seemed to have persuaded himself that for him to make a report on the Claiborne material now in hand would be no infringement on Conrad's rights. He began to work on the description of these fossils, as he said later, "with double stimulus"; for he was amply supplied with specimens and he had the sharp eyes of his two boys for microscopic work. In less than four months, to be quite accurate by the twenty-second of August, he had completed the descriptions of 202 fossils.

Dr. Lea's own statement, contained in several letters of attempted self-justification addressed to Judge Tait, are rather illuminating. In the letter of December 14, 1833, he wrote:

> I went on and finished the descriptions of all the species (200 as far as then made out) you sent me except those which Mr. C. had taken from me by previous publication. These I respected as much as if they were made by Cuvier himself so far as I could make them out— As soon as this was done I called on Dr. Morton to inform him of the course I had considered it my duty to you and myself to pursue and that I was not desirous that Mr. C. should be put to any more inconvenience or loss than was necessary and that I thought he ought to be informed of it without delay. In doing this I then felt & I do now that it was an act of kindness to one who had injured me. I wished Mr. M— to write but stated that if he thought it better that I should I would do so— He wished me to do so & he promised to

call within 2 days to read my letter & to give me Mr. C's address not supposing he had left you. Four days went over without seeing him. He then sent a friend to inform me that he considered I had no right to publish my descriptions! ! ! & as I would not suppress my labours I was informed that Dr. M. had written to Mr. C. & that Mr. C's 3d No. would appear next day (Tuesday 27 Aug.) . . .

One can see how the storm thickens from Lea's letter of December 2, 1833:

On informing Dr. Morton of this . . . he told me that he considered that *I had no right to do it.* In answer I told him I could not see that any one could doubt my right to describe fossils that a friend had sent me several years before— He said under the circumstances he w[oul]d consider it an infraction of our agreement. I consented that the agreement[62] should be at an end. or be continued as he might think most to (the interest of) Mr. C; it made no difference to me.— It was agreed that I should write to Mr. C— which I then did (possibly three mo since) but have never recd an answer from him—[63]

[62] Lea himself said, with reference to an agreement, in a letter to George W. Tryon, Jr., March 30, 1865:

My assistance of Mr. Conrad pecuniarily was at the request of Dr. Morton, who called on me some months after Mr. Conrad's departure. Dr. Morton wished assistance, and proposed that I should have all the new fresh-water and land shells, found by Mr. Conrad, to describe, and that I should also have a portion of the fossils for my cabinet. [Evidently there was no thought in the mind of Dr. Lea at that time that he was to describe the fossils. And there is an intimation in this letter that Dr. Lea was not an *original* subscriber to Mr. Conrad's expedition.] I never have had from Dr. Morton nor Mr. Conrad a single specimen but the *Unio* mentioned above, which was returned to Dr. Morton, he having returned to me the money advanced for Mr. Conrad. This was done on finding in the spring he had in the autumn of 1832 handed to Mr. Conrad the fossils [the Gates collections] belonging to me, without my consent and without any justification whatever . . .

In this reference Lea would intimate that he did not discover that Conrad had named fossils from the Gates collection until the spring of 1833; but Scudder in his biography of Isaac Lea said that "Mr. Lea was not made acquainted with the fact until he saw the first numbers of Mr. Conrad's published descriptions." Conrad's Numbers 1 and 2 were published in October and December, 1832, respectively, in ample time for Lea to have become thoroughly familiar with them before Conrad left for the South, probably by the middle of December. Lea could scarcely have failed to notice Conrad's statement on the back cover of No. 2, containing his plan for twelve numbers, material for which "the author expects to obtain whilst on a visit to the Southern States in the course of the present winter."

[63] That Conrad did not ignore Lea's letter is apparent in the former's letter to Morton, written on September 13th as a postscript to his

In his letter to Judge Tait under date of September 15, 1834, Dr. Lea again refers to the matter:

> Some unfounded reports, he says (were circulated about him). One was that although I had made an agreement with Mr. C. to permit him to describe all the tertiary fossils, yet when he sent them on I went to describing them without his knowledge. Now I believe he had not sent on any from your locality when I published my species — at all events I never saw or heard of them. Every shell described in the book from Claiborne came *from you* to me and I gave you credit for *them all as you most justly deserved.*

Several deductions can be made from these statements, which should be given here:

First, Dr. Lea completed his descriptions of the 202 fossils before he made any effort to acquaint Mr. Conrad with the fact that he was himself entering the field of Tertiary paleontology.

Second, Dr. Lea admitted that there was an agreement between him and others who were interested in Mr. Conrad and his work, which fact he later denied in a letter to George W. Tryon, Jr., under date of March 30, 1865.[64]

Third, Dr. Lea "believed" that Conrad had not sent any shells from Claiborne when he published his species. (He referred to his *first paper* in his *Contributions* which was read, on August 27th, before the Academy). We do not know that Dr. Lea described any shells from the box sent to him from Mobile on April 22, 1833; but we do know that his change of attitude toward Conrad came after April 29th, and that the box of Claiborne fossils could have easily reached him by the middle of May.

Years afterwards, Mr. Conrad wrote to Mr. George W. Tryon, Jr., the editor of the American Journal of Conchology, who was seriously trying to settle the matter of priority:

> Whilst residing at Claiborne, I collected at the request of Judge Tait, a box of fossils in this bed of sand for Dr. Lea, and shipped them myself at Mobile, and doubtless he described from this collection some of his species, in violation of a promise he

letter of September 11th. In this letter he gave Morton permission to repress his letter to Lea, if it has "too much gall in the ink." And Dr. Morton evidently preferred to discuss the matter with Dr. Lea than to display the indignation of his friend.

64 *Rectification of T. A. Conrad's, "Synopsis of the Family of Naiades of North America"*, Isaac Lea, pp. 43-45, 1872.

made me before my departure for Alabama, that he would yield to me the description of the Claiborne fossils. In return I agreed to send him the *Unionidæ,* which I did, but Mr. Lea commenced describing for publication both the Unionidæ and the fossils.[65]

Exasperated by the announcement that Dr. Lea had already written a book that promised to make his sacrifice for science a farce, Conrad could scarcely restrain his indignation. Immediately on the receipt of a letter from Dr. Morton revealing the intentions of Dr. Lea, he replied—on September 11, 1833—as follows:

You may guess that my surprise hardly equaled my indignation when I learned of the nefarious conduct of Mr. Lea. I call it nefarious, because Judge Tait informed him when he sent the box of fossils that they were *collected under my supervision.* Indeed I took the utmost pains to select such places as I thought most abundant in species, and even risked life and limb in one dangerous spot, and assisted the frightened servant to *carry* the box along a terrace, in the greatest danger of being precipitated on the shelving rocks below . . . But as Mrs. Tait says, if I have the mortification to lose a friend in Mr. Lea, I have the inexpressible satisfaction to find in you an attachment rarely shown by one mortal to another.''

In a postscript to this letter Conrad begs Dr. Morton, for the sake of his host's feelings, never to divulge the Judge's real opinion of Dr. Lea's conduct, as Judge Tait preferred not to engage in a quarrel with anyone. His attitude, however, has come to light indirectly in a letter from Lea to Tait, dated September 10, 1834:

What you say in regard to the neutrality you take in the misunderstanding between Mr. C. and myself is perfectly correct and exactly what I would expect of you. I feared, however, from the shortness and I then thought coldness of your letters that Mr. C. might have taken advantage of his presence with you to say something prejudicial to me.

In 1832 Dr. Lea certainly never questioned Mr. Conrad's right to work up the Claiborne material collected by Dr. Gates, which was put into his hands because he was the most promising Tertiary specialist available. The results of his study were published, and were undoubtedly known to Dr. Lea, before Conrad left for Alabama, and when he wrote his glowing recommendations to Judge Tait in the spring of 1833. Yet in August, 1833, while Conrad was going through all sorts of privations and utter-

[65] *Rectification of T. A. Conrad's ''Synopsis of the Family of Naiades of North America''*, Isaac Lea, 1872, p. 43. Conrad's letter is not dated, but was a reply to Lea's letter of March 24, 1832. Lea's reply to Conrad is dated, March 30, 1832.

ly unconscious of the Doctor's disaffection, he referred to Conrad as "one who injured me."

Dr. Benjamin Silliman, the editor of the *American Journal of Science,* did not hesitate to publish the following statement:[66]

> It is really cheering to observe that this department of American geology, is now in fair way to be fully elucidated; and we must confess our surprise that such interesting facts, such multiplied materials for geological research, should not sooner have called forth the talent and attention they so justly merit. . . . Mr. Conrad is now on a tour of the southern states, collecting material for the continuation of his work; from this cause the third number may be delayed until April or even until May. Those persons who feel interested in the geology of our country, may look forward with pleasing anticipations to the results of Mr. Conrad's journey.

NEW LIGHT FROM OLD LETTERS

The following information concerning the dates of the works under discussion will be found convenient for reference.[67] The Minute Book of the Academy of Sciences, quoted by Conrad, in the American Journal of Conchology, Vol. 1, p. 190, 1865, gives the official record of the publication of the papers:

> Aug. 27th, 1833, Mr. Lea read his paper on "Tertiary Formation of Alabama" before the Academy of Natural Sciences, describing 202 species.
>
> Sept. 3d, 1833. Mr. Conrad's work, "Fossil Shells of the Tertiary Formations," presented to the Library.
>
> Nov. 26th, 1833, Dr. Morton presented to the Library the 4th No. of Conrad's "Tertiary Fossils."
>
> Dec. 10th, 1833. Lea's "Contributions to Geology" (including his paper on Tertiary Fossils of Alabama) presented by the author.

Though Dr. Lea read his paper on the Tertiary Formations of Alabama before the Academy at its meeting on August 27, 1833, the Academy declined to publish it, giving the reason that its publication funds were exhausted. Later Dr. Lea read three other short papers before the Academy, which were bound up with his paper of August 27 to make an octavo volume, entitled *Contributions to Geology.* That this book as such did not come

[66] Review of Conrad's *Fossil Shells of the Tertiary Formations of the United States*, Am. Jr. Sci., Vol. 23, p. 405, January 1833.

[67] It is needless to say that the writer, desirous of avoiding any complications, is using freely the materials so carefully assembled by Prof. Harris and by Dr. Dall.

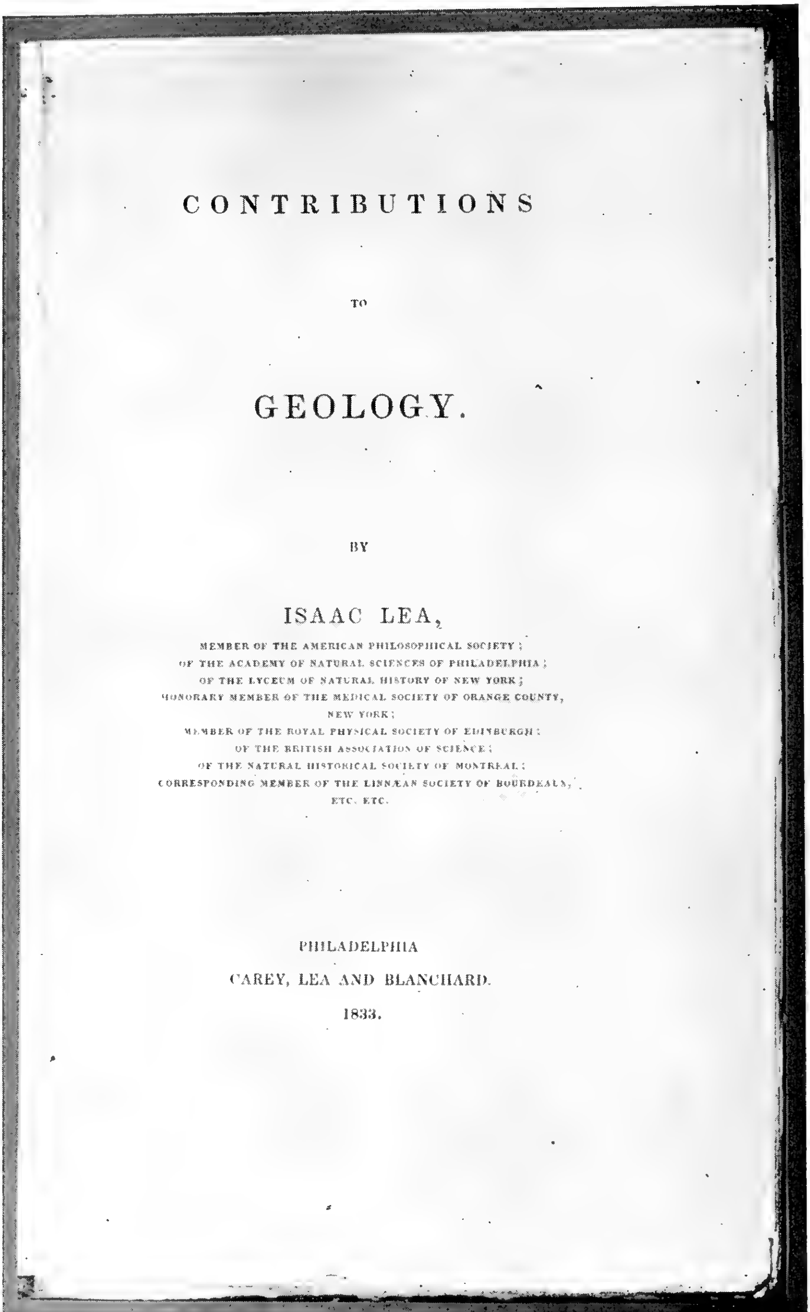
off the press before December 3 we have in the Doctor's own handwriting. His immediate concern, after the book was in print, was to get copies to Judge Tait, to the Academy, and to Prof. Silliman, who reviewed it in the January number, 1834, of the American Journal of Science. The first meeting of the Academy following December 3 was December 10, at which meeting the copy presented to the Academy by Dr. Lea was formally registered.

About the same time that Dr. Lea read his paper before the Academy, on August 27, the third number of Conrad's *Fossil Shells* appeared in print, namely on August 29.[68] It contained descriptions of forty species, and gave references to plates and figures, which plates were, however, not ready for publication. Conrad has admitted that Morton and Say prepared this number for publication. Before Conrad went south it was agreed between them all that the publication of the work would be continued during Conrad's absence from Philadelphia. In Conrad's letter, dated October 26, 1833, and addressed to Dr. Morton, we find the very descriptions which had already appeared in print. Hence it would seem that Conrad must have furnished the names of the species described, and probably a part of the descriptive matter, when he sent on his boxes to the Academy.

On November 26, the *Fourth* number of the *Fossil Shells* was presented to the Academy. It has been commonly thought that the entire text was hurriedly prepared by Morton and Say with the avowed purpose of protecting Conrad's rights. Conrad, however, wrote to Tryon in March, 1865, that he wrote every line of his No. 4 at Claiborne, and sent the descriptions to Dr. Morton for immediate publication. At any rate there was a race between the *Fourth Number* of Conrad and the *Contributions* of Lea to see which should actually qualify under the new rules of priority.

Dr. Lea's contention, never abandoned so far as we know, that the date of presentation of a manuscript should be accepted as the true date of publication instead of the presentation of a printed paper, seems to have wearied his friends and the officers of

68 Dr. Lea states that he secured a copy of this number at the publishers on August 29, the clerk informing him that it was published that day. See Lea, *Rectification,* New Edition, 1872, p. 10, footnote.



CONTRIBUTIONS

TO

GEOLOGY.

BY

ISAAC LEA,

MEMBER OF THE AMERICAN PHILOSOPHICAL SOCIETY;
OF THE ACADEMY OF NATURAL SCIENCES OF PHILADELPHIA;
OF THE LYCEUM OF NATURAL HISTORY OF NEW YORK;
HONORARY MEMBER OF THE MEDICAL SOCIETY OF ORANGE COUNTY,
NEW YORK;
MEMBER OF THE ROYAL PHYSICAL SOCIETY OF EDINBURGH;
OF THE BRITISH ASSOCIATION OF SCIENCE;
OF THE NATURAL HISTORICAL SOCIETY OF MONTREAL;
CORRESPONDING MEMBER OF THE LINNÆAN SOCIETY OF BOURDEAUX,
ETC. ETC.

PHILADELPHIA
CAREY, LEA AND BLANCHARD.
1833.

Title Page of *The Contributions to Geology* by Isaac Lea the Academy. This may be the reason for Conrad's statement in a letter to Judge Tait, posted early in April after his arrival in Philadelphia, that he was "surprised to find how universally Mr. Lea was discredited among men of science.[68a] This could not have been an echo from Dr. Morton, for he was then in the South himself.

When George W. Tryon, Jr., a very good friend of Dr. Lea's, was making a conscientious effort to settle the matter in 1865, he begged Dr. Lea to prove a closer date for the publication of his *Contributions* than the accepted and indisputable date of Conrad's *Number Four,* namely November 26. Dr. Lea labored to do so, contending that while he could not name an earlier date of *publication* the text of his *first* paper in the *Contributions* on the Alabama fossils was printed long before Mr. Conrad's presentation of his *Number Four.*

> It went to press late in September, after being reported on by the Academy of Natural Sciences early in October and probably copies were issued, but not the whole volume with the other papers. (Rectification, p. 41, 1872.)

This sentence begs the question. Besides, not a single copy of a separately printed edition of his first paper has ever been discovered.

Dr. Lea might have furnished the date which Mr. Tryon so much desired. *He had it immediately at hand.* But to state the fact, however simply, would have settled the doubt in favor of his rival, and he preferred to leave the matter indefinite. In his letter to Judge Tait, posted December 3, 1833, he says:

> The last proof (of my *Contributions*) is printing off today (December 2) and the first I have completed shall be sent to you through the mail.

This is the long-buried documentary evidence that throws Lea's case out of court. Dr. Lea admitted that he mailed a copy of his *Contributions* to Judge Tait on December 3; his letter to Judge

[68a] This controversy was the immediate reason why the major collections of Dr. Lea, consisting of his mineral cabinet, his extensive series of *Unios,* and all of his fossils with the exception of the Claibornian types, was passed on to the United States National Museum. With these collections was included an endowment, later supplemented by his family, which has served to develop in a very important way the ardent work of this pioneer conchologist and mineralogist. The Claibornian fossils, as well as the Conradian series, are in the Philadelphia Academy of Natural Sciences; the former were thoroughly studied and catalogued by Prof. G. D. Harris in 1895.

Tait shows that he could not have mailed a copy to him, nor to anyone else, earlier.[69]

Dr. Lea acknowledges that he bought a copy of Conrad's No. 4, but he never admitted that he attempted to buy up the whole edition. What he did secure he destroyed, according to Dr. Dall, not because it was offensive in type and appearance, but because its disappearance would debar a very objectional though invulnerable rival to his precious *Contributions.* He was successful to the extent of making this particular pamphlet of Conrad's one of the rarest items in scientific literature.

In Mr. Conrad's letter dated October 30, 1833, permission was given to Dr. Morton to arrange the enclosed notes so as to publish a third number of his *Fossil Shells,* in accordance with their understanding before he left Philadelphia. A few days before this, on October 26, Conrad says:

> Excuse me for sending descriptions of Tertiary fossils as I am very anxious to anticipate Lea in all the species I could.

At this time he reported that he had found 170 species and was still hard at work every day.

> Perhaps (he added) the descriptions I send you will make another no. but many of them may be described by Lea; where there is any doubt of the kind, they might be omitted. (Conrad could not have known at this time whether Lea's paper had been printed or not.)

When one reads the October letters with their many descriptions and some well-drawn figures, it seems certain enough that he wrote every line of his No. 4, as he himself claimed. Only a critical examination of these letters, which was not possible at the time of writing this paper, will determine the exact status of the case. Whether Morton and Say prepared the descriptions from the specimens which Conrad selected (as types), or whether they received Conrad's descriptions in time to use them in No. 4, is really immaterial now. We have seen that it was *entirely possible for Conrad to have posted a letter on October 30th at Claiborne, Alabama, and have a reasonable hope that it would be delivered to Dr. Morton in Philadelphia not later than November 15.* If that really happened, then Dr. Morton, with the assist-

[69] Compare also, letter of Dr. Lea, dated March 15, 1865, in his *Rectification,* New Edition, pp. 37, 38, 1872.

ance of Mr. Say, had full ten days or more to get into print a little eight-page pamphlet using Conrad's own descriptive matter. The pamphlet has, moreover, the marks of Conrad's workmanship.

Dr. Lea seems to have exhausted his own material and attempted nothing more in continuation of his *Contributions* as far as Claiborne is concerned, unless we except the paper prepared by his son Henry[69a], which was published in the *American Journal of Science* late in 1840. In this paper there are descriptions of twenty-four minute species, seventeen of which are valid. On October 10, 1833, Dr. Lea wrote to Judge Tait:

> My little fellows have assisted me greatly in searching out with their microscope many fine minute specimens from the sand & they have often said within a week ''father do write to Mr. Tait tomorrow to send you more shells''.

On March 18, 1835, the year of Judge Tait's death, Dr. Lea wrote again:

> My boys & I have just finished picking out all the good & rare shells from the box you so kindly sent me last. There are still new species from that extraordinary stratum of your bluff.

The cost of this controversy to science can hardly be estimated. One of the greatest discouragements to younger students of paleontology has been the perplexing search for accepted names of the Claibornian specimens, especially when types were not accessible and when two or more names for the same species were contending for priority. Besides, the descriptions and figures have often been an additional vexation, prepared, as some of them were, not in the interest of completeness, but rather in the protection of personal rights.

To relieve, in part, this situation, Captain A. W. Vogdes, in 1879, republished the third and fourth numbers of Conrad's *Fossil Shells;* and Prof. Harris, in 1893, republished all four numbers together with the Plates. He included in this work the variant editions of the prefaces, the new No. 3, of 1835, and an illuminating discussion of historic and bibliographical matters. About

[69a] Henry Charles Lea was born in 1825 and was therefore but fifteen years old when his paper was published. The descriptions being in Latin is an additional presupposition that the work was done by his father. The boy was hardly more than eight years old when he was doing the microscopic work alluded to in his father's letter to Judge Tait in 1833. The other son was Matthew Carey Lea, born in 1823.

the same time—1893—Dr. Dall, who had already published his careful study of the dates of Conrad's *Fossil Shells,* republished the *Medial Tertiary,* with an account of Conrad's life and habits. This republication also contained plates. In both the Harris and Dall republications, the covers of the original parts were included. Besides this, Prof. Harris published in 1895, as the first number of his *Bulletins of American Paleontology,* his paper on *Claiborne Fossils,* which was a study of the synonymy of the Conrad and Lea type collections, including that of H. C. Lea. With these accessories the present-day student is fairly well equipped for original work.

There remains to be written an evaluation of the elaborate works of DeGregorio and Cossmann, who did their work in Europe, and without access to the type collections in the United States. Indeed, there is sorely needed an exhaustive monograph on the Eocene Paleontology of the United States, correlating the results of the several paleontologists who have so greatly enlarged our knowledge of the marine fauna of that important period.

The literature of the subject is scattered through books, pamphlets, and periodicals, making a stratum as difficult to classify and evaluate as the fossils themselves. Such a project would call for the review of the writings of Whitfield, Clark, Heilprin, Langdon, Meyer, Aldrich, Harris, Dall, Gabb, and Johnson, to mention only a few of those who have dealt with the paleontological aspects of the story.

It would be difficult to estimate the amount of time and thought that all these authors have devoted to the problems that have presented themselves in the course of their studies, and their work has laid a foundation for a recapitulation of the facts which more than a hundred years of research have accumulated.

Nevertheless, there is so much of beauty and wonder and vividness in the impressions to be had by a study of the organic remains left on the shores or bottoms of the Eocene sea, that we do not wonder that the fossils of the Tertiary formations hold, and will continue to hold, a fascination for the geological student who loves to linger, as Conrad did, by the side of the quiet waters of the Tertiary ocean, gathering treasures that stagger his imagination and deepen his reverence for truth.

PART EIGHT

ESTIMATES AND APPRECIATIONS

PART VIII

ESTIMATES AND APPRECIATIONS

To make any just estimate of Conrad's scientific work, it is necessary to take into account the handicaps and limitations which beset the early, as well as the passing, years of the poet-conchologist. We have already seen that his work was frequently suspended by periods of mental depression. His professional engagements—and few they were—seldom furnished him with congenial associates, and such engagements never lasted for any length of time. He was certainly happier (and probably in better health) in a southern clime, and yet he was able to spend less than three years of his seventy-four under southern skies. If we were to add up all his life's earnings derived from strictly scientific service, exclusive of his salary for the five years he was with the New York State Survey, the total would be less than a curator's salary for a single year. The cost of all his field excursions and journeyings would hardly have equipped a single short-season expedition under modern museum requirements.

When Sir Charles Lyell, the great English geologist, made his first visit to the United States in 1841, one of his chief objectives was a conference with Mr. Conrad. The two became very congenial, and Lyell developed great respect for Conrad's opinions The two authorities on Tertiary geology made an excursion to the Greensand localities of New Jersey, collecting some forty species of fossils, five of which were new to Mr. Conrad and to Dr. Morton. Lyell wrote to Hall on October 1, 1842:[70]

> I have been so much pleased with Conrad, and am sure that were he not so isolated and could have more frequent intercourses with congenial souls, he would no longer see difficulties or dwell so much on his constitutional maladies.

[70] Clarke, John Mason, *Life of James Hall*, p. 115, 1921.

There is a happy sequel to this association; for on Lyell's second visit to the United States in 1846 he hurried to Trenton[71], where Conrad was then living. It appears from the diary of Dr. Charles C. Abbott (1843-1919) that on this occasion Lyell dined with the family[72]. Lyell's reference to Conrad's maladies must refer either to his dyspepsia or his melancholy, or perhaps to both. Dr. W. H. Dall is quoted by Merrill[73] as saying:

> A period of moping would usually end in his (Conrad's) writing some verses which nobody would praise, and this seemed sufficiently to nettle him, to rouse him thoroughly, and he would become again enthusiastic in the matter of shells and fossils.

Mr. Richard M. Abbott writes me that his father, Dr. Charles Conrad Abbott, in preparing his account of Conrad for the *Popular Science Monthly* (Vol. 47: 257-263, June 1895, with frontispiece portrait) made this record in his diary after a visit to a younger sister of Conrad's:

> Aunt Anna Hewitt tells me that as a young man Uncle Tim Conrad was always grunty and dyspeptic, moody; would sit with his head on his hands for hours. It was not supposed that he was melancholic, but given the credit of being buried in thought.

This moodiness was recurrent, an infection which victimized his happiness and discolored his views of life. He often worked by the side of unappreciative men. His best friends sometimes lost patience with his opinions or his peculiarities. There is reason to think that Conrad, pursued by the "grinning demons" that mocked his hunger for domestic happiness, and tortured by the ever-present spectre of ill-health, was more than once tempted to end his own life, but that he shrank from the consequences of such cowardice[74]. Such a temperament, perpetually harassed by physical ailments, could hardly have escaped sufferings of the most acute nature. Fortunately, when these spells of depression

[71] Lyell *A Second Visit to the United States*, Vol. 1: 252, 1849.

[72] This clears the curious reference in the Obituary of Conrad, in the Daily State Gazette (Trenton, New Jersey), under date of August 11, 1877, to a visit of Sir John Lubbock to Trenton with a primary interest of meeting Mr. Conrad. Sir John, as far as I can learn, was never in the United States. At any rate there would have been little in common between the two, Lubbock being interested in ants and archeology, two subjects which Conrad seems never to have mentioned. Sir John was, however, a correspondent of Conrad's nephew, Dr. Charles C. Abbott.

[73] Introduction to the *Republication of Conrad's Medial Tertiary;* Merrill, *The First One Hundred Years of American Geology*, p. 202.

[74] Merrill, *The First Hundred Years of American Geology*, p. 202, 1924.

passed, he plunged again into his work; and his published writings seldom bear witness to the difficulties under which they were produced.

Conrad had a few harmless idiosyncrasies, some of which no doubt made him the victim of innocent pranks, such as the hiding of his pepper box. There is a tradition at the Academy of Natural Sciences and in his family that he was very found of red pepper, and that one could almost trail his route through the Academy collections by the pepper he left behind in the trays. Conrad was also fond of bran, hickory nuts, and watermelons, but generally averse to eating meat. Dr. Rudolph Ruedemann, the present paleontologist of the New York State Museum, writes of another habit:

> Our former draftsman, Simpson, told me that Conrad was a most unassuming man who used to go down to the boat landing to buy a basket of berries for his lunch and eat them there sitting on a barrel.

That Conrad was sometimes too modest in his estimates of his own work is reflected in a letter written to Dr. James Hall in 1838, which is now on file in the Merrill collections at the United States National Museum. Conrad found it impossible to accept the theory of Louis Agassiz as to the origin of boulders and gave reasons well worth consideration. He says: "I have prepared a paper on the subject for Silliman, but hesitate to send it, as I never published anything yet without heartily despising it after it appeared." This paper, or papers, appeared in the *American Journal of Science* in 1839, Vol. 35, pp. 237-249, with editorial comments on pp. 250-251.

On one occasion—possibly when he thought Conrad was in an approachable mood—John Ford, a very intimate friend, asked him for his picture. Conrad flared back, "If you ever ask me for my picture again, I will never speak to you as long as I live." This aversion accounts for there being no satisfactory portrait of Conrad in existence. The portrait used by Abbott in his biographical sketch was made by an artist in the family from a photograph of the naturalist taken after his death.

Nothing, however, more seriously menaced Conrad's reputation as a scientist than his carelessness. His table or desk was often piled with trays of shells and fossils, with books, papers, and what not, to such an extent that there had to be a periodic cleaning up to save what material was not already in hopeless confusion. No wonder that some of his types and specimens cannot now be located. His notes were written on scraps of paper, and such a thing as a filing system was wholly outside his consciousness. He kept no records of his various field excursions, nor of the honors that were conferred upon him. Extensive search has failed to locate any of the letters written to him by his many friends and correspondents.

Notwithstanding his carelessness he had a mind that clearly visualized the significance of his discoveries and the part they played in the interpretation of larger problems. Though his descriptions were often too sketchy to satisfy the requirements of careful differentiation, his drawings sometimes more than compensated for this defect. Those which he used in his *Fossil Shells*, and in his *Monograph of the Unionidæ* lacked nothing in accuracy of delineation and beauty of execution. Conrad had two or three lithographic stones upon which he engraved his own plates. After he had pulled what he thought would be a sufficient number of copies, he would scrape the stone in readiness for another engraving. This fact explains the scarcity of original plates.

Commenting on Conrad's unfortunate carelessness, especially in furnishing essential details, or in giving references, Dr. Dall remarks:

> This inaccuracy is absolutely characteristic of Conrad in citations . . . When we consider his work with that of the naturalists of the French "New School" of the present day, there seems in comparison little to complain of in Conrad's methods.
>
> Mr. Conrad's extrarodinary and habitual carelessness, or want of memory, which grew upon him, especially in later years, to such an extent that he finally decided to attempt no more work, was a marked factor in inducing variations[75].

[75] Bulletin Philosophical Society, Washington, Vol. 12: 225, 229, 1888. Dr. Dall means that he gave up any attempt to complete certain projects, like his *Marine Conchology*, and his *Fossil Shells of the Tertiary Formations.*

GRATITUDE

But all these peculiarities and shortcomings of the dreamer-scientist are, at least in spirit, atoned for by his devotion to his friends and by his gratitude to those who aided his work in any way. He felt that had it not been for the ministry of Mrs. Roberts at Mobile Point he might not have survived the breakdown which he suffered at that time. His attachments were warm and constant, especially for such friends as Dr. W. D. Moore of Mississippi, whose death affected him greatly; for Dr. Francis Moore, of Texas, whose home life he beautifully depicted in one of his poems; and for his favorite sister Susan, the mother of Dr. C. C. Abbott, with whom he made his home in Trenton.

He did not fail to express his appreciation for what his scientific friends at the Academy of Sciences had meant to him, not only by words but also by dedications of new species and books. He named some of his finer fossils and shells for Morton, for Say, and for Poulson[76]. He dedicated his *Fossil Shells of the Tertiary Formations* to "Samuel George Morton, M. D.":

> In publishing the fossil shells of our Tertiary formations, it is a pleasure as well as a duty to inscribe to you a work, which, whatever its merits, would not have appeared without your encouragement and assistance . . .[77]

His friend, Mr. Charles A. Poulson, is honored in the dedication of his *New Fresh Water Shells of the United States*:

[76] In the third number of his *Fossil Shells* he named the first species described, a *Voluta,* for Say. ''I dedicate this species to my distinguished friend Mr. T. Say'' (p. 29). This would indicate that Conrad *did* have something to do with the authorship of that much-questioned number. Say would hardly have dedicated a species to himself in that way.

[77] Dr. Morton was like a brother to Conrad, and his faith in him never failed. The quotation which follows is a characteristic expression of Morton's confidence and appreciation:

> Before concluding this letter, I have much pleasure in mentioning that our Atlantic tertiary deposits are in a fair way to be brought to light. Under the patronage of the Academy of Natural Sciences, those of Maryland and Virginia, have been repeatedly visited of late, by my friend Mr. T. A. Conrad; a young geologist whose discriminating judgment, and untiring industry, have already attracted the favorable notice of the scientific public. A work which this gentleman has now in hand will make us acquainted with nearly two hundred species of fossil shells from the Upper marine deposits of the state (Alabama) above named; nor are these remains inferior in beauty and preservation to those of the tertiary beds of Europe.

I take the liberty to dedicate this volume to you, whose liberality has afforded the friends of science the use of a library, richer in works on conchology than any other in the United States; and of a collection of shells almost unrivalled by any private cabinet . .

He did not fail to express his indebtedness to the many Alabama friends who in one way or another made possible his studies of fossil and fresh-water shells.

I shall ever feel grateful to them for their attentions to a stranger, who sought health in the bland air of a southern clime, and recreation and instruction in the study of the fossiliferous strata, in a State, probably the richest of the Union in organic remains, and certainly more interesting than any I have visited . .

To John B. Toulmin, Esq. of Mobile, I return my thanks for his hospitality and disinterested exertions on my behalf. I shall also ever remember my kind friend, Dr. Robert Withers, of Greene County, Major Chamberlain and Judge Harris, of St. Stephens, and many other gentlemen in various parts of Alabama.

Captain A. H. Gazzam, reference to whose services in Conrad's behalf has already been made, is also mentioned in the same connection.

No more touching evidences of appreciation and gratitude can be found in literature than the expressions by Conrad to Judge Tait and members of his family in various letters, and in the introduction to the work just cited:

Many of these shells herein described, I procured during a residence of six months at Claiborne, a village on the Alabama River, beautifully situated on an abrupt bluff, two hundred feet[78] in elevation, and whose base is shaded by the evergreen magnolias, and the umbrella tree, with its gigantic leaves. In company with the kindest friends which it has been my lot to meet with in my pilgrimage through life, CHARLES TAIT, Esq., and Mrs. TAIT, whom I must always remember with feelings akin to filial attachment, time passed rapidly and agreeably away. May the evening of life be calm and serene, and, as the meridian was passed in exertions honourable to himself and useful to his country, my friend needs no eulogium from a humble votary of Natural Science. (Page 23.)

From Mobile, on May 6, 1833, Conrad wrote to Judge Tait:

I shall be very happy, when my engagements permit me to revisit Claiborne . . . Give my best respects to Mrs. Tait, and my prayers for her health and happiness; no one deserves them more.

Conrad concludes this letter in characteristic manner:

Accept, dear sir, my thanks for your kind attention and permit

[78] When Conrad measured the height of the bluff he found it to be actually 160 feet above the level of the river. Lea also published the height of the bluff as 200 feet, based upon the guess Judge Tait communicated to him in a letter.

me to subscribe myself,
Your affectionate friend and servant,
T A Conrad.

On June 7, of the same year, he wrote:

> I regret to hear Mrs. Tait is unwell; I hope it is but a transient affection, a passing cloud over the sunny landscape of life. I feel deeply grateful to her and to you, dear sir, for the kind wishes expressed, and the attentions you have shown me, and shall repay you in the only way I am capable, in renewed and zealous endeavours to bring to light the scientific treasures of Alabama.

On December 16, he wrote from St. Stephens:

> To Mrs. Tait I tender my enduring gratitude for all those favours which have rendered my residence in Alabama so comfortable and delightful, and to both of my estimable friends I can truly say that time can never diminish the feelings of pride and satisfaction which your condescension to an unfriended wanderer has given birth.

On January 14, 1834, in a letter written to Judge Tait from Mobile to explain his sudden departure from Claiborne, he added in a postscript:

> To Mrs Tait I send my sincere regards and esteem and beg to be remembered to her, as one who wherever his lot may be cast, will never lose the remembrance of her kindness, and whatever of good or evil, fate may have in store for me, I will pray that for you all indulgent time may mingle in his cornucopia of blessings as few of the bitter fruits of humanity as may be consistent with the designs of Omnipotence.

In his letter to Judge Tait on his return to Philadelphia (April 14, 1834), in which his mother also sent her gratitude for the kindness of the Judge to her son, Conrad said:

> You may be assured, dear sir, that I daily think of you all, and offer up to the source of all our blessings, silent prayers for your health and happiness . . . I need not assure Mrs Tait of my gratitude to her; her kindness nothing but Death can obliterate from my daily remembrance; I sometimes in reflecting on it, like Bulwer in his visit to the stream consecrated by early recollections "forget myself to tears", tears which I hope may render me for "days afterwards a better and a kinder man".

HONORS AND RECOGNITIONS

Many honors were bestowed on Conrad; but outside the circle of intimate friends who contacted his immediate interests, he was almost unknown. Had Mr. Conrad been privileged to travel abroad, as he so much desired to do, or had he been able to publish his books in a style befitting his discoveries, he might have won earlier and wider recognition. When we lay any one or all of the original paper-backed "Parts" of his *Fossil Shells* beside the finished *Contributions* of his rival, Dr. Lea—text, plates, and binding, "all complete"—the comparison does not suggest any parallelism of ability nor urge any immediate need for academic honors. However that may be, Conrad was never guilty of rubbing in on his friends what recognitions he did receive, as his wealthy and highly sensitive competitor was very prone to do. His modesty, indeed, left his critics in possession of the field he might better have defended had he chosen to do so[79].

Sir Roderick I. Murchison, President of the London Geological Society, in his Anniversary Address before that body in 1833, paid a high compliment to Mr. Conrad as an expositor of the tertiary shells of North America but expressed his surprise that he was ignorant of conchological distinctions recently applied to tertiary formations by Desnoyers, Lyell, and Deshayes. He called attention to other statements made by Conrad in his first fasciculus of the *Fossil Shells of the Tertiary Formations,* but allows that these defects are excusable and easily mended since the author was simply following the lead of his geological predecessors. He concludes his review of Conrad's work in these words:

> The high merits of the undertaking of Mr. Conrad are to be found in the accurate delineation of the organic remains, and in his faithful account of the manner in which the strata containing them have succeeded to each other. By his description we now learn for the first time, that the whole line of coast of North America has been elevated after the creation of existing mollusca, and that the highest or youngest of these fossil groups is spread over a zone of land of 150 miles in breadth! . . . . I have now to express my hopes that Mr. Conrad may meet with such encouragement, that he may complete not only the illustration of these younger and tertiary shells, but succeed also in his laudable ambition of describing the remains of the secondary and older formations of North America.

On learning of Murchison's strictures on his ignorance of developments in his own field, Conrad wrote to Judge Tait that it could hardly be expected of a man buried in the wilderness for more than a year following the publication of his first contributions to cover the findings of European geologists. While the President of the London Geological Society was reviewing his first modest paper Conrad was gathering unnamed fossils in a Southern State.

[79] Dr. Lea almost stuffed his letters to Judge Tait with accounts of his superior abilities, as reflected in the press notices of his work.

M. Antoine De Gregorio, the brilliant Sicilian paleontologist, in his preface to his *Monographie de la Faune Eocènique de l'Alabama,* says:

> It seems to me of the authors who have occupied themselves with the tertiary fauna of Alabama, without a doubt, it is Conrad who deserves the greatest merit. He has written a truly considerable number of notes, of pamphlets, booklets, etc.

Dr. William H. Dall, the friend of both Lea and Conrad, who deplored the controversies that embittered their relations, pays high tribute[80] to Conrad, while recognizing his faults:

> Conrad had an acute and observant eye, and an excellent, if somewhat hasty judgment on matters of geology and classification. He was in advance of his time in discriminating genera, and in field researches and work on the specimens showed more than ordinary capacity. In those branches of his work which required knowledge of literature and systematic research he took less interest and pains.

Even more explicitly Dr. Dall writes:

> Like many shy people, he was brought rather than ventured into numerous controversies, which are now ancient history, and need not be further alluded to . . . He had the defect of his qualities but whether for good or evil he was the principal worker in the field of Tertiary geology in America for many years. He has left a voluminous literature, and neither his faults nor his virtues can by any means be ignored. (P. viii.)

Dr. William B. Clark, who reviewed the history of North American Tertiary Geology in great detail, says[81]:

> With the publication of Conrad's article "*On the Geology and Organic Remains of a part of the Peninsula of Maryland*", with an appendix containing descriptions of new species of fossil shells, a new era in the investigation of the Atlantic and Gulf Coast strata was inaugurated. It is true that Say had described several Tertiary species, but, as stated in Conrad's paper, he did not "draw any geological inferences from the organic remains examined". Conrad from the first applied the paleontological evidence he possessed to an interpreattion of the stratigraphy; and although many of his conclusions were erroneous, still the knowledge of the geology of the coastal plain was very materially advanced. In this first paper such well known Tertiary forms as *Turritella Mortoni, Cucullæa gigantea,* and *Crassatella alæformis* are figured and described, and the presence of *Venericardia planicosta* Lamarck is also noted. Making use of the data afforded by these investigations, the strata at Fort Washington were correlated with the London Clay of England.

In 1884, Angelo Heilprin, in referring to his own work on the

80 *Republication of Conrad's Fossil Shells of the (Medial) Tertiary Formations,* p. viii et seq.
81 *The Eocene of the United States,* Bull. 83, U. S. Geol. Surv., p. 21; see also Bull. 141, U. S. Geol. Surv., p. 25.

stratigraphy of the Tertiary formations in Maryland, says:

> At the time I prepared the article above referred to on the "Stratigraphical Evidence afforded by the Tertiary Fossils of the Peninsula of Maryland", wherein I indicated the existence and positions of the two divisions of the Maryland "Medial Tertiary"[82] I was not aware that Conrad, some forty-five years before[83] had arrived at conclusions approximately identical with my own (although the data supporting his position were of a rather fragmentary and not exactly satisfactory character), but which he appears to have completely ignored at a later date.

Dr. Eugene Allen Smith, late State Geologist of Alabama, in his presidential address before the Geological Society of America in 1913[84], says:

> The year 1832 is conspicuous in the geological history of the Mississippi Embayment by reason of the beginning of a publication by Timothy A. Conrad, the "Fossil Shells of the Teritary Formations of North America" . . . The Third number, published in 1835, contained a geological map of Alabama, which, so far as I know, is the first published geological map of the state.

Speaking of Conrad's opinion that the prevalent limestone of Florida would be included in the later Eocene division of the Tertiary, Dr. Smith adds that "this prediction has been abundantly verified by later observations". In fact it was through the field work of Dr. Smith himself that the work of Conrad was checked and found to be correct.

Furthermore, speaking of Sir Charles Lyell's services to the State of Alabama, Dr. Smith says that the English geologist verified the statement of Conrad as to the proper geologic horizon to which the bones of the *Zeuglodon* must be referred. He also states that Conrad's contributions to the Tertiary paleontology of the Gulf Region "will always remain among the most important publications in this field."

To Charles Lyell belongs the honor of applying the name EOCENE to the Tertiary Formations of England and France, formations formerly known as the *London Clay* and the *Calcaire Grossier* respectively. Isaac Lea is the first author to apply Lyell's name to the Claiborne deposits, but Conrad had already made the correlations and deserves the credit of developing the

82 Jour. Acad. Nat. Sci., Vol. 9: 12, 128; see also pp. 117, 121.

83 *Tertiary Strata of the Atlantic Coast,* Am. Jr. Sci., Vol. 28: 106, 1835.

84 Bulletin, Geological Society of America, Vol. 25: 157-178, March 1914.

Claiborne Bluff, showing contact of Claibornian and St. Maurice beds

The "Ferruginous Sand Beds," Claiborne Bluff, showing fossils *in situ*

Photos by Q. B. Schenk, December 22, 1934 facts which identify the Atlantic and Gulf Tertiaries as of Eocene age[85].

We may fittingly tie together this bouquet of eulogies with the splendid and truly deserved words with which Prof. Gilbert D. Harris begins the *Introduction* to his *Republication of Conrad's Fossil Shells of the Tertiary Formations*:

> He who would become versed in the marine Tertiary geology and paleontology of this country must first of all have a thorough understanding of Conrad's FOSSIL SHELLS OF THE TERTIARY FORMATIONS OF NORTH AMERICA; it marks the beginning of systematic research into this period of our continent's history.

IN CONCLUSION

Timothy Abbott Conrad was a geologist of penetrating mind. He deserves credit for discovering the connection between the vast Tertiary strata of our eastern and southeastern seaboards, and for determining the nature and extent of the Eocene divisions of that period. Despite his early poverty, his ill-health, his timidity, and his melancholy, he figures actively in the literature of conchology and paleontology for nearly fifty years. No student of either of these subjects can hope to attain any degree of confidence who does not saturate himself with the findings of this prolific author.

Conrad came to Alabama when it was yet young as a political division of the Union. One scientist after another followed in succeeding decades; and pilgrimages are yet made to the classic localities where he worked and suffered—localities which will continue to have a perennial interest for original investigators.

Today there shines with ever increasing brightness the splendid work of a young naturalist, which survived his limitations and discouragements. There is a fragrant memory of devoted and loyal friends, of sunny skies, and Southern hospitality. There are

85 Lea, *Contributions to Geology*, pp. 14, 18; Clark, *Eocene of the United States*, Bull. 83, U. S. Geol. Surv., p. 21; and Conrad, cover of *Fossil Shells*, No. 3, 1835, and pp. 29-31. On page 31 of this Part, in citation just given, Conrad says:

> In the Introduction to this work (pp. 13, 14, dated October 1, 1832), I gave the first notice of this interesting locality, and referred it to the period of the *London Clay* and *Calcaire Grossier*, giving it a provisional name which I glady abandon since a better has been supplied in the *Eocene* of Prof. Lyell. That it is the the same, or nearly the same age, I think the organic remains, described in the following pages will incontestably prove.

glimpses of pioneer conditions in territories newly acquired from the Indians and full of promise to the agriculturalist. There are eposides richly tinted with the political aspirations of the times and with the dawn of an industrial age. But for the youthful conchologist a bed of fossils or a stream of water held all the fascination and interest his soul could desire; and today we are paying our respects to his genius for the discovery and interpretation of the *Tertiary Formations of the United States of North America.*

APPENDICES

I

ABBOTTVILLE[1]

By Archibald Bartram

Sweet Nottingham! thy charms I prize,
Where yonder hills abruptly rise,
Which gird thy valleys green;
At dawn, at noon, or closing day,
Along thy heights I love to stray,
And gaze upon the scene.

In silent wonder, there I stood,
To see emerging from the wood,
The glorious orb of day;
Nor less the joy that filled my breast,
When o'er the purple glowing west,
He sheds his parting ray.

Luxuriant are the wide spread meads,
Where graze the herds and prancing steeds, ,
By Nature's bounty fed,
Attired in all their summer's pride,
The tall trees climb thy hilly side,
And o'er the lowland spread.

How vast the view! my eager eye
Would o'er the varied landscape fly,
Its utmost bounds to trace;
At once, survey the sounding shore,
The distant mountain's brow explore,
The valley's milder grace.

But vain the wish! Ye features strong
Of Nature's grand design belong
To nobler pens than mine;—
A Thomson's comprehensive mind;
A Burns might here a subject find
For genius sublime.

With humbler aim then let me steal
Along yon little purling rill
To indulge the darling theme;
Pursue its gurgling through the wood
Till lost amid the bolder flood
Where Crosswicks pours his stream.

There seen above its bow-shaped hill,
The mansion stands of Abbottville,
Dear hospitable seat;

[1] The original name of the estate described in the poem was Nottingham. The poem was written in 1802, the author being at the time engaged to Miss Hannah Abbot, a sister of Elizabeth Abbot, the mother of Timothy Abbott Conrad. The untimely death of Mr. Bartram, who was a nephew of William Bartram, the distinguished botanist and traveler, defeated his prospects of marriage. Hannah died in 1825. Abbottville is on the bank of Crosswicks Creek, four miles above its mouth at Bordentown on the Delaware River. Edwin and Clarinda in the poem are respectively Solomon W. Conrad and Elizabeth Abbott, Timothy's parents. See the poem, "*Farewell to Abbottville*" in *A Geological Vision and Other Poems.*

Where no rude passions vex the soul,
Where harmony prevades the whole,
And love and friendship greet.

Philanthropy, with pure delight,
Sees brothers, sisters, all unite,
To tie the social band;
Come, copy these, thou jarring world,
Command thy bloody flag be furled,
Bid discord fly the land!

Methinks in yon descending grove,
I see the family of love,
In blissful ease reclined;
And now bright wit and sportive tale,
In laughter float upon the gale;
Now, converse more refined.

How sweet this innocent repose,
O! never may invading foes
Your tranquil hours molest;
No cold neglect call forth the tear,
Nor envious clouds o'ershadow here,
The sunshine of the breast.

Across the stream that midway flows,
His fondling arm the beech-tree throws,
As if to guard the brook,
Thus parent love exerts its care,
Bends o'er its infant offspring there,
With many an envious look.

Then sensibility shall cast
Her eye reflective on the past,
By memory hither brought,
The pensive nymph will gladly claim,
Graved on the bark full many a name,
And many a tender thought.

The friend of infancy beloved,
Perhaps to distant climes removed,
Hath left a name behind;
Memorial dear of by-gone hours,
When life's gay path seemed strewed with flowers,
And hope was ever kind.

And may the bard that rudely flings
His fingers o'er the lyric strings
To wind his simple song
Say, can he hope, nor be too bold,
To have his humble name enrolled
Among the friendly throng?

To the lone dell remote from noise,
The city's tumults, giddy joys
And all the world of care,
The mind of wisdom oft retires
To gather home its scattered fires,
Its energies repair.

Some sister of the muse, I ween,
Enraptured with the charming scene,
When evening shades prevail,

Hath visited this peaceful grot
And given the consecrated spot,
The name of Happy Vale.

This was the seat, and this the shade,
Where youthful Edwin wooed the maid
With all the lover's art;
And here Clarinda's blush confessed
The passion reigning in her breast,
And here she gave her heart.

Fond faithful pair! whom love hath crowned,
And sacred nuptial rights have bound
In fetters of delight;
May heavenly smiles propitious play
Around your heads each passing day,
And each returning night.

The kindly torch that lights you now,
Still bright and brighter may it glow,
As long as life shall last;
Thus breathes the friend whose breast retains,
Deep centered there, the sad remains
Of joys forever past.

Adieu! Sweet Nottingham, adieu!
Thy walks no more must I pursue
Nor trace thy trembling rill,
Yet oft shall memory linger here
To contemplate the inmates dear
Of social Abbottville.

II

FLORA OF CLAIBORNE BLUFF, ALABAMA*

By Roland M. Harper, Ph.D.

Plants seen on the bluff (including river-banks and tributary ravines) at Claiborne, Alabama, on April 23, 1927 and November 11, 1932.

The species are divided into size classes and arranged in approximate order of abundance in each class. Introduced species in parentheses. Where no specific name is given the identity of the species is uncertain. E indicates evergreens.

LARGER TREES

	Liquidambar Styraciflua (sweet gum)
E	Magnolia grandiflora (magnolia)
	Liriodendron Tulipifera (poplar)
	Platanus occidentalis (sycamore)
	Quercus Muhlenbergii (chinquapin oak)
	Ulmus Americana? (elm)
	Acer Floridanum (sugar maple)
E	Juniperus Virginiana (cedar)
	Quercus Schneckii? (red oak)
	Ulmus alata (elm)
E	Magnolia glauca (bay)
	Tilia sp. (lin)
	Fraxinus Americana (ash)
	Fagus grandifolia (beech)
	(Diospyros Virginiana) (persimmon)
E	Pinus echinata (near top) (short-leaf pine)
E	Pinus glabra (ravines) (spruce pine)
	Quercus alba (white oak)
	Celtis sp. (hackberry)
E	Persea Borbonia (red bay)
	Magnolia acuminata (cucumber tree)
	Catalpa bignonioides (catalpa)

SMALLER TREES

Cercis Canadensis (redbud)
Cladrastis lutea (yellow-wood)
Cornus alternifolia
Viburnum rufidulum (red haw)
Oxydendrum arboreum (near top) (sourwood)
Magnolia macrophylla (cucumber tree)
Halesia diptera
Cornus florida (dogwood)
Acer leucoderme (maple)
Robinia Pseudo-acacia (black locust)

* Since the vegetation on Claiborne bluff is probably about the same that it was in Conrad's day, this list of plants and trees, made both in summer and winter, will be of special interest to historians as well as to botonists.

WOODY VINES

- Parthenocissus quinquefolia (Virginia creeper)
- Rhus radicans (poison ivy)
- E Bignonia crucigera (cross-vine)
- Ampelopsis arborea
- Vitis aestivalis (wild grape)
- Decumaria barbara
- E Smilax lanceolata (wild smilax)
- Berchemia scandens (rattan vine)
- E Lonicera sempervirens (honeysuckle)

SHRUBS

- Dirca palustris (leatherwood)
- Hydrangea quercifolia (seven-bark)
- Hydrangea arborescens
- E Arundinaria sp. (reed)
- Rhamnus Caroliniana
- Ptelea trifoliata
- E Hypericum aureum
- Aesculus parviflora (white buckeye)
- E Rhapidophyllum Hystrix (needle palm)
- Amorpha fruticosa
- Calliocarpa Americana (French mulberry)
- Philadelphus sp.
- Viburnum semitomentosum
- E Kalmia latifolia (ivy, or mountain laurel)
- E Euonymus Americanus (strawberry bush)
- Hamamelis Virginiana (witch-hazel)

HERBS

- E Adiantum Capillus-Veneris (maidenhair fern)
- E Equisetum robustum
- E Tillandsia usneoides (Spanish moss)
- Polygonatum biflorum
- Onoclea sensibilis (a fern)
- E Polypodium polypodioides (a fern, on trees)
- E Dryopteris patens? (a fern)
- Ruellia strepens?
- Melica mutica (a grass)
- E Viola Walteri
- (Perilla frutescens)
- Elephantopus Carolinianus
- E Yucca filamentosa (bear-grass)
- Aristolochia Serpentaria (snake root)
- E Hepatica triloba (hepatica)
- Arisaema triphyllum (Indian turnip)
- Eupatorium ageratoides?
- Eupatorium incarnatum?
- E Oplismenus setarius (a grass)

BRYOPHYTES

- E Several mosses and liverworts, not identified.

III

BIBLIOGRAPHY

PUBLISHED WRITINGS OF CONRAD

This Bibliography enumerates 198 titles, eleven of which are parts of serial monographs or abstracts of papers. If, however, all the vari-dated parts of his major contributions are entered separately, the total count is 205. In other words, during a period of forty-six years, from 1831 to 1877, Conrad published on an average between four and five books or papers annually, each averaging about eight or nine pages. His contributions aggregate some 1700 pages and more than 300 plates, besides numerous text figures. As Conrad lived before the invention of the typewriter and photo-engraving, his writings and illustrations represent an enormous amount of work.

1830 On the Geology and Organic Remains of a part of the Peninsula of Maryland.
Jour. Acad. Nat. Sci., Phila., (1), Vol. 6:205-230.

1830 Description of fifteen new species of recent and three of fossil shells, chiefly from the coast of the United States.
Jour. Acad. Nat. Sci., Phila., (1), Vol. 6:256-268, one plate. (Read October 5.)

1831 American Marine Conchology; or descriptions and colored figures of the shells of the Atlantic coast of North America.
Phila., printed for the author. 72 pages, 17 colored plates.
Part 1, pp. 1-12. Plates 1, 2. April 1831.
Part 2, pp. 13-28, Plates 3-5. Sept. 1831.
Part 3, pp. 29-40, Plates 6-8. May 1832.
Part 4, pp. 41-72. Probably completed in 1834. Plates 9-11, 13-17. Plate 12 is changed to Plate "XVII" in pencil. Noticed in Advocate of Science and Annals of Natural History, October 1834.

1832 Fossil Shells of the Tertiary Formations of North America.
Vol. 1, No. 1, pp. i-viii, 9-20, Plates 1-6, Phila., Oct. 1, 1832.
A laudatory review of this work, dated Sept. 23, 1832 appeared in Am. Jour. Sci., Vol. 23:204-205, 1833.
Vol. 1, No. 2, pp. 21-28, Plates 7-14, Phila., Dec. 1832.

1833 Claiborne.
A hitherto unpublished poem, in letter to Dr. Samuel C. Morton, dated April 20, 1833. See text p. 28.

1833 Fossil Shells of the Tertiary Formations.
Vol. 1, No. 3, pp. 29-38, no plates, Phila., August 1833. On back of cover, "August 24".
Vol. 1, No. 4, pp. 39-46, no plates, Phila., Nov. 26. On cover "Nov. 1, 1833". See Harris' reprint, 1893.

1833 On some new Fossil and Recent Shells of the United States.
Am. Jour. Sci., Vol. 23:339-346. Communication dated, Philadel-

phia, Dec. 5, 1832. Several species from the "London Clay" at Claiborne.

1834 New Fresh Water Shells of the United States, with Colored Illustrations, and a Monograph of the Genus Anculotus of Say; also a Synopsis of the American Naiades.
Pp. 1-76, 8 plates, 12mo. Philadelphia, 1834.
Contains three papers: I. New Fresh Water Shells, pp. 1-57, plates 1-8 (partim); 2. Monograph of the Genus Anculotus of Say, pp. 58-64, plate 8 (partim); 3. Synoptical Table of the Species of American Naiades, with Synonyms, pp. 65-73. All this is followed by an Index, pp. 75, 76. (See also first paper of 1865 which is usually bound up with this.)

1834 Observations on the Tertiary and more recent formations of a portion of the Southern States.
Jour. Acad. Nat. Sci., Phila., (1), Vol. 7:116-129.

1834 Descriptions of new Tertiary fossils from the Southern States.
Jour. Acad. Nat. Sci., Phila., (1), Vol. 7:130-~~178~~. 15

1834 Description of a new genus of Fresh Water Shells.
Jour. Acad. Nat. Sci., Phila., (1), Vol. 7:178-181, Plate 13. Read August 1834.
A *Pleiodon* (*Macmurtrei*) from Liberia described. (Spelled *Macmurtriei* on plate.)

1834 Description of a New Species of Hinnita.
Jour. Acad. Nat. Sci., Phila., (1), Vol. 7:182-183, Plate 14. Read Sept. 1, 1834.
Locality not given.

1834 Description of some New Species of Fresh Water Shells from Alabama, Tennessee, etc.
Am. Jour. Sci., Vol. 25:338-343, Plate 1.
Several from Warrior River, three from Randon's Creek, near Claiborne, Alabama, in supplementary note, p. 343. Note at end reads, "To be continued".

1834 Claiborne.
Adv. Sci. and Ann. Nat. Hist., Phila., Vol. 1:26-31, August.

1834 Mobile, Alabama.
Adv. Sci. and Ann. Nat. Hist., Phila., Vol. 1:57-61, September.
A general description.

1834 Sketches from the Note Book of a Traveller.
Adv. Sci. and Ann. Nat. Hist., Phila., Vol. 1:153-163, November.
Experiences in North Carolina.

1835 Additions to, and corrections of, the Catalogue of Species of American Naiades, with descriptions of new species and varieties of Fresh Water Shells.
Appendix to Synoptical Table in *New Fresh Water Shells of the United States*, pp. 1-8, with Plate 9, October 1835.
All copies seen are bound with *New Fresh Water Shells*, 1834.

1835 Fossil Shells of the Tertiary Formation of North America. Subtitle: Eocene Fossils of Claiborne, with observations on this formation in the United States, and a geological map of Alabama.
Phila., March 1, 1835, pp. 29-56, Plates 15-18.
Reviews about two-thirds of the matter in *Fossil Shells*, Numbers 3 and 4, with new matter. Contains colored geological map of Alabama.

1835 Notices of the Geology of West Florida.
Adv. of Sci., and Ann. Nat. Hist., Phila., Vol. 1:351-352, March.

1835 Observations on the Tertiary strata of the Atlantic coast.
Am. Jour. Sci., Vol. 28:104-111, 280-282, one diagram on p. 280.
Two separate articles with the same title.

1835 Description of five new species of fossil shells . . . (coal measures of Pennsylvania).
Trans. Geol. Soc. Penn., Vol. 1:267-270, Plate 12.

1835 Observations on a portion of the Atlantic Tertiary region.
Trans. Geol. Soc. Penn., Vol. 1:335-341, Illus.

1835-1840 Monography of Uniondiæ or Naiades of Lamarck (Fresh Water Bivalve Shells) of North America. Phila., 118 pages, 65 Plates.
Part 1, December 1835.
Part 2, January 1836. Published also in Paris and "Hamburg"
Part 3, February 1836. Published also in Paris and "Hamburg".
Part 4, March 1836. Published also in Boston, Pittsburgh, London, Paris, and Hamburg.
Part 5, June 1836. Published also in Boston, Pittsburgh, London, Paris, and Hamburg. *Anodonta virgata* described on last page of cover.
Part 6, July 1836. Published also in Boston, Pittsburgh, London, Paris, Hamburg. Contains advertisement of *New Fresh Water Shells* on cover.
Part 7, December 1836. Published also in Boston, Pittsburg, New York, London, Paris, and Hamburg. Repeats advertisement of *New Fresh Water Shells.*
Part 8, February 1837. Published as above. On fourth page cover, *Anodonta caninifera* is described. *Unio gibbosus,* var. *preobliquus* is raised to specific rank.
Part 9, March 1837. Published as above. Description of *Anodonta carinifera* repeated on cover.
Part 10, May 1838, Published as above.
Part 11, November 1838. Published as above, New York omitted. On the fourth page of the cover occurs the following note: "The 12th No is in press and will contain the following new species: Unio planilateris; Unio iridescens; Unio saxeus" (from Claiborne). All are briefly described. Then follows a corrigenda of four lines, and the following note: "Note—In the Trans. Philos. Soc., *Pleiodon macmurtrii,* nob. is referred by Mr. Lea to the *Iridina ovata,* Swains, because Mr. Gray *thinks* them identical. This must be a wilful error on the part of Mr. Lea."
Part 12, January 1840. Published as above, New York being omitted.
Incomplete: stops in the middle of a word, on page 118, the description of *Unio trabalis* left unfinished.

1837 Description of New Marine Shells from Upper California, collected by Thomas Nuttall, Esq.
Jour. Acad. Nat. Sci., Phila., Vol. 7:227-268, Plates 17-20.
Read in January and February 1837. Some species from Fayal and Hawaii.

1837 Queries proposed by the Geologists of the new survey of the State of New York.
Am. Jour. Sci., Vol. 23:124-133.
Article signed by W. W. Mather and T. A. Conrad, Committee in behalf of the State Geologists.

1837 First Annual Report on the Geological Survey of the Third District of the State of New York.

New York Geol. Surv., Ann. Rep., Vol. 1:155-186.

1838-1861 Fossils of the Tertiary Formations of the United States. (This is the general title of the whole work on the ''Medial'' Formations.) Philadelphia.

Part 1, pp. 1-32, Plates 1-17.

Part 2, pp. 33-56, Plates 18-29, May 7, 1840.

Part 3, pp. 57-80, Plates 30-32, 34-44. (Plate 33 was never published.) ''Jan. 1845''.

Part 4, pp. 81-89, Plates 45-49. Date, according to Gabb, about March or April, 1861.

See notes in Dall's reprint, 1893. See notes on new cover, furthur on, under appropriate dates.

1838 Report on the Paleontological Department of the Survey (of the State of New York).

New York Geol. Surv., Ann. Rept., Vol. 2:107-119.

1838? American Conchology, Thomas Say, 1830-1834; Part 7 by T. A. Conrad, Philadelphia, Plates 61-68, colored (?). See discussion in text, pp. 62, 63. On the death of Thomas Say, in 1834, Conrad agreed to carry on his ambitious project to publish and illustrate all species of American shells. Just when Conrad's only continuation as Part 7 appeared is not known. In 1858 W. G. Binney brought out a republication of the Complete Works of Thomas Say, and included this contribution of Conrad's. Some of Say's descriptions which originally appeared in the *New Harmony Disseminator,* and in the *Transylvania Journal of Medicine,* and which had not been published in his *American Conchology,* were reprinted in pamphlet form by Mrs. Say, at New Harmony, Indiana, in 1840.

An announcement was made of this part of the work in the Advocate of Science and Annals of Natural History for January 1835 (p. 296), in which it was stated that the Plates for the following species were already engraved: Unio lineolatus, Rafinesque; Donax variabilis and D. fossor, Say: Arca zebra, Swainson; and Venus alveata, Conrad. Not listed in Union Catalogue.

1839 Second Annual Report of the Paleontological Department of the Survey (of the State of New York).

New York Geol. Surv., Ann. Rept., Vol. 3:57-66.

Abstract in Am. Jour. Sci., Vol. 26:12-15, 1839.

1839 New Cover for Part One of Fossil Shells of the Tertiary Formations (''Medial''), Part 1.

Dated: April 16. On this edition *nine* new species were described.

1839 Notes on American Geology: Observations on characteristic fossils, and upon a fall of temperature in different geological epochs (pp. 237-243); Remarks on the Transition or Silurian System (pp. 243-246); Organic Remains of the Transition (pp. 246-249).

Am. Jour. Sci., Vol. 35:237-249; Remarks by the Editors, pp. 250-251.

1840 New Copy for the *second* page of Cover for Fossil Shells of the Tertiary Formations (''Medial''), Part 1.

Dated: March. *One* new species described.

This cover was also used for cover of Part 2.

1840 Fossil Shells of the Tertiary Formations, ''Medial'', Part 2:33-56, Plates 18-29. Dated May 7.

1840 On the Silurian System, with a table of the strata and characteristic fossils.
Am. Jour. Sci., Vol. 38:86-91.

1840 Observations on the Plastic Clay.
Am. Jour. Sci., Vol. 38:91-92.

1840 Observations on the Genus Gnathodon, with a description of a new species of G. flexuosa, from Fla.
Am. Jour. Sci., Vol. 39-91-93, one figure.

1840 On the geognostic position of the *Zeuglodon,* or *Basilosaurus* of Harlan.
Am. Jour. Sci., Vol. 38:381-382.

1840 New fossil shells from North Carolina.
Am. Jour. Sci., Vol. 39:387-388.
On p. 388: ''The twelfth number of Mr. Conrad's Naiades has been published Mr. J. Dobson, Philadelphia.''

1840 Third Annual Report of the Paleontological Department of the Survey (of the State of New York).
New York Geol. Surv., Ann. Rep., No. 50:199-207.

1841 New Cover for Part 2, Fossil Shells of the Tertiary Formations (''Medial'' Tertiary).
Probably September; contains diagnosis of *four* new species.

1841 Descriptions of three new species of Unio from the rivers of the United States.
Proc. Acad. Nat. Sci., Phila., Vol. 1:19-20.

1841 Descriptions of twenty-six new species of fossil shells, from Maryland, etc.
Proc. Acad. Nat. Sci., Phila., Vol. 1:28-33.

1841 Fifth Annual Report of the Paleontology of the State of New York.
New York State Geol. Surv., Ann. Rep., No. 150, for 1841, 25-57.
Abstract in Am. Jour. Sci., Vol. 42:229-235, 1842.

1841 Appendix (to Observations on the Secondary and Tertiary Formations of the Southern Atlantic States, by James T. Hodge) describing the new shells, etc.
Am. Jour. Sci., (1) Vol. 41:344-348, Pl. 2.
Species described mostly from North Carolina.

1842 Description of three new species of Unio from the Rivers of the United States.
Jour. Acad. Nat. Sci., Phila., Vol. 8:178-180.
From Jackson, Louisiana.

1842 Description of twenty-four new species of Fossil Shells chiefly from the Tertiary deposits of Calvert Cliffs, Maryland.
Jour. Acad. Nat. Sci., Phila., Vol. 8:183-190.
Read June 1, 1841.

1842 Observations of the Silurian and Devonian systems of the United States, with Descriptions of new Organic Remains.
Jour. Acad. Nat. Sci., Phila., Vol. 8: 228-280, Plates 12-17.

1842 Observations on the Silurian and Devonian systems of the United States, with descriptions of new organic remains.
Proc. Acad. Nat. Sci., Phila., Vol. 1:142.

1842 On the identity of the middle Cretaceous formation of the United States with the Faxoe Limestone of Europe.
Proc. Acad. Nat. Sci., Phila., Vol. 1:143-144.
Abstract only.

1842 Observations on a Portion of the Atlantic Tertiary Region, with a Description of New Species of Organic Remains.

Proc. Nat. Inst. Prom. Sci., Washingotn, Bull. 2:171-194. Plates 1, 2.
Ostræa sellæformis redescribed and figured.

1843 Descriptions of Tertiary fossils from the Carolinas.
Ass. Amer. and Geol. Natur., Rep. of 1st, 2nd, and 3rd Meetings, pp. 108-111.

1843 Description of a new genus and twenty nine new Miocene and one Eocene fossil shells of the United States.
Proc. Acad. Nat. Sci., Phila., Vol. 1:305-311.

1844 Descriptions of nineteen species of Tertiary fossils of Virginia and North Carolina.
Proc. Acad. Nat. Sci., Phila., Vol. 1:323-329.
Read Dec. 26, 1843; published Jan. 1844. See report in Proc. Acad. Nat. Sci., of papers read on Nov. 21 and Dec. 19, action on which was taken by the Academy in favor of publication.

1844? Observations on the lead-bearing limestone of Wisconsin and descriptions of a new genus of trilobites and fifteen new Silurian fossils.
Proc. Acad. Nat. Sci., Phila., Vol. 1:329-335.

1845 Descriptions of eight new fossil shells of the United States.
Proc. Acad. Nat. Sci., Phila., Col. 2:173-175.
Issued Jan. or Feb. 1845. *Cardita densata*, etc., described.

1845 Fossils of the Miocene Formation of the U. S., Part 3 of Fossil Shells of the Tertiary Formations (''Medial'' Tertiary).
Pages 57-80, Plates 30-32, 34-45. Plate 33 was never issued.

1845 Descriptions of new species of fossil and recent shells and corals.
Proc. Acad. Nat. Sci., Phila., Vol. 3:19-27, Pl. 1.

1846 Observations on the Eocene formation of the United States with description of species of shells, &c., occurring in it.
Am. Jour. Sci., (2) Vol. 51:209-221, two plates, issued in March; pp. 395-405, three plates, May. Many species from Claiborne.

1846 Notices of Fresh Water Shells, etc., of Rockbridge County, Va.
Am. Jour. Sci., (2) Vol. 51: 405-407.

1846 Observations on the geology of a part of East Florida.
Am. Jour. Sci., (2), Vol. 52:36-48.

1846 Tertiary of Warren County, Mississippi.
Am. Jour. Sci., (2), Vol. 52:124-125.

1846 Eocene Formation of Walnut Hills, etc., Mississippi.
Am. Jour. Sci., (2), Vol. 52: 210-215.

1846 Catalogue of shells inhabiting Tampa Bay and other parts of the Florida Coast.
Am. Jour. Sci., (2), Vol. 52:393-398.

1846 Descriptions of new species of organic remains from the upper Eocene limestone of Tampa Bay, Fla.
Am. Jour. Sci., (2), Vol. 52:399-400; nine illustrations.

1847 Observations on the Eocene formation, and descriptions of one hundred and five new fossils of that period from the vicinity of Vicksburg, Mississippi; with an appendix (Descriptions of new Eocene Fossils [from South Carolina] in the cabinet of Lardner Vanuxem).
Proc. Adac. Nat. Sci., Phila., Vol. 3:280-296; Appendix, pp. 297-299.
Same, with larger pages, in Jour. Acad. Nat. Sci., Phila., (2), Vol. 1: 111-134, Plates 11-14, 1848.

1848 Description of two new genera and new species of recent shells, etc.
Proc. Acad. Nat. Sci., Phila., Vol. 4: 12.

1848 Fossil Shells from Tertiary deposits on the Columbia River, near Astoria [Oregon].
Am. Jour. Sci., (2), Vol. 5:432-433, with fifteen illustrations. Reprinted by Dall in U. S. Geol. Surv. Prof. Paper, 59: 150-151 Fig. 1-14, 1909. The title of the Professional Paper No. 59 is, *The Miocene of Astoria and Coos Bay, Oregon,* by William H. Dall.

1848 The New Diogenes.
A cynical poem, consisting of ''2500 lines of faultfinding'', Phila., published anonymously.

1849 Descriptions of new fresh water and marine shells.
Proc. Acad. Nat. Sci., Phila., Vol. 4: 152-156.

1849 Descriptions of new Fossil and recent shells of the United States.
Jour. Acad. Nat. Sci., Phila., (2), Vol. 1: 207-209, Plates 38, 39.

1849 Notes on Shells, with Descriptions of new Genera and Species.
Jour. Acad. Nat. Sci., Phila., (2), Vol. 1: 210-214.

1849 Fossils from northwestern America [fossil shells of Astoria, Oregon].
In J. D. Dana, Geology. Vol. 20 of the U. S. Exploring Expedition . . . under Charles Wilkes, pp. 723-728, Phila.
Reprinted by Dall in U. S. Geol. Surv. Prof. Paper, 59:153-157, 1909.

1850 Descriptions of new fresh water and marine shells.
Jour. Acad. Nat. Sci., Phila., (2), Vol. 1: 275-280, Plates 37-39.

1850 Descriptions of one new Cretaceous and seven new Eocene Fossils.
Jour. Acad. Nat. Sci., Phila., (2), Vol. 2: 39-41, Pl. 1.

1850 Description of New Species of Fresh Water Shells.
Proc. Acad. Nat. Sci., Phila., Vol. 5:10, 11.
Incorrectly indexed by Academy of Natural Sciences as ''Description of New Fresh Water Shells from Arkansas and Australia''.

1852 Description of the fossils of Syria, collected in the Palestine Expedition.
Official Report of the United States expedition to explore the Dead Sea and the River Jordan, U. S. 30th Congress, 2nd Session, Senate Document, 34, 4to, 236 pages, 16 Plates, Baltimore. Conrad's paper on pages 221-256, with letter of transmission, p. 209.

1852 Remarks on the Tertiary strata of St. Domingo and Vicksburg, [Miss.].
Proc. Acad. Nat. Sci., Phila., Vol. 6:198-199.

1853 Notes on Shells, with Descriptions of new species.
Proc. Acad. Nat. Sci., Phila., Vol. 6:199-299, January 31. Reprinted by Dall in U. S. Geol. Surv. Prof. Paper, 59: 158, 1909.

1853 A Synopsis of the Family of the Naiades of North America, with notes and a table of some of the genera and sub-genera of the family, according ot their geographical distribution, and description of genera and sub-genera.
Proc. Acad. Nat. Sci., Phila., Vol. 6:243-269.

1853 Notes on Shells.
Proc. Acad. Nat. Sci., Phila., Vol. 6: 320-321.

1853 Monograph on the genus *Fulgur.*
Proc. Acad. Nat. Sci., Phila., Vol. 6: 316-319.

1853 Synopsis of the genus *Cassidula* Humph., and a proposed new genus *Athleta.*
Proc. Acad. Nat. Sci., Phila., Vol. 6:448-449.

1853 Omissions and Corrections to the ''Synopsis of the North American Naiades''.
Proc. Acad. Nat. Sci., Phila., Vol. 6: p. 449. (One-fourth page.)

1853 Descriptions of New Fossil Shells of the United States.
Jour. Acad. Nat. Sci., Phila., (2), Vol. 2:273-276, Plate 24, Jan.
Reprinted by Dall in U. S. Geol. Surv. Prof. Paper, 59:159-161, 1909.

1854 Descriptions of New Species of Unio.
Jour. Acad. Nat. Sci., Phila., (2), Vol. 2: 295-298, Plates 26-27.

1854 Synopsis of the Genus Pleiodon.
Jour. Acad. Nat. Sci., Phila., (2), Vol. 2: 298-299.

1854 Description of New Fossil Shells of the United States.
Jour. Acad. Nat. Sci., Phila., (2), Vol. 2: 299-300.

1854 Monograph of the Genus Argonauta, Linnè, and Descriptions of Five New Species.
Jour. Acad. Nat. Sci., Phila., (2), Vol. 2:331-334, Plate 34.

1854 Synopsis of the Genera *Parapholas* and *Penicilla.*
Jour. Acad. Nat. Sci., Phila., (2), Vol. 2: 335.

1854 Rectification of the generic names of Tertiary Fossil Shells.
Proc. Acad. Nat. Sci., Phila., Vol. 7: 29-31.

1854 Notes on shells, with descriptions of three recent and one fossil species.
Proc. Acad. Nat. Sci. Phila., Vol. 7:31-32, March.
Reprinted by Dall in U. S. Geol. Surv. Prof. Paper, 59: 162, 1909.

1854 Fossils of the Vicksburg Eocene Beds.
In B. L. Wailes' Report on the Agriculture and Geology of Mississippi, pp. 287-288. List apparently compiled from Conrad's publications in Jour. Acad. Nat. Sci., Phila., Vols. 1 and 2.

1854 Fossil Testacea of the Tertiary Green-sand Marl-bed of Jackson, Miss.
In Wailes' Report on the Agriculture and Geology of Mississippi, p. 289, Plates 14-17.

1855 Descriptions of three new species of Unios.
Proc. Acad. Nat. Sci., Phila., Vol. 7: 256.

1855 Observations on the Eocene Deposits of Jackson, Mississippi, with descriptions of thirty-four new species of shells and corals.
Proc. Acad. Nat. Sci., Phila., Vol. 7:257-263.

1855 Descriptions of eighteen new Cretaceous and Tertiary Fossils, etc.
Proc. Acad. Nat. Sci., Phila., Vol. 7: 265-268.

1855 Description of one Tertiary and eight New Cretaceous Fossils from Texas, in the collection of Major Emory.
Proc. Acad. Nat. Sci., Phila., Vol. 7:268-269.

1855 Descriptions of a new species of Melania [from California].
Proc. Acad. Nat. Sci., Phila., Vol. 7: 269. (One-fourth page.)

1855 Remarks on the fossil shells from Chile, collected by Lieut. Gilliss, with description of the species.
App. H., U. S. Naval Astron. Exp. to the Southern Hemisphere during 1849-52; Vol. 2: 282-286, Plates 41-42, U. S. 33rd Cong., 1st Sess., House Doc. 121.
A few recent species are also listed.

1855 Description of new species of Pentamerus [from Indiana].
Proc. Acad. Nat. Sci., Phila., Vol. 7: 441. (One-tenth page.))

1855 Note on the Miocene and Post-Pliocene deposits of California, with dscriptions of two new fossil corals.
Proc. Acad. Nat. Sci., Phila., Vol. 7:441, Dec.
Reprinted by Dall in U. S. Geol. Surv. Prof. Paper, 59:172, 1909.

1855 Report on the fossil shells collected in California by Wm. P. Blake, geologist under command of Lieutenant R. S. Williamson.
U. S. Pacific R. R. Expl. Appendix to Rep. of W. P. Blake, U. S.

House Document, 129, 5-20, July. In part in Am. Jour. Sci., (2), Vol. 21: 268-270, 1856.
Reprinted by Dall in U. S. Geol. Surv. Prof. Paper, 59:163-171, 1909.

1856 Descriptions of fossil shells (Williamson's Reconnaissance in California).
U. S. Pacific R. R. Expl., Vol. 5:317-329, Plates 2-9. Final Report (quarto) containing same descriptions as in the Preliminary Report of 1855, illustrated, but Dall says that the numbers do not correspond exactly to those assigned in the earlier, octavo, edition.
See Dall U. S. Geol. Surv. Prof. Paper, 59:163-171, 1909.

1856 On a New Species of Unio.
Am. Jour. Sci., (2), Vol. 71: 172, text figure.
Unio diversus from Shoal Creek, Lauderdale County, Alabama, described. Includes also a note on *Unio virides* Raf. from Pennsylvania.

1856 Descriptions of three new genera, twenty-three new species, Middle Tertiary fossils from California and one from Texas.
Proc. Acad. Nat. Sci., Phila., Vol. 8:312-316.
Reprinted by Dall in U. S. Geol. Surv. Prof. Paper, 59:173-175, 1909.

1857 Description of the Tertiary fossils collected on the Survey. (Williamson's survey in California and Oregon.)
U. S. Pacif. R. R. Expl., Vol. 6:69-73, Plates 2-5, (Section 2).
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1857 Report on the paleontology of the survey. (Parke's surveys in California.) Appendix to report of Thomas Antisell, U. S. Pacif. R. R. Expl., Vol. 7: 189-196, Plates 1-10.
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1857 Descriptions of Cretaceous and Tertiary Fossils.
In W. H. Emory, Report on the United States and Mexican Boundary Survey, Vol. 1: 141-174, Plates 1-21.

1858 Description of two new genera of shells.
Proc. Acad. Nat. Sci., Phila., Vol. 9: 165-166.

1858 Rectification of some of the Generic Names of American Tertiary Fossils.
Proc. Acad. Nat. Sci., Phila., Vol. 9:166.

1858 Description of a new species of Myacites [from Pennsylvania].
Proc. Acad. Nat. Sci., Phila., Vol. 9: 166.

1858 Description of a new genus of the Family Dreissenidæ.
Proc. Acad. Nat. Sci., Phila., Vol. 9: 167.
Mytilus leucophaetus, from Virginia, described.

[1858? Description of new species of fresh water shells.
Proc. Acad. Nat. Sci., Phila., Vol. 10:10.]
Indexed in the Proceedings of the Academy, through apparently no such paper was published.

1858 Observations of a group of Cretaceous Fossil Shells, found in Tippah County, Miss., with Descriptions of fifty-six new species.
Jour. Acad. Nat. Sci., Phila., New Series, Quarto, Vol. 3:323-336, Plates 34-35. Author's separata dated January 1858.

1860 Description of New Species of Cretaceous and Eocene Fossils of Mississippi and Alabama.

Jour. Acad. Nat. Sci., Phila., New Series, Quarto, Vol. 4:275-298, Plates 46-47.

Cretaceous species, pp. 275-291, mostly collected in Tippah County, Miss., by Dr. Spillman, but some from Barbour County, Alabama, collected by Tuomey, and a few from Tennessee, collected by Safford.

Eocene species, pp. 291-297, mostly collected in Alabama by Dr. Schowalter, but for the most part without definite location.

1860 Illustrations of some fossils described in the Proceedings of the Academy of Natural Sciences. In collaboration with William M. Gabb.

Proc. Acad. Nat. Sci., Phila., Vol. 12:55, Plate 1. (One-fourth page.)

1860 Notes on Shells.

Proc. Acad. Nat. Sci., Phila., Vol. 12: 231-232.

1861 Fossil Shells of the Tertiary Formations.

Part 4, pp. 81-86, and Index, pp. 87-89.

Published in March or April.

1862 Descriptions of New Genera, Subgenera and Species of Tertiary and recent shells.

Proc. Acad. Nat. Sci., Phila., Vol. 14:284-291.

Dated June; issued probably in July.

1863 Catalogue of the Miocene Shells of the Atlantic slope.

Proc. Acad. Nat. Sci., Phila., Vol. 14: 559-582.

Dated Dec. 1862; Issued Feb. 1863.

1863 Description of new, recent and Miocene shells.

Proc. Acad. Nat. Sci., Phila., Vol. 14: 583-586.

Dated Dec. 1862, issued Feb. 1863.

1864 Notes on Shells, with descriptions of new fossil Genera and Species.

Proc. Acad. Nat. Sci., Phila., Vol. 16: 211-214; two figures in text. ''Sept''; probably Dec.

1865 Catalogue of the Eocene and Oligocene Testacea of the United States.

Am. Jour. Conch., Vol. 1: 1-34. Dated Feb. 25.

1865 Descriptions of new Eocene shells from Enterprise, Mississippi.

Am. Jour. Conch., Vol. 1: 137-141.

1865 Description of New Eocene Shells of the United States.

Am. Jour. Conch., Vol. 1: 142-149, Plate 2.

1865 Catalogue of the older Eocene Shells of Oregon.

Am. Jour. Conch., Vol. 1: 150-154.

1865 Descriptions of new Eocene shells, and references with figures to published species.

Am. Jour. Conch., Vol. 1: 210-212, Plates 20, 21.

1865 Descriptions of five new species of older Eocene Shells from Shark River, Monmouth Co., N. J.

Am. Jour. Conch., Vol. 1: 213-215.

1865 Observations of certain Eocene fossils described as Cretaceous by Mr. W. M. Gabb, in his report published in the ''Palaeontology of California''.

Am. Jour. Conch., Vol. 1: 362-365.

1865 Observations on the Eocene Lignite formation of the United States.

Proc. Acad. Nat. Sci., Phila., Vol. 17: 70-73.

Reprinted in Am. Jour. Sci., Vol. 90: 265-268.

1865 Catalogue of the Eocene Annulata, Foraminifera, Echinodermata, and Cirripedia of the United States.

Proc. Acad. Nat. Sci., Phila., Vol. 17: 73-75.

1865 Descriptions of new species of Echindiæ.
Proc. Acad. Nat. Sci., Phila., Vol. 17: 75.

1865 Observations of American Fossils, with descriptions of two new species.
Proc. Acad. Nat. Sci., Phila., Vol. 17:184.

1866 Check List of the Invertebrate Fossils of North American (Eocene and Oligocene).
Smiths. Misc. Coll., Vol. 7, Art. 6:i-iv, No. 200.

1866 Letter to Prof. Joseph Henry about Chalk at Smoky Hill, Colorado. dated Philadelphia, Feb. 16, 1866.
Smiths. Inst. Ann. Rep. for 1865, p. 125 (six lines).

1866 Illustrations of Miocene fossils, with descriptions of new species.
Am. Jour. Conch., Vol. 2: 65-74, Plates 3, 4.

1866 Note on the genus Gadus, with descriptions of some new genera, and species of American fossil shells.
Am. Jour. Conch., Vol. 2:75-78.
Describes a new genus, *Diploschiza*, from Alabama.

1866 Further observations on Mr. Gabb's Palæontology of California.
Am. Jour. Conch., Vol. 2, 97-100.

1866 Observations on recent and fossil shells, with proposed new genera and species.
Am. Jour. Conch., Vol. 2: 101-103.

1866 Description of New Species of Tertiary, Cretaceous and Recent Shells.
Am. Jour. Conch., Vol. 2: 104-106, Plates 8-9.
Two Alabama species.

1866 Description of a new species of Unio.
Am. Jour. Conch., Vol. 2: 107.
Unio depygis from Harpeth River, Tenn.

1866 Notice of a new group of Eocene shells.
Am. Jour. Sci., Vol. 91: 96.
Shell Bluff group, near Vicksburg, Miss.

1867 Observations on Pleiodon Macmurtrii.
Am. Jour. Conch., Vol. 3: 4, April.

1867 Paleontological Miscellanies.
Am. Jour. Conch., Vol. 3: 5-7, April.
Four different notes.

1867 Descriptions of new genera and species of fossil shells.
Am. Jour. Conch., Vol. 3: 8-16, April.
Mostly changes in nomenclature.

1867 Synopsis of the genera *Sycotypus*, Brown and *Buscyon*, Bolten.
Am. Jour. Conch., Vol. 3: 182-185, Sept.

1867 Description of new Miocene Shells.
Am. Jour. Conch., Vol. 3: 186-187, Sept.
Mostly changes in nomenclature.

1867 Notes on fossil shells and descriptions of new species.
Am. Jour. Conch., Vol. 3: 188-189, Sept.

1867 Description of a new genus of Astartidæ.
Am. Jour. Conch., Vol. 3: 191, Sept.
Description of Cyclocardia, based on *Cardita borealis* Con.

1867 Descriptions of new west coast shells.
Am. Jour. Conch., Vol. 3: 192-193, Sept; erratum on p. 335, April 1868.

1867 Tertiary of North and South Carolina.
Extract from a letter to one of the editors. Am. Jour. Sci., Vol. 93: 260, March.

1867 Reply to Mr. Gabb on the Cretaceous rocks of California.
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1868 Catalogue of the family *Solenidæ*.
Am. Jour. Conch., Vol. 3: Part 3, Appendix, pp. 22-29, Jan.

1868 Catalogue of the family *Mactridæ*.
Am. Jour. Conch., Vol. 3, Part 3, pp. 30-47.
Errata on p. 335 of Part 4, April 1868.

1868 Descriptions of new genera and species of Miocene shells, with notes on other fossil and recent species.
Am. Jour. Conch., Vol. 3:267-270, Plates 19-24, April.

1868(?) Catalogue of the family *Anatinidæ*.
Am. Jour. Conch., Vol. 4: Appendix, pp. 23 (49), 50-58, June.
Apparently came at the end of the volume, May, 1867, but may have been with No. 1, June 1868.

1868 Descriptions of Miocene shells of the Atlantic slope.
Am. Jour. Conch., Vol. 4: 64-68, Illus., Oct.

1868 Synopsis of the invertebrate fossils of the Cretaceous formation of New Jersey.
In George H. Cook's Geol. New Jersey, pp. 721-731.

1868 Catalogue of Eocene shells and fish from Shark River.
Ibid, pp. 731-732.

1869 Notes on recent and fossil shells, with descriptions of new genera.
Am. Jour. Conch., Vol. 4: 246-249, Feb.

1869 Descrpitions of and references to Miocene shells of the Atlantic slope, and descriptions of two new supposed Cretaceous species.
Am. Jour. Conch., Vol. 4: 278-279, May.
Text indicates Triassic rather than Cretaceous species. The specimens are from Middlesex Co., N. J.

1869 Descriptions of a new *Unio* and fossil *Goniobasis*.
Am. Jour. Conch., Vol. 4: 280, Plate 80, May.
The *Unio* is from a brook near Tampa, Florida; the *Goniobasis* from the Tertiary of Colorado.

1869 Description of Miocene, Eocene and Cretaceous Shells.
Am. Jour. Conch., Vol. 5: 39-45, Plates 1, 2, July.

1869 Observations on the genus *Astarte*, with descriptions of three other genera of *Crassatellidæ*.
Am. Jour. Conch. Vol. 5: 46-48, July.

1869 Descriptions of new fossil Mollusca, principally Cretaceous.
Am. Jour. Conch., Vol. 5: 96-103, Plate 9, Oct.

1869 Notes on recent Mollusca.
Am. Jour. Conch. Vol. 5: 104-108, Plates 10 (fig.1), 12, 13, Oct.

1869 Notes on American Fossiliferous strata.
Am. Jour. Sci., Vol. 97:358-364, one illustration in text.

1870 Notes on recent and fossil shells, with descriptions of new species.
Am. Jour. Conch., Vol. 6: 71-78, Plates 1, 3 (in part), July.

1870 On the mixture of Cretaceous and Eocene fossils.
Am. Jour. Sci., Vol. 99: 275. (One-third page.)

1870 Abstract of paper on the Shells of the Upper Amazon.
Am. Jour. Sci., Vol. 100: 424. Eleven lines.

Read Oct. 6, 1870. Published in American Journal of Conchology, Vol. 6: 192-198, April 1871.
(See below.)

[1870 Description of new Tertiary Fossils.
Am. Jour. Conch., Vol. 6:299-301.]
This title, though given in some bibliographies, does not seem to be valid.

1871 A Geological Vision. (Poems.)
100 pages. Trenton, New Jersey. Published anonymously. Edited by C. C. Abbott.

1871 Descriptions of new fossil shells of the Upper Amazon.
Am. Jour. Conch., Vol. 6: 192-198, April.
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(See above.)

1871 Description of new Tertiary fossils, with notes on two genera of Lamellibranchiata.
Am. Jour. Conch., Vol. 6: 199-201, Plates 11, 13, April.

1871 On the Eocene beds of Utah.
Am. Jour. Sci., Vol. 101: 381-383.

1871 On some points connected with the Cretaceous and Tertiary of North Carolina.
Am. Jour. Sci., Vol. 101: 468-469, May.

1871 Paleontological Notes.
Am. Jour. Conch., Vol. 6: 314-315, Plate 13, in part, June.
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1872 Descriptions and Illustrations of Genera of Shells.
Proc. Acad. Nat. Sci., Phila., Vol. 24: 50-55, Plates 1, 2, June.

1872 Descriptions of a New Recent Species of Glycimeris, from Beaufort, North Carolina, and of Miocene Shells of North Carolina.
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1874 Remarks on the Tertiary Clay of the Upper Amazon, with descriptions of new shells.
Proc. Acad. Nat. Sci., Phila., Vol. 26: 25-32, Plate 1, May.
Shells collected by Mr. Steere, and sent in by E. W. Hilgard.

1874 Descriptions of two new fossil shells of the Upper Amazon [from Iquitos].
Proc. Acad. Nat. Sci., Phila., Vol. 26: 82-83, Plate 12, Aug.

1874 Descriptions of new mollusks from Cretaceous beds of Colorado.
Appendix to report of E. D. Cope, in Hayden's U. S. Geol. and Geogr. Surv. Terr., 7th Ann. Rept., pp. 455-456.

1875 Descriptions of New Genera and Species of Fossil Shells of North Carolina in the State Cabinet at Raleigh.
W. C. Kerr, Geology of North Carolina, 1875, Vol. 1: 1-13, Plates 1, 2.

1875 Synopsis of the Cretaceous mollusca of North Carolina.
Ibid, Vol. 1: 13-24, Plates 3, 4.

1875 Remarks on the Tertiary formations of the Atlantic Slope.
Ibid, Vol. 1: 24-25.

1875 Remarks on Some Genera of Shells.
Ibid, Vol. 1: 26-28, Illus.

1875 Descriptions of two new species of Haploscapha from Niobrara beds, near Fort Hays, Kansas.

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1875 Descriptions of a new fossil shell from Peru.
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1875 Notes on the genus Catellus, Brongn.
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1877 Note on a cirripede of the California Miocene, with remarks on fossil shells.
Proc. Acad. Nat. Sci., Phila., Vol. 28: 273-275, Jan.

1877 Note on the relations of Balanus estrallanus (*Tamiostoma gregaria*) with the *Rudistæ,* of the California Miocene.
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1877 On certain generic names proposed by Zittel, Stoliczka, and Zekeli.
Proc. Acad. Nat. Sci., Phila., Vol. 29: 22-23, March.

1877 Notes on Shells.
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Probably Conrad's last writing. His decease announced briefly on p. 275 of this volume of the Proceedings.

IV

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Conrad-Joseph Henry and Spencer F. Baird, originals and letter books in archives of the Smithsonian Institution, Washington, D. C.

Conrad-Morton, originals in the library of the Academy of Natural Sciences, Philadelphia, Pa.

DALL, WILLIAM HEALEY

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A short sketch with a poem of fourteen stanzas, written by John Ford in Philadelphia January 1873, and addressed to Conrad.

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ERRATA

Page 6, line 9: For ''August 7,'' read August 8.

The exact date of Conrad's death is in doubt. The family records are not explicit. His grave is not marked. The encyclopædias generally give August 9 as the date. Another account says: ''August 8-9''. The Trenton Daily State Gazette, issue of August 10, 1877, plainly states that Conrad died on the 8th, but in another column of the same issue the time is given as ''yesterday morning''. Interpreted, this may mean that Conrad passed away on the 8th about midnight or very shortly afterward.

Page 22, f.n., lines 2, 3: for ''*Conradiana*'', read *Conradina.*

Page 56, line 22: For ''Sidney'', read Gideon.

Page 112, line 14: For ''June'', read July.

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A Microfauna from the Monmouth and Basal Rancocas Groups of New Jersey

By Philip H. Jennings

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A MICROFAUNA FROM THE MONMOUTH AND BASAL RANCOCAS GROUPS OF NEW JERSEY

By

Philip H. Jennings

"Submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy in the Faculty of Pure Science, Columbia University."

INTRODUCTION

The Monmouth and Rancocas groups of the Upper Cretaceous and Eocene of New Jersey outcrop in a belt striking N 55° E, which extends from the Delaware River near the town of Salem in Salem County to the vicinity of Red Bank and Atlantic Highlands in Monmouth County.

This paper presents the results of a detailed study of the foraminifera and ostracodes of these formations. The identifications which have been made permit a more detailed correlation with the Cretaceous and Eocene standard columns than was heretofore possible.

Little active work has been done on the foraminifera of New Jersey for the last thirty-eight years, and much of this early work is of little use due to the fact that in many cases the forms found were not figured. Practically no work has been done on the Cretaceous and Eocene ostracodes of the northern part of the coastal plain. One short paper was published describing a few species from the Monmouth group of Maryland;[1] a few Eocene forms were described in the Eocene report of the Maryland Survey.[2] Some of these were described as occurring in New Jersey. It has therefore been necessary to rework the ostracodes and foraminifera of this region in order to complete the study of the distribution of Cretaceous and Eocene micro-faunas in North America.

[1]Willard, B. E., Am. Jour. Sci., ser. 5, vol. 9, 1925, pp. 481-487.
[2]Ulrich, E. O. Md. Geol. Surv., Eocene, 1901, pp. 116-122.

ACKNOWLEDGMENTS

The author gratefully acknowledges the assistance and criticism of Dr. H. N. Coryell and Dr. G. Marshall Kay in the preparation of this paper. To Mrs. Helen Jeanne Plummer, for furnishing material from the type localities of the Cretaceous and Eocene in Texas, and to Dr. J. A. Cushman for permitting the author to use his material for comparison, great thanks are due. Thanks are also due to Dr. Brooks F. Ellis for permission to use for comparison the manuscript of the Illustrated Catalogue of Foraminifera.

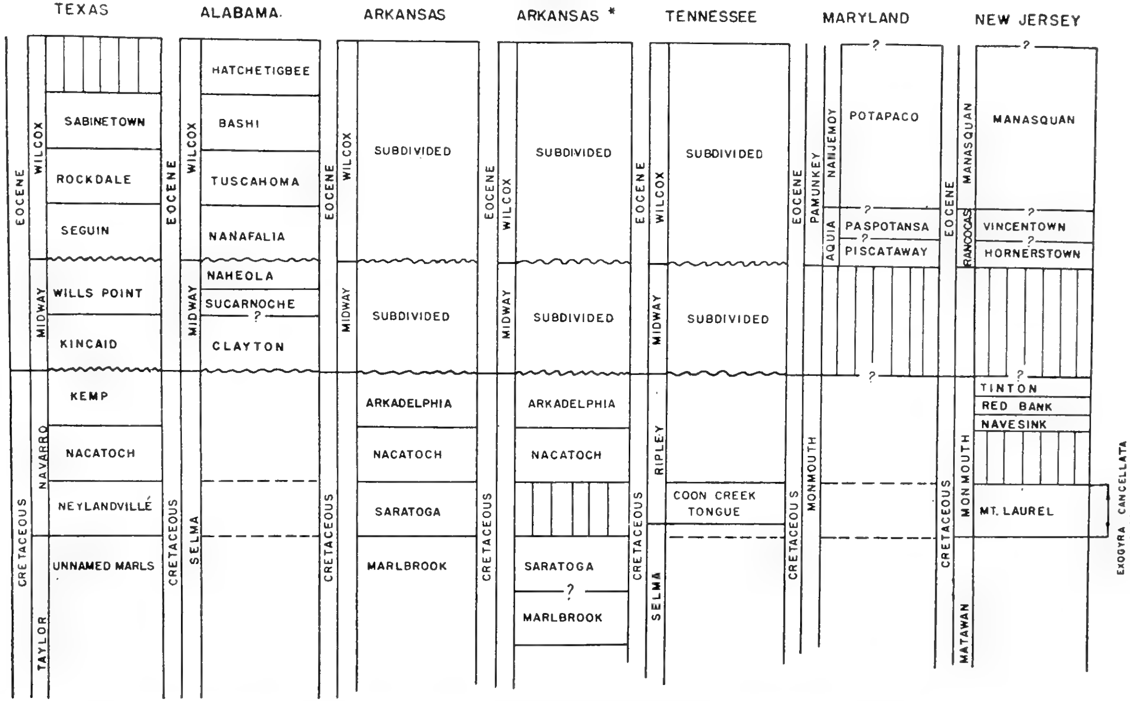
STRATIGRAPHY

That part of the stratigraphic column treated in this paper includes the Mt. Laurel, Navesink, Red Bank, and Tinton formations of the Monmouth group of Cretaceous age, and the Hornerstown formation, the basal formation of the Rancocas group of Eocene age. (See Figure 1.)

The Mt. Laurel consists of from 5 to about 100 feet of quartz sand containing varying amounts of glauconite. The formation thickens to the southeast from its minimum at Atlantic Highlands, reaching its maximum near the center of the state. It is extremely difficult to distinguish the Mt. Laurel from the underlying formation lithologically and to obtain accurate measurements of these beds. A new faunal element is introduced at this point, however, which serves to separate them. The Mt. Laurel is the lowest formation in the *Exogyra costata* zone in New Jersey and in addition forms the *Exogyra cancellata* subzone.

The Mt. Laurel is overlain unconformably by the Navesink formation which consists of from 25 to 40 feet of poorly consolidated sandy glauconitic marl. The glauconite content varies somewhat but the minimum amount appears to exceed the maximum found in the Mt. Laurel. In some localities, as in the road cut at Beers Hill, leaching and weathering has proceeded to a marked degree and the fossils have been largely destroyed or replaced by vivianite; in such places the microfauna has been destroyed. The best preserved microfaunules occur in disconuous shell beds which are fairly common in the Navesink. In

Figure I



TENTATIVE CORRELATION

Cretaceous correlation modified from Stephenson, Tenn. Geol. Surv., Bull. 41, 1931, p. 14.
*Arkansas Cretaceous from Thomas and Rice, Jour. Pal., vol. 5, 1931, p. 326.
Eocene correlation of Texas and Alabama, W. S. Adkins, Univ. Texas Bull. 3232, 1932, p. 580.
New Jersey and Maryland correlation, Cooke and Stephenson, Jour. Geol., vol. 36, no. 2, 1928, p. 147.

the parts of the formation that do not contain macrofossils the quantity and quality of the microfauna is poor.

The Red Bank formation conformably overlies the Navesink. It consists of from a few inches to 100 feet of reddish to yellow quartz sand with small amounts of glauconite. The exposure of this formation is confined to the northeastern part of the Cretaceous outcrop belt, reaching across the Monmouth County line about one mile north of New Egypt and dying out about one mile to the west of Sykesville in Burlington County. The microfauna in this formation is poorly preserved and no definitely identifiable forms were found in the localities visited. The macrofossils have suffered to the same degree and only poorly preserved molds and casts were found.

The Red Bank is conformably overlain by the Tinton formation which consists of from a few inches to 20 feet of clay, sand, and glauconite. The exposure of the Tinton is confined to the extreme eastern part of the Cretaceous outcrop belt in Monmouth County. The fauna in general seems to be rather similar to the fauna of the Navesink. As a whole the fossils are poorly preserved and no microforms were found.

The Navesink, Red Bank, and the Tinton are overlain unconformably by the Hornerstown which consists of about 30 feet of highly glauconitic sand, with lithology similar to that of the Navesink. The unconformity between the underlying Cretaceous and the Eocene Hornerstown is marked, as the Hornerstown rests on successively older beds as the outcrop is followed towards the southwest, cutting out successively the Tinton, Red Bank, and the upper part of the Navesink. Near the top of the Hornerstown there is a fairly consistent shell bed formed largely of the brachiopod *Terebratula harlani.* The microfauna of this bed is fairly diverse and quite profuse.

LOCALITIES

Mt. Laurel, Nutt's Farm, on Crosswick's Creek, 0.6 mi. north of New Egypt, Ocean Co., New Jersey.

Navesink, Crawford's Corner, about 5 mi., So. of Keyport, New Jersey.

Hornerstown, Tributary to Crosswick's Creek, south of New Egypt.

CORRELATION

The correlation of the Monmouth and Rancocas groups in New Jersey has passed through a variety of phases. The earlier workers all classified these groups as Cretaceous. The lower dividing line was often in dispute, as some of the authors could not differentiate between the Mt. Laurel formation forming the base of the Monmouth group and the Winonah formation which forms the top of the underlying Matawan group. The very marked break between the top of the Monmouth and the base of the Rancocas groups was observed, however, by all the workers. Weller[3] pointed out that the only significant faunal break in the New Jersey "Cretaceous" section was at this point, and it was here that he drew the line between his Ripleyan and Jerseyan divisions. It is probable that if Weller had been more familiar with the Tertiary and Mesozoic faunas he would have realized that the fauna of the Rancocas was definitely Eocene and not Cretaceous. As it was, twenty-one years elapsed before Cooke and Stephenson recognized the Eocene age of this group. At the present time their classification of these beds is accepted.

In 1933 Stephenson[4] recognized the impcitance of the Mt. Laurel fauna which is characterized by the presence of *Exogyra cancellata*. This fossil sub-zone is confined to the Mt. Laurel formation in New Jersey and has been traced by Stephenson from Atlantic Highlands to Texas.

At the present time there is some discussion regarding the age of the *Exogyra cancellata* zone. In Texas it occupies that portion of the Navarro section below the Nacatoch sand and above the Taylor. The name Neylandville has been suggested for these beds by Stephenson and Adkins.[5]

[3]Weller, S., New Jersey Geol. Surv., Paleontology, vol. 4, Cretaceous Faunas, 1907, pp. 178-179.

[4]Stephenson, L. W., Am. Assoc. Pet. Geol., Bull., vol. 17, no. 11, 1933, pp. 1351-1360.

[5]Adkins, Univ. Texas Bull. 3232, 1932, pp. 488 and 516.

This zone appears to correlate with the Saratoga chalk in Arkansas.[6] In their discussion of the faunas and correlation of the Saratoga, Thomas and Rice[7] point out that its fauna is more closely related to the Taylor fauna than to that of the Navarro. According to these authors this is especially true in respect to the microforms. They list as the typical Taylor forms occurring in the Saratoga, *Gyroidina micheliniana, Heterostomella faveolata, Bolivinoides decorata, Cibicides constricta,* and *Planulina taylorensis.* The only typical Navarro form that Rice and Thomas list as occurring in these beds is *Robulus navarroensis,* and they further state that the representatives of this species found in the Saratoga differ from the specimens found in the Navarro proper. Of the forms listed by these authors as diagnostic of the type Taylor none occurs in the *Exogyra cancellata* zone in New Jersey. Of the thirty-four forms that are listed by Mrs. Plummer[8] as diagnostic of the Taylor in Texas, only two were found in the New Jersey material, namely, *Marssonella oxycona* and *Valvulineria nelsoni.* Of these two, however, the latter is diagnostic of the very top of the Taylor in Texas and the former occurs also in higher beds of undoubted Navarro age in New Jersey. In his report on the Tennessee foraminifera, Cushman[9] lists *Anomalina clementiana* as one of the distinctive species of the fauna of the Coon Creek formation which forms part of the *Exogyra cancellata* zone in that state. He concludes that this fauna is to be placed in the Navarro, somewhere near the Taylor-Navarro contact. This species is very common in the Mt. Laurel formation in New Jersey. Other fossils in the Mt. Laurel listed as diagnostic of the Navarro by Plummer[10] are *Gümbelitria cretacea, Loxostoma plaitum,* and *Dorothia bulletta.* These fossils indicate that the age of the *Exogyra cancellata* zone in New Jersey is Navarro, and the great abundance of *Anomalina*

[6]Dane, C. H., Ark. Geol. Surv., Bull. 1, 1929, p. 111. Stephenson, L. W., Am. Assoc. Pet. Geol., Bull. 11, 1927, p. 15.

[7]Thomas, N. L., and Rice, E. M., Am. Assoc. Pet. Geol., Bull. 15, 1931, p. 996. Thomas, N. L. and Rice, E. M., Jour. Pal., vol. 5, 1931, p. 326.

[8]Plummer, H. J., Univ. Texas Bull. 3501, 1936, p. 282.

[9]Cushman, J. A., Tenn. Geol. Surv., Bull. 41, 1931, p. 15.

[10]Plummer, H. J., Univ. Texas Bull. 3501, 1936, p. 282.

clementiana would indicate that it is equivalent to about the Coon Creek and is therefore lowest Navarro in age.

The Navesink overlies the Mt. Laurel unconformably,[11] though the unconformity is inconspicuous in the field. The correlation of the Navesink with the type section in Texas is a little difficult, due to the fact that there may be an unconformity below the Navarro series in Texas. Stephenson[12] has pointed out that as one proceeds southward from the type section of the Navarro in Navarro County, Texas, the basal members of the Navarro are cut out and, in Travis County in the vicinity of Austin, the *Exogyra cancellata* zone and the Nacatoch are missing. Hence the lowest Navarro of the Austin region is younger than the Nacatoch sand. The Jersey section seems to support the contention of Stephenson, for the Navesink fauna appears to be equivalent to the "basal" Navarro fauna of the Austin region as given by Mrs. Plummer.[13] Of the twenty-eight species that are listed as occurring near Austin, Texas, eighteen are found in the Navesink. Of these *Vaginulina webbervillensis* is given by Cushman[14] as a guide fossil to the *Bulimina* zone of the middle Navarro above the Nacatoch sand. *Bulimina quadrata* is also present in fairly large quantities in the material from the Navesink and though this fossil occurs in other horizons, when present in large numbers it is regarded as an index fossil of the *Bulimina* zone of the middle Navarro.

The two uppermost formations in the Monmouth did not yield any recognizable microfossils. The material was leached to such an extent that none of the smaller forms were preserved in collections made in a number of places in the restricted outcrop area in Monmouth County.

The Hornerstown formation of the Rancocas group is the basal Eocene formation of New Jersey. The fauna of these beds is more or less unique among the Eocene faunas of the United

[11]Stephenson, L. W., op. cit., p. 1360.

[12]Stephenson, L. W., Am. Assoc. Pet. Geol., Bull., vol. 13, 1929, pp. 1331-1332.

[13]Plummer, H. J., Univ. Texas Bull. 3101, 1931, pp. 121-122.

[14]Cushman, J. A., op. cit., p. 14.

States. The only other place where similar faunas occur is in Maryland and as far south as Virginia.[15] The Hornerstown fauna is characterized by the first appearance of *Terebratula harlani* and it is this fossil that Weller[16] regarded as being the most characteristic of his Jerseyan group. This fossil also characterizes the Piscataway stage of the Aquia formation in Maryland[17] with which the Hornerstown formation is now correlated.[18]

The microfauna of the Hornerstown differs from other previously described Eocene microfaunas. It has only five forms that are identical with forms found in the Midway of Texas. These are *Allomorphina "trigonia," Globigerina compressa, G. triloculinoides, Nodogenerina sagrinensis,* and *Pulvinulinella exigua* var. *obtusa.*[19] These species do not appear to be diagnostic of the Midway and several have fairly long ranges. Several of the forms that are found in the Hornerstown, however, show close relationships to forms that are found in the Midway. *Cibicides mortoni,* one of the commonest forms in the Hornerstown, appears to be closely related to *Cibicides alleni* and *C. vulgaris* from the Midway.

Only one faunule has been described from the Wilcox[20] and the exact age of this is difficult to determine as the formation from which it was gathered is not given. The location from which it was collected is not of much aid as the geologic map of Alabama shows several formations outcropping in the immediate vicinity. It appears that the faunule cannot be older than the topmost beds of the Tuscahoma however, and it is probably Bashi or possibly Hatchetigbee in age. The Wilcox faunule has one species in common with the Hornerstown and this is

[15]Weller, S., New Jersey Geol. Surv., Paleontology, vol. 4, Cretaceous Faunas, 1907, p. 179. Md. Geol. Surv., Eocene, 1901, p. 83.
[16]Weller, S., New Jersey Geol. Surv., Paleontology, vol. 4, Cretaceous Faunas, 1907, p. 179.
[17]Maryland Geol. Surv., Eocene, 1901, p. 61.
[18]Cooke and Stephenson, Jour. Geol., vol. 36, no. 2, 1928, pp. 147-148.
[19]Plummer, H. J., Univ. Texas Bull. 2644, 1927, p. 66.
[20]Cushman, J. A., Contrib. Cushman Lab. Foram. Res., vol. 8, 1932, pp. 51-72.

also found in the Midway. It is *Pulvinulinella exigua* var. *obtusa.* There does not appear to be as close a relationship between the faunule described by Cushman and the Hornerstown as there is between the Midway and the Hornerstown. None of the described Claiborne and only one Jackson form were found in the Hornerstown.

In spite of the closer relationship between the Midway and Hornerstown than between the Hornerstown and the described Wilcox fauna, it does not seem that the Hornerstown is Midway in age. The guide fossils to the Midway are missing, and the large number of new species present makes it still more doubtful that the Hornerstown should be Midway in age. It seems most probable that the Hornerstown correlates with the Nanafalia formation of the Wilcox group. This correlation agrees with that made by the Maryland Survey[21] in which it is stated that the Aquia has a closer relationship with the lower Chickasawan or Wilcox than with any other part of the Eocene. This correlation accounts for the similarities of the fauna with that of the Midway and at the same time accounts for the differences between the Hornerstown and the only described Wilcox fauna which would be a good deal younger than the Hornerstown as shown on the accompanying chart. (See Figure 1.)

SYSTEMATIC DESCRIPTIONS

Order FORAMINIFERA d'Orbigny, 1826
Family TEXTULARIIDAE d'Orbigny, 1846
Genus TEXTULARIA Defrance, 1824

Textularia cf. dibollensis Cushman and Applin — Pl. 1, figs. 1a-b.

Textularia dibollensis Cushman and Applin, Am. Assoc. Pet. Geol., Bull., vol. 10, 1926, p. 165, pl. 6, figs. 12-14.

This test is rare in the New Jersey Eocene, only one complete specimen having been found. It resembles *T. dibollensis* but has more chambers. In other respects it seems to be the same and is therefore referred to this species. Length, 0.45 mm.; width, 0.25 mm. Hornerstown.

[21]Maryland Geol. Surv., Eocene, 1901, p. 87.

Genus SPIROPLECTAMMINA Cushman, 1927

Spiroplectammina laevis (Roemer) var. **cretosa** Cushman Pl. 1, figs. 2a-b.

Spiroplectammina semicomplanata Plummer, (*non* Carsey) Univ. Texas Bull. 3101, 1931, p. 129, pl. 8, fig. 8 (not fig. 7).
Spiroplectammina laevis (Roemer) var. *cretosa* Cushman, Contr. Cushman Lab. Foram. Res., vol. 8, 1932, p. 87, pl. 11, figs. 3a-b.

The New Jersey forms seem to agree with those shown in fig. 8 by Mrs. Plummer. Cushman has separated these out as a variety of Roemer's species and as distinct from *S. semicomplanata* as originally made by Mrs. Carsey.

Mt. Laurel and Navesink.

Family VERNEUILINIDAE Cushman, 1927

Genus VERNEUILINA d'Orbigny, 1839

Verneuilina bronni Reuss Pl. 1, figs. 3a-b.

Verneuilina bronni Reuss, Verstein. Bohm. Kreide, 1845-46, p. 38, pl. 12 fig. 5; —White, Jour. Pal., vol. 2, 1928, p. 309, pl. 42, figs. 3a-b; —Plummer, Univ. Texas Bull. 3232, 1932, p. 510 (list).

This finely arenaceous and almost equidimensional form appears to be the one identified by Reuss. The material in New Jersey is not well enough preserved to show the sutures and aperture with any great degree of distinctness. Length, 0.50 mm.; width, 0.45 mm. Navesink.

Verneuilina kurti, n. sp. Pl. 1, figs. 4a-b.

Test small, pyramidal, almost equidimensional, triangular in cross-section, margins rounded; early chambers flush, later chambers slightly inflated; early sutures almost invisible, later ones somewhat depressed; wall finely arenaceous, smooth, with much cement; aperture an arched opening in the center of the base of the last chamber. Length, to 0.45 mm.; width, 0.40 mm.

This form differs from *V. bronni* in the greater rounding of the margins and in the inflated character of the later chambers. Also the upper surface and aperture are more arched.

Navesink. Columbia Univ. Coll. No. M 38.

Genus GAUDRYINA d'Orbigny, 1839

Gaudryina rugosa d'Orbigny Pl. 1, fig. 5.

Gaudryina rugosa d'Orbigny, Mem. Soc. Geol. France, vol. 4, 1840, p. 44, pl. 4, figs. 20-21.
Gaudryina pupoides Carsey (*non* d'Orb.), Univ. Texas Bull. 2612, 1926, p. 27, pl. 4, fig. 5.
Gaudryina rugosa Plummer, Univ. Texas Bull. 3101, 1931, p. 135, pl. 8,

fig. 11; —Cushman, Tenn. Geol. Surv., Bull. 41, 1931, p. 20, pl. 1, figs. 9-10.

This form appears to be typical of the species. Length, up to 0.80 mm.; width, up to 0.41 mm.

Mt. Laurel and Navesink.

Family VALVULINIDAE Cushman, 1927

Genus CLAVULINA d'Orbigny, 1826

Clavulina insignis Plummer Pl. 1 fig. 6.

Clavulina triquetra Martinotti, (*non* Reuss), Atti. Soc. Ital. Sci. Nat., vol. 64, 1925, p. 177, pl. 4, figs. 8-9.

Tritaxia tricarinata Carsey (*non* Reuss), Univ. Texas Bull. 2621, 1926, p. 27, pl. 6, fig. 4.

Clavulina insignis Plummer, Univ. Texas Bull. 3101, 1931, p. 138, pl. 8, figs. 1-4.

This form appears to be the one Plummer described from Texas. Length, 1.45 mm.; width, 0.35 mm.

Navesink.

Genus ARENOBULIMINA Cushman, 1927

Arenobulimina cuskleyae, n. sp. Pl. 1, fig. 8.

Test subfusiform, apical end pointed, apertural end broadly rounded; test composed of about 4 whorls, the first two rapidly expanding, the last two forming eighty per cent of the test, 4 to 5 chambers to a whorl; spiral suture obliquely depressed, transverse sutures flush, very slightly limbate; test smoothly arenaceous with much cement; aperture virguline, extending from the suture into the septal face which is slightly depressed. Length, 0.95 mm.; width, 0.20 mm.

Hornerstown. Columbia Univ. Coll. No. M 2.

Arenobulimina malkinae, n. sp. Pl. 1, fig. 7.

Test subconical, apical end narrowly rounded, apertural end broadly rounded, chambers 4 to 5 in final whorl, early chambers small, rapidly expanding final whorl forming over half of specimen; wall smoothly arenaceous with much cement; aperture virguline, extending from the suture into the septal face. Length, 0.40 mm.; width, 0.25 mm.

Hornerstown. Columbia Univ. Coll. No. M 1.

Arenobulimina footei, n. sp. Pl. 1, fig. 9.

Test subfusiform, apical end bluntly pointed, apertural end rounded; test composed of about 4 whorls expanding rapidly but uniformly, 4 chambers to a whorl in mature portion; spiral suture strongly depressed, transverse sutures slightly depressed; aperture broadly virguline, extending into the septal face from the suture; test smoothly arenaceous with much cement. Breadth, 0.30 mm.; length, 0.65 mm.

This form differs from *A. cuskleyae* in that the whorls expand more uniformly instead of the last two being almost equal in size, and the transverse sutures are depressed. It resembles somewhat *A. truncata* (Reuss) but it does not have as many whorls.

Mt. Laurel. Columbia Univ. Coll. No. M 3.

Arenobulimina haffi, n. sp. Pl. 1, fig. 10.

Test suboval, apical end very bluntly pointed, apertural end broadly rounded, test composed of two or three whorls, extremely embracing, last whorl forms more than ninety per cent of test, final chamber one-half of test, four chambers to a whorl; sutures slightly depressed; aperture a very long virguline slit in the flat septal face. Length, 0.70 mm.; width, 0.55 mm.

Mt. Laurel. Columbia Univ. Coll. No. M 4.

Genus MARSSONELLA Cushman, 1933

Marssonella oxycona (Reuss) Pl. 1, figs. 11a-b.

Gaudryina oxycona Reuss, Sitz. Akad. Wiss. Wien, vol. 40, 1860, p. 229, pl. 12, figs. 3a-c; —Cushman, Jour. Pal., vol. 5, 1931, p. 300, pl. 34, figs. 4a-b; —Sandidge, Jour. Pal., vol. 6, 1932, p. 268, pl. 41, figs. 2-3; —Cushman, U. S. Nat. Mus., Pr., vol. 80, art. 14, 1932, p. 18, pl. 5, figs. 1-2

Marssonella oxycona Cushman, Contr. Cushman Lab. Foram. Res., vol. 9, pt. 2, 1933, p. 36, pl. 4, figs. 13a-b.

This form is typical of Cushman's material. Length, to 1.2 mm.; breadth, to 0.50 mm.

Mt. Laurel and Navesink.

Genus DOROTHIA Plummer, 1931

Dorothia bulletta (Carsey) Pl. 1, fig. 12

Gaudryina bulletta Carsey, Univ. Texas Bull. 2612, 1926, p. 28, pl. 4, fig. 4.

Dorothia bulletta Plummer, Univ. Texas Bull. 3101, 1931, p. 132, pl. 8, figs. 13-17.

Agrees with the forms figured by Plummer. Length, 0.70 mm.; thickness, 0.35 mm.

Mt. Laurel and Navesink.

Family LAGENIDÆ Cushman, 1923

Genus ROBULUS Montfort, 1808

Robulus aldrichi Sandidge Pl. 1, fig. 13.

Robulus aldrichi Sandidge, Jour. Pal., vol. 6, 1932, p. 272, pl. 42, figs. 3-4.

This form resembles *Lenticulina degolyeri* Plummer but has a robuline aperture and a more strongly developed rim on the border. Length, 0.70 mm.; thickness, 0.30 mm.; width, 0.60 mm.

Common in Mt. Laurel, rare in Navesink.

Robulus navarroensis (Plummer) Pl. 1, figs. 14a-b.

Cristellaria cultrata Carsey (*non* Montfort), Univ. Texas Bull. 2612, 1926, p. 38, pl. 6, fig. 3.
Cristellaria navarroensis Plummer, Univ. Texas Bull. 2644, 1927, p. 39, figs. 4a-b (in text).
Cristellaria midwayensis Berry and Kelly (*non* Plummer) U. S. Nat. Mus., Pr., vol. 76, art. 19, 1929, p. 7, pl. 1, fig. 3.
Cristellaria orbicularis d'Orb. var. *minuta* Berry and Kelly, loc. cit., p. 8, pl. 1, fig. 2.
Lenticulina navarroensis Plummer, Univ. Texas Bull. 3101, 1931, p. 141.
Robulus navarroensis Cushman, Tenn. Geol. Surv., Bull. 41, 1931, p. 25, pl. 2, figs. 8a-b.

This form is fairly common in the Mt. Laurel and the Navesink. It agrees with Plummer's forms and shows in general the development of the robuline slit. Diameter, 1 mm. or more.

Robulus hookerae, n. sp. Pl. 1, figs. 15a-b.

Test elongate, compressed, involute, periphery with a sharp delicate keel; six to seven rapidly expanding chambers in the final whorl; sutures limbate, curved, and raised, often showing ridge-like elevations or nodes for a part or all of their length; the sutures join in the center to form an irregular boss or group of node-like protuberances; apertural face laterally bounded by low ridges, aperture at the apex of the apertural face, radiate, with a robuline slit down the apertural face. Length 1.10 mm.; diameter, 0.80 mm.; thickness, 0.60 mm.

A few herontic specimens have been found in which the tendency to become evolute is marked. The average form is involute in its mature stage.

This form appears to belong to the *R. vicksburgensis* Cushman group; it differs from *R. vicksburgensis* in the rapidity of the expansion of the chambers and in the greater fusing of the septa.

Hornerstown. Columbia Univ. Coll. No. M 15.

Robulus convergens (Bornemann) Pl. 1, fig. 16.

Cristellaria convergens Bornemann Zeitsch. deutsch. geol. Ges., vol. 7, 1855, p. 327, pl. 13, figs. 16-17.

Cristellaria convergens Cushman, Jour. Pal., vol. 1, 1927, p. 152, pl. 23, fig. 12.

Lenticulina ? convergens Cushman and Dusenbury, Contrib. Cushman Lab. Foram. Res., vol. 10, pt. 3, 1934, p. 54, pl. 7, figs. 7a-b.

The lenticuline forms with curved apertural faces appear to belong to this species of Bornemann. Diameter, 0.75 mm.

Mt. Laurel.

Genus **LENTICULINA** Lamarck, 1804

Lenticulina degolyeri (Plummer) Pl. 1, figs. 17a-b.

Cristellaria degloyeri Plummer, Univ. Texas Bull. 2644, 1927, p. 97, pl. 7, figs. 7a-b.

Lenticulina degolyeri Plummer, Univ. Texas Bull. 3232, 1932, p. 567 (list); —Scott, Geol. Soc. Am., Bull. 45, 1934, p. 1131 (list).

These forms agree with the Midway material described by Plummer. Dr. Scott has pointed out that in addition to being found in the Midway, the form is also found in the Navarro section in Texas. Length, up to 1 20 mm.; width, to 0.85 mm.

Navesink.

Genus **MARGINULINA** d'Orbigny, 1826

Marginulina costata (Batsch) Pl. 1, fig. 18.

Nautilus (Orthoceras) costatus Batsch, Conch. des Seesandes, 1791, p. 2, pl. 1, fig. 1.

Marginulina raphanus d'Orbigny, Ann. Sci. Nat., vol. 7, 1826, p. 258, no. 1, pl. 10, figs. 7-8.

Marginulina costata Brady, Challenger Report, vol. 9, 1884, p. 528, pl. 65, figs. 10-13; —Cushman, U. S. Nat. Mus., Bull. 100, vol. 4, 1919, p. 256, pl. 41, figs. 5-8; —Plummer, Univ. Texas Bull. 2644, 1927, p. 107, pl. 5, figs. 8a-c.

Similar to the forms described by Plummer. Length, 0.50 mm. - 1.10 mm.

Mt. Laurel and Navesink.

Marginulina bullata Reuss Pl. 2, fig. 1.

Marginulina bullata Reuss, Verstein. bohm. Kreide, pt. 1, 1845-46, p. 29, pl. 13, figs. 34-38; —Cushman and Jarvis, Contr. Cushman Lab. Foram. Res., vol. 4, 1928, p. 96, pl. 14, figs. 7-8; —U. S. Nat. Mus., Pr., vol. 80, art. 14, 1932, p. 26, pl. 8, figs. 7-8.

Test elongate, rounded in cross-section, composed of a few chambers, early ones coiled, later ones evolute and inflated; sutures depressed in later portion of the test; aperture round, radiate, produced. Length, 0.25-0.55 mm.

Mt. Laurel.

Genus HEMICRISTELLARIA Stache, 1864

Hemicristellaria rancocasensis, n. sp. Pl. 2, fig. 2.

Test elongate, slightly compressed, periphery narrowly rounded; early chambers (4 to 5) coiled, compressed, later chambers (6 to 8) evolute; sutures limbate and raised and curved, sutures in the coiled portion almost as large as the chambers; last two or three chambers inflated in the center, the inflation dying out towards the margins, the sutures showing as narrow transverse ridges in the depressed portion between the inflated portions of the chambers; aperture marginal, radiate, produced. Length, 1.40 mm.; width, 0.50 mm.; thickness, 0.26 mm.

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Hemicristellaria ensis (Reuss) Pl. 2, fig. 3.

Marginulina ensis Reuss, Verstein. Bohm. Kreid. pt. 1, 1845-46, p. 29, pl. 12, fig. 13; pl. 13, figs. 26-27.
Cristellaria lineara Carsey (*non* d'Orb.) Univ. Texas Bull. 2612, 1926, p. 36, pl. 2, fig .3.
Hemicristellaria ensis Plummer, Univ. Texas Bull. 3101, 1931, p. 146, pl. 10, figs. 1-4.

Test elongate, compressed; first three or four chambers arranged in a distinct coil; later chambers not as compressed as the early ones, oblique to the longitudinal axis; sutures depressed and marked laterally by elongate nodes, which in some forms, in the later chambers, form ridges across the specimen; aperture eccentric, radiate, produced. Length, 1.20 mm.; width, 0.32 mm.

Mt. Laurel.

Genus DENTALINA d'Orbigny, 1826

Dentalina communis (d'Orbigny) Pl. 2, fig. 4.

Nodosaria (Dentalina) communis d'Orbigny, Ann. Soc. Nat. Sci., vol. 7, 1826, p. 254, No. 35.
Nodosaria (Dentalina) communis Jones, Parker and Brady, Ann. and Mag. Nat. Hist., ser. 4, vol. 8, 1871, p. 158, pl. 9, fig. 46.
Nodosaria communis Carsey, Univ. Texas Bull. 2612, 1926, p. 34, pl. 7, fig. 5.
Dentalina communis Plummer, Univ. Texas Bull., 3101, 1931, p. 149, pl. 11, fig. 4.

Test elongate, curved, tapering with the later chambers inflated, early chambers flush; sutures inclined slightly to axis of the test, in later chambers depressed, early ones shown as dark lines; aperture radiate, eccentric, protruding. Length, 0.75 mm. to 1 mm.

Mt. Laurel and Navesink.

Dentalina confluens Reuss Pl. 2, fig. 5.

Dentalina confluens Reuss, Sitz. d. K. Akad. Wiss. Wien., Bd. 44, no. 21, 1861 (1862), p. 335, pl. 7, fig. 5; —Cushman, Jour. Pal., vol. 5, 1931, p. 304, pl. 35, fig. 1.

Nodosaria confluens Egger, Abh. d. II Cl. d. K. Akad. Wiss., vol. 21, Abth. 1, Munchen, 1899 (1900), p. 72, pl. 9, figs. 27-28.

Fragments of a fairly large dentaline form, with the later chambers inflated and numerous, coarse, rather rounded costae which are somewhat oblique to the longitudinal axis of the test, are fairly common in the Navesink.

Navesink.

Dentalina granti (Plummer) Pl. 2, fig. 6.

Nodosaria filiformis Carsey (*non d'Orb.*) Univ. Texas Bull. 2612, 1926, p. 33, pl. 7, fig. 8.

Nodosaria granti Plummer, Univ. Texas Bull. 2644, 1927, p. 83, pl. 5, fig. 9.

Dentalina granti Plummer, Univ. Texas Bull. 3101, 1931, p. 149, pl. 11, figs. 8-9.

Some fragments of a dentaline form with very elongate and slightly constricted chambers appear to belong to this species.

Mt. Laurel.

Dentalina legumen (Reuss) var. **spirans** Cushman Pl. 2, fig. 7.

Dentalina legumen (Reuss) var. *spirans* Cushman, Tenn. Geol. Surv., Bull. 41, 1931, p. 28, pl. 3, fig. 2.

Test slender, elongate, tapering and curved; chambers distinct, inflated, initial chamber bearing a short stout spine; sutures distinct, depressed and oblique; aperture round, radiate, extended on a neck; surface ornamented by elongate spiral costae that are continuous from chamber to chamber. Length, up to 1 mm.

Mt. Laurel.

Dentalina nana Reuss Pl. 2, fig. 8.

Dentalina nana Reuss, Sitz. Akad. Wiss. Wien, vol. 46, pt. 1, 1862-63, p. 39, pl. 2, figs. 10-18; —Cushman, Tenn. Geol. Surv., Bull. 41, 1931, p. 29, pl. 3, fig. 21.

Test elongate, curved, tapering, increasing in size rapidly, diameter greatest towards the apertural end; chambers distinct and of uniform shape; sutures distinct, oblique and depressed;

surface smooth; aperture radiate, eccentric and terminal. Length, to 1 mm.; diameter, 0.20 mm.

Mt. Laurel.

Dentalina raristriata (Chapman)

Nodosaria (Dentalina) raristriata Chapman, Jour. Roy. Micr. Soc., 1893, ser. 2, vol. 13, p. 591, pl. 9, fig. 4.
Nodosaria intrasegma Carsey, Univ. Texas Bull. 2612, 1926, p. 33, pl. 4, fig. 10.
Dentalina raristriata Plummer, Univ. Texas Bull. 3101, 1931, p. 152, pl. 11, figs. 10-11.

A few fragments with longitudinal costæ across the sutural constrictions and not on the chambers were found in the Navesink. They appear to belong with the forms that were described by Plummer and are referred to this species.

Navesink.

Genus NODOSARIA Lamarck, 1812

Nodosaria fissicostata (Gümbel) Pl. 2, fig. 9

Dentalina fissicostata Gümbel, K. bayer. Akad, Wiss. Munchen, Cl. 2, Abh., vol. 10, 1868-1870, p. 626, pl. 1, fig. 46.
Nodosaria fissicostata Cushman, Contr. Cushman Lab. Foram. Res. vol. 1, 1925, p. 66, pl. 10, fig. 8; Jour. Pal., vol. 1, 1927, p. 154, pl. 24, figs. 10-11; U. S. Geol. Survey., Prof. Pap. 181, 1935, p. 22, pl. 5, figs. 8-9.

Fragmentary tests of a large nodosarian form with a gradually tapering shape are fairly common. The later chambers are inflated; the surface is ornamented with numerous (20 to 25), low, rounded, costæ; the aperture is radiate and produced.

Hornerstown.

Nodosaria latejugata Gümbel var. **carolinensis** Cushman Pl. 2, fig. 10

Nodosaria latejugata Gümbel var. *carolinensis* Cushman, Contr. Cushman Lab. Foram. Res. vol. 9, 1933, p. 5, pl. 1, fig. 16; U. S. Geol. Surv., Prof. Pap. 181, 1935, p. 21, pl. 5, figs. 10-13.

A number of fragments of a nodosarian form with from 14 to 20 carinæ are found in the Hornerstown. The carinæ are sharp and well developed. The forms appear to be the same as those described by Cushman.

Hornerstown.

Nodosaria paupercula Reuss Pl. 2, fig. 11

Nodosaria paupercula Reuss, Verstein. böhm. Kreide, pt. 1, 1845-46, p. 26, pl. 12, fig. 12;—Cushman, U. S. Nat. Mus., Pr., vol. 80, art. 14, 1932, p. 33, pl. 10, figs. 14-15.

Fragments of a large nodosarian form with from 12 to 17 large sharp costæ are fairly common in the Mt. Laurel. These forms agree with those figured by Cushman, especially with that one shown as fig. 15 in the Proceedings of the U. S. National Museum.

Mt. Laurel.

Nodosaria radicula (Linné) Pl. 2, fig. 12

Nautilus radiculus Linné, Syst. Nat., 12 Ed., 1767, p. 1164, no. 285.
Nodosaria (*Nodosaria*) *radicula* d'Orbigny, Ann. Sci. Nat. vol. 7, 1826, p. 252, Model no. 1.
Nodosaria radicula Brady, Challenger Report, vol. 9, 1884, p. 495, pl. 61, figs. 28-31;—Cushman, U. S. Nat. Mus., Bull. 100, vol. 4, 1919, p. 190, pl. 34; Bull. 71, pt. 3, 1913, p. 52; Bull. 104, pt. 4, 1923, p. 73.
Nodosaria larva Carsey, Univ. Texas Bull. 2612, 1926, p. 31, pl. 2, fig. 2.
Nodosaria radicula Plummer, Univ. Texas Bull. 2644, 1927, p. 77, pl. 4, figs. 9a-b; Bull. 3101, 1931, p. 155, pl. 11, fig. 1;—Sandidge, Jour. Pal., vol. 6, 1932, p. 275, pl. 42, fig. 7.

Test is typical of this species. Length, up to 0.70 mm.; diameter, to 0.20 mm.

Mt. Laurel.

Nodosaria zippei Reuss Pl. 2, fig. 13

Nodosaria zippei Reuss, Geogn, Skizze aus Böhmer, 1844, p. 210; Verstein. böhm. Kreide, pt. 1, 1845-46, p. 25, pl. 8, figs. 1-3.
Nodosaria affinis Cushman, Tenn. Geol. Surv., Bull. 41, 1931, p. 30, pl. 3, figs. 16-20; Jour. Pal., vol. 5, 1931, p. 305, pl. 35, figs. 2-5; U. S. Nat. Mus., Pr., vol. 80, 1932, art. 14, p. 34, pl. 10, fig. 13.
Nodosaria zippei Plummer, Univ. Texas Bull. 3101, 1931, p. 157;—Sandidge, Jour. Pal. vol. 6, 1932, p. 275, pl. 42, figs. 13-14.

Test large, elongate, uniserial, tapering, 8 or more chambers in a test, initial chamber somewhat larger than the others and bears a large initial spine; sutures constricted in the later stages, almost flush in the early part of the test; surface ornamented with from 10 to 12 sharp longitudinal costæ; aperture round, radiate, and protruding. Length, up to 2.2 mm.

This form appears to be the same one that is described by Cushman and Sandidge. Reuss' figures for *Nodosaria affinis* and for *Nodosaria zippei* seem to show that Sandidge's argument for including these forms in the latter species is correct.

Navesink.

Genus SARACENARIA Defrance, 1824

Saracenaria acutauricularis (Fichtel and Moll) Pl. 2, figs. 14a-b

Nautilus acutauricularis Fichtel and Moll, Test. Micr., (1st Ed. 1798, 2nd Ed. 1803) p. 102, pl. 18, figs. g-i.

Cristellaria acutauricularis Sherborn and Chapman, Roy. Micro. Soc., Jour. Tr. 2nd ser. vol. 6, pt. 2, art. 12, 1886, p. 753, pl. 15, figs. 22a-b.
Saracenaria acutauricularis White, Jour. Pal., vol. 2, 1928, p. 200, pl. 28, fig. 10;—Cushman, Contr. Cushman Lab. Foram. Res., vol. 5, 1929, p. 88, pl. 13, fig. 12.

The New Jersey specimen is a little smaller than those found by White and has two fewer chambers. It agrees, however, in all other respects and is, therefore, assigned to that species. Length, 0.35 mm.; width, 0.27 mm.; thickness, 0.25 mm.

Mt. Laurel.

Genus VAGINULINA d'Orbigny, 1826

Vaginulina webbervillensis Carsey Pl. 2, fig. 15

Vaginulina webbervillensis Carsey, Univ. Texas Bull. 2612, 1926, p. 39, pl. 2, fig. 7;—Cushman, Contr. Cushman Lab. Foram. Res., vol. 6, 1930, p. 27, pl. 4, fig. 14; Tenn. Geol. Surv., Bull. 41, 1931, p. 33, pl. 4, fig. 6;—Moreman, Jour. Pal., vol. 1, 1927, p. 98, pl. 16, fig. 2;—Plummer, Univ. Texas Bull. 3101, 1931, p. 160.

Test large, elongate, compressed, tapering, greatest width close to the apertural end; periphery multicarinate and narrowly rounded, ventral edge straight, dorsal edge curved; chambers numerous, 10 or more in a mature specimen; sutures curved, distinct and limbate, raised in the mature portion of the test; proloculum bulbous and ornamented with strong costæ which extend towards the mature portion of the test, becoming less and less strongly developed and finally only showing at the points where they cross the sutures; aperture round, radiate, protruding, located on the dorsal angle. Length, to 8.0 mm.

This form differs from the typical Texas forms in that the surface of the mature portion of the test is not always smooth as the costations of the proloculum extend as striations over the early mature portion of the test.

Common in the Navesink; rare in the Mt. Laurel.

Vaginulina gracilis var. cretacea Plummer Pl. 2, fig. 16

Vaginulina gracilis var. *cretacea* Plummer, Univ. Texas Bull. 2644, 1927, p. 172, pl. 2, fig. 8.

This form agrees with the form illustrated by Plummer and has the sutural nodes which differentiate it from *V. gracilis*. Length, 2.85 mm.; width, about 0.30 mm.

Navesink.

Genus FLABELLINA d'Orbigny, 1839

Flabellina reticulata Reuss Pl. 2, fig. 17

Flabellina reticulata Reuss, Haid. Nat. Abhandl., vol. 4, pt. 1, 1851, p. 30, pl. 1, fig. 22.
Frondicularia reticulata Bagg, U. S. Geol. Surv., Bull. 88, 1898, p. 50, pl. 3, fig. 6.
Frondicularia cf. *interpunctata* Cushman, Am. Assoc. Pet. Geol. Bull., vol. 10, no. 6, 1926, p. 598, pl. 20, fig. 6.
Frondicularia reticulata Plummer, Univ. Texas Bull. 2644, 1927, p. 39, pl. 2, fig. 5.
Flabellina reticulata Franke, Abhandl. Geol., Pal. Instit. Univ. Greifswald, vol. 6, 1925, p. 64, pl. 5, fig. 14;—White, Jour. Pal., vol. 2, 1928, p. 204, pl. 28, fig. 15;—Cushman, Contr. Cushman Lab. Foram. Res., vol. 6, pt. 2, 1930, p. 32, pl. 4, figs. 18-19.

Fragments of this striking reticulate form are found in the Navesink. No whole specimens were recovered.

Navesink.

Genus FRONDICULARIA Defrance, 1826

Frondicularia archiaciana d'Orbigny Pl. 2, figs. 18a-b

Frondicularia archiaciana d'Orbigny, Mem. Soc. Geol. France, ser. 1, vol. 4, 1840, p. 20, pl. 1, figs. 34-36;—Cushman, Contr. Cushman Lab. Foram. Res., vol. 6, 1930, p. 37, pl. 5, figs. 9-12.

Test flabellate in outline, compressed, with a fairly prominent proloculum sometimes with costæ; sutures with the peculiar sigmoid curve which appears to characterize the species.

No whole specimens of this species were found but several fragments were recovered that had the typical sutures.

Navesink.

Frondicularia clarki Bagg Pl. 2, fig. 21

Frondicularia clarki Bagg, Johns Hopkins Univ. Circ., vol. 15, no. 121, 1895, p. 11; U. S. Geol. Surv., Bull. 88, 1898, p. 48, pl. 3, fig. 4.
Frondicularia alata Carsey (*non* d'Orb.) Univ. Texas Bull. 2612, 1926, p. 40, pl. 2, fig. 1.
Frondicularia clarki Cushman, Contr. Cushman Lab. Foram. Res., vol. 6, 1930, p. 34, pl. 5, figs. 1-2;—Plummer, Univ. Texas Bull. 3101, 1931, p. 171, pl. 9, figs. 16, 17.

Test lanceolate in outline, compressed strongly, greatest width slightly below the middle; sutures very slightly raised and slightly limbate; aperture terminal. Length, 1.50 mm.; width 0.50 mm.

This form resembles the one that is illustrated in Plummer's paper on the Cretaceous of Texas.

Navesink.

Frondicularia cuspidata Cushman Pl. 2, figs. 19a-b

Frondicularia cuspidata Cushman, Tenn. Geol. Surv., Bull. 41, 1931, p. 36, pl. 5, figs. 4-5;—Sandidge, Jour. Pal., vol. 6, no. 3, 1932, p. 278, pl. 42, figs. 16-17.

Test elongate, slender, later part compressed; widest at the base of the last chamber; consists of an elongated proloculum, round in cross-section, tapering to a long spine at the initial end, and from 2 to 4 additional compressed chambers; proloculum ornamented with 5 to 6 longitudinal costæ; lateral margins channeled; sutures distinct, depressed; surface smooth. Length, to 1.35 mm.; width, 0.25 mm.

The New Jersey specimens are larger than those described by Cushman, but the striking proloculum is the same. The New Jersey forms appear to be more mature specimens than those found in Tennessee.

Mt. Laurel.

Frondicularia lanceola Reuss Pl. 2, fig. 20

Frondicularia lanceola Reuss, Sitz. Akad, Wiss. Wien, vol. 40, 1860, p. 168, pl. 5, fig. 1;—Bagg, U. S. Geol. Surv., Bull. 88, 1898, p. 49;—Cushman, Contr. Cushman Lab. Foram. Res. vol. 8, pt. 2, 1930, p. 38, pl. 5, figs. 18-19.

Fragments of a frondicularian form that resemble portions of *Frondicularia lanceola* are fairly common in the Navesink.

Mt. Laurel and Navesink.

Genus LAGENA Walker and Jacob, 1798

Lagena hispida Reuss Pl. 2, fig. 22

Lagena hispida Reuss, Zeit. deutsch. geol. Gesel., vol. 10, 1858, p. 434; Sitz. Akad. Wiss. Wien, Bd. 46, Ab. 1, 1863, p. 335, pl. 6, figs. 77, 79;—Plummer, Univ. Texas Bull. 3101, 1931, p. 159, pl. 10, fig. 12;—Cushman, Tenn. Geol. Surv., Bull. 41, 1931, p. 37, pl. 5, fig. 6.

Test small, globular, covered with small spines that are evenly distributed over the entire test; aperture at the end of a small tube, often broken. Diameter, 0.22 mm.

Hornerstown.

Lagena sulcata (Walker and Jacob) var. **semiinterrupta** Berry Pl. 2, fig. 23

Lagena sulcata (Walker and Jacob) var. *semiinterrupta* Berry, Berry and Kelly, U. S. Nat. Mus., Pr., vol. 76, art. 19, 1929, p. 5, pl. 3, fig. 19;—Cushman,, Tenn. Geol. Surv., Bull. 41, 1931, p. 37 pl. 5 figs.9-11.

Test small, subglobular, with a slender neck and aperture; surface covered with coalescing costæ, 10 to 15 in number in the

New Jersey specimens; these costæ appear to fuse to a ring at the base. Length, 0.25-0.30 mm.; diameter, 0.12-0.15 mm.

The New Jersey forms resemble those illustrated by Cushman especially that shown in Tenn. Geol. Surv., Bull. 41, pl. 5, fig. 9.

Mt. Laurel and Navesink.

Lagena rostra, n. sp. Pl. 3, figs. 1a-b

Test small, suboval in outline, very slightly compressed; aperture round on a short neck; the sides are ornamented with four keels, the two outer ones being low and regular; the inner ones form flanges which are usually broken; these two fuse together on the neck of the specimen and form one keel on the neck, flanked by the two outer keels. Length, 0.20 mm.; width, 0.16 mm.; thickness, 0.13 mm.

Mt. Laurel and Navesink. Columbia Univ. Coll. No. M 13.

Lagena adepta, new name Pl. 3, fig. 2

Lagena vulgaris Cushman (*non* Williamson), Jour. Pal., vol. 5, no. 4, 1931, p. 308, pl. 35, fig. 11.

Test globular, smooth, with a neck that is shorter than the round portion of the test.

This form appears to agree with the specimen that is figured by Cushman from the Saratoga chalk. The specimen figured by Williamson was elongate, the width being less than a quarter of the length in the type figure.

Mt. Laurel.

Family POLYMORPHINIDÆ d'Orbigny, 1846

Genus GUTTULINA d'Orbigny, 1839

Guttulina hantkeni Cushman and Ozawa Pl. 3, fig. 5

Polymorphina acuta Hantken, (*non* d'Orbigny), A magy. kir. földt. int. erkön. vol. 4, 1875 (1876) p. 51, pl. 8, fig. 4; Mitt. Jahr. K. Ungar. Geol. Anstalt, vol. 4, 1875, (1881), p. 60, pl. 8, fig. 4.

Guttulina hantkeni Cushman and Ozawa, U. S. Nat. Mus., Pr., vol. 77, art. 6, 1930, p. 33, pl. 15, figs. 4-6.

Test oval to botryoidal, more or less rounded at the base, acute at the apertural end; greatest breadth above the middle; chambers ovate, but little embracing, arranged in a counter-clockwise quinqueloculine series, each chamber removed farther from the base; sutures depressed, distinct; wall smooth and thick; aperture produced and radiate. Length, to 1.50 mm.; breadth, 0.90 mm.

Mt. Laurel and Navesink.

Genus GLOBULINA d'Orbigny, 1839

Globulina lacrima Reuss var. **subsphaerica** (Berthelin) Pl. 3, figs. 6a-b

Polymorphina subsphaerica Berthelin, Mem. Soc. Geol. France, ser. 3, vol. 1, 1880, p. 58, pl. 4, figs. 18a-b.

Globulina lacrima Reuss var. *subsphaerica* Cushman and Ozawa, U. S. Nat. Mus., Pr., vol. 77, art. 6, 1930, p. 78, pl. 19, figs. 5-7;—Cushman, Tenn. Geol. Surv., Bull. 41, 1931, p. 41, pl. 6, figs. 10a-c.

Test subglobular, slightly compressed, the base broadly rounded, apertural end slightly rounded; chambers few, extending far back towards the base; sides straight; aperture radiate. A few specimens have fistulose apertures. Length, 0.50 mm.; height, 0.45 mm.; thickness, 0.37 mm.

Mt. Laurel.

Genus POLYMORPHINA d'Orbigny, 1826

Polymorphina subrhombica Reuss Pl. 3, fig. 7

Polymorphina subrhombica Reuss, Sitz. Akad. Wiss. Wien. vol. 44, pt. 1, (1861) 1862, p. 339, pl. 7, fig. 3;—Cushman and Ozawa, U. S. Nat. Mus., Pr., vol. 77, art. 6, 1930, p. 114, pl. 30, figs. 1-3.

Test compressed, rhomboidal in adult, rhombic in young, margin angular; chambers broad, not much embracing, alternating; wall smooth and thick; sutures distinct, not depressed; aperture radiate. Length, 1.50-2.50 mm.; width, up to 0.80 mm.

Hornerstown.

Family NONIONIDÆ Reuss, 1860

Genus NONIONELLA Cushman, 1926

Nonionella cretacea Cushman Pl. 3, figs. 3a-b

Nonionella cretacea Cushman, Tenn. Geol. Surv., Bull. 41, 1931, p. 42, pl. 7, figs. 2a-c.

The largest of these forms is larger than the size given by Cushman, but some of the smaller forms found agree in dimensions. These are fairly rare forms in the New Jersey Cretaceous. Length, up to 0.35 mm.; width, up to 0.24 mm.

Mt. Laurel.

Genus ELPHIDIUM Montfort, 1808

Elphidium cynicalis, n. sp. Pl. 3, figs. 4a-b

Test almost circular, involute, slightly compressed, periphery broadly rounded and somewhat lobulate, umbilical region a little depressed; eight slightly inflated chambers in the final whorl; sutures distinct, depressed, and barely curved; retral processes distinct, 7 to 8 visible in lateral view; wall smooth; aperture a row of small openings at the base of the septal face. Diameter, 0.37 mm.; thickness, 0.20 mm.

This form resembles *Elphidium eocenicum* Cushman and Ellisor from the Jackson of the Gulf Coast. The difference lies in the greater compression shown in the Jackson species; the ratio of diameter to thickness is given as 2½ or 3 to 1, while the New Jersey forms have a ratio of less than 2 to 1.

Hornerstown. Rare. Columbia Univ. Coll. No. M 11.

Family HETEROHELICIDÆ Cushman, 1927

Genus SPIROPLECTOIDES Cushman, 1927

Spiroplectoides emmendorferi, n. sp. Pl. 3, fig. 8

Test minute, compressed; early portion coiled, about nine chambers in the coiled portion; later portion biserial with from two to three sets of chambers in the biserial portion; aperture terminal. Length, 0.18 mm.; width, 0.11 mm.

Hornerstown. Columbia Univ. Coll. No. M 16.

Spiroplectoides rosula (Ehrenberg)

Spiroplecta rosula Ehrenberg, Mikrogeologie, 1854, pl. 32, pt. 2, fig. 26.
Spiroplectoides rosula Cushman and Waters, Contr. Cushman Lab. Foram. Res., vol. 3, 1927, p. 114, pl. 23, figs. 6-7; p. 62, pl. 13, figs. 9a-b;—Cushman, Tenn. Geol. Surv., Bull. 41, 1931, p. 44, pl. 7, fig. 9; Contr. Cushman Lab. Foram. Res., vol. 10, 1934, p. 38, pl. 6, figs. 10-13.

This species is very fragile and no complete specimens were found in the New Jersey material, but the numerous fragments were ample to establish the identification. It has been frequently figured and is shown in Cushman's textbook.

Navesink.

Genus GÜMBELINA Egger, 1899

Gümbelina globulosa (Ehrenberg) Pl. 3, fig. 9

Textularia globulosa Ehrenberg, Abhandl. Preuss. Akad. Wiss. Berlin, 1839, p. 135, pl. 4, fig. B.
Gümbelina globulosa Cushman, Jour. Wash. Acad. Sci., vol. 15, no. 6, 1925, p. 134;—White, Jour. Pal., vol. 3, no. 1, 1929, p. 36, pl. 4, fig. 10;—Cushman, Tenn. Geol. Surv., Bull. 41, 1931, p. 43, pl. 7, figs. 3-5.

Test minute, biserial, V-shaped, tapering uniformly from the initial end; chambers globular, increasing uniformly in size as added, about 4 to 5 pairs of chambers form a test; wall material smooth; aperture an arched opening at the inner margin at the base of the final chamber. Length, 0.17-0.20 mm.; width, 0.11-0.15 mm.

Mt. Laurel and Navesink.

Gümbelina tessera (Ehrenberg) Pl. 3, figs. 10a-b

Grammostomum tessera Ehrenberg, Mikrogeologie, 1854, pl. 32, pt. 2, fig. 18.
Gümbelina tessera Cushman, Jour. Pal., vol. 6, 1932, p. 338, pl. 51, figs. 4-5.

Test minute, biserial, strongly compressed, rhomboidal in front view, chambers uniformly expanding; sutures distinct, depressed, curved; surface of the test smooth; aperture an arched opening at the base of the final chamber. Length, 0.26 mm.; width, 0.18 mm.

This smooth compressed form appears to be the same as that described by Cushman and Ehrenberg. It is rare in the New Jersey sediments.

Navesink.

Gümbelina ultimatumida White Pl. 3, fig. 11

Gümbelina ultimatumida White, Jour. Pal., vol. 3, 1929, p. 39, pl. 4, figs. 13a-b.

Test minute, broadly V-shaped; chambers spherical, the last two very much enlarged, early chambers sometimes faintly striate; aperture a lunate opening at the base of the final chamber. Length, 0.20 mm.; width, 0.12 mm.

The New Jersey specimens are smaller than those found by White in Mexico, but they have the characteristic very large final pair of chambers.

Mt. Laurel.

Genus GÜMBELITRIA Cushman, 1933

Gümbelitria cretacea Cushman Pl. 3, fig. 12

Gümbelitria cretacea Cushman, Contr. Cushman Lab. Foram. Res., vol. 9, pt. 2, 1933, p. 37, pl. 4, figs. 12a-b.

Test minute, triserial throughout, chambers inflated, sub-globular; sutures depressed; aperture a high arched semi-lunar opening at the base of the final chamber. Length, 0.16 mm.; width, 0.10 mm.

This minute fcrm is one of the commonest in the Cretaceous of New Jersey. There is considerable variation in the length-height ratios and it is possible that further study may show that there is more than one species included here.

Mt. Laurel and Navesink.

Genus VENTILABRELLA Cushman, 1928

Ventilabrella carseyae Plummer Pl. 3, figs. 13a-b

Textularia globulosa Carsey (*non* Ehrenberg) Univ. Texas Bull. 2612, 1926, p. 25, pl. 5, figs. 2a-b.

Ventilabrella carseyae Plummer, Univ. Texas Bull. 3101, 1931, p. 178, pl. 9, figs. 7-10;—Sandidge, Am. Mid. Nat., vol. 13, 1932, p. 362, pl. 31, fig. 29.

Test V-shaped, compressed, composed through much of its early development of appressed, inflated, and distinctly striate biserial chambers that increase rapidly in size with growth; later polyserial chambers arranged irregularly in the place of biseriality, forming a mature test that is somewhat fan-shaped in peripheral outline; sutures deeply incised; aperture a broad lunate opening at the base of the septal face in the biserial part of the test, and in the polyserial part the apertures are formed at the base of each chamber.

The megaspheric forms are biserial throughout their development, the polyserial part never developing; their aperture is a broad low lunate slit at the base of the last chamber.

Mt. Laurel and Navesink.

Genus BOLIVINTA Cushman, 1927

Bolivinita crawfordensis, n. sp. Pl. 3, fig. 14

Test small, elongate, cuneiform, compressed; narrow keel of clear shell material running down the center; sutures limbate and raised, formed of clear material, but not raised as high as central keel; chambers 7 to 8 to a side; aperture elongate slit, often slightly produced. The later chambers in this form are often collapsed. Length, 0.25 mm.; width, 0.14 mm. Type broken.

Hornerstown. Columbia Univ. Coll. No. M5.

Genus EOUVIGERINA Cushman, 1926

Eouvigerina hispida Cushman Pl. 3, fig. 15

Eouvigerina hispida Cushman, Tenn. Geol. Surv., Bull. 41, 1931, p. 45, pl. 7, figs. 12-13.

This form appears to be the same as the one that Cushman illustrates in the Tennessee Bulletin though it lacks the initial spine which is shown in one of the views and not in the other. Length, 0.25 mm.; width, 0.17 mm.

Mt. Laurel.

Genus PSEUDOUVIGERINA Cushman, 1927

Pseudouvigerina triangularis, n. sp. Pl. 3, figs. 16a-b

Test small, elongate, triangular in cross-section with the species truncated by a curved surface; greatest width well above the middle; early chambers appear to be biserial, later chambers triserial, inflated, distinct; sutures distinct, depressed, and strongly curved in the latter part of the test; surface of the test finely perforate; aperture terminal, ovate, and with a slight lip. Length, up to 0.45 mm.; width, 0.25 mm.

The ratio of length to width varies considerably in this species. It has some resemblance to *P. cretacea* Cushman but is not coarsely perforate and the margins are not as round. The aperture has not the tooth described in *P. plummerae* Cushman nor is the margin as angulate.

Hornerstown. Columbia Univ. Coll. No. M37.

Genus NODOGENERINA Cushman, 1927

Nodogenerina sagrinensis (Bagg) Pl. 3, fig. 17

Nodosaria sagrinensis Bagg, U. S. Geol. Surv., Bull. 513, 1912, p. 58, pl. 16, fig. 4;—Plummer, Univ. Texas Bull. 2644, 1927, p. 85, pl. 4, fig. 16.

Fragments of a straight uniserial form with strongly inflated, slightly pyriform chambers, the upper parts of which carry close [illegible] which do not extend to the base of the chambers and therefore impart an obscure angulation to the outline of the test;

aperture round, flaring, with a slight lip.

These imperfect forms appear to be the same as those described by Plummer and by Bagg. The chambers are not as pyriform as the ones illustrated in the Texas Bulletin, but they are close to them and may be classified in the same species.

Hornerstown.

Family BULIMINIDÆ Jones, 1876

Genus BULIMINELLA Cushman, 1911

Buliminella fusiforma, n. sp. Pl. 3, fig. 18

Test fusiform, initial end pointed, apertural end rounded; about three whorls to a test, the last forming 80 per cent of the test; four chambers to a whorl; sutures distinct, depressed, spiral suture much more strongly depressed than transverse; aperture virguline, in a depression in the septal face forming a strong angle with the axis of the test. Length, 0.21-0.32 mm.; width, 0.18 mm.

Navesink. Columbia Univ. Coll. No. M7.

Genus BULIMINA d'Orbigny, 1826

Bulimina quadrata Plummer Pl. 3, fig. 19

Bulimina quadrata Plummer, Univ. Texas Bull. 2644, 1927, p. 72, pl. 4, figs. 4-5.

Bulimina pupoides Carsey (*non* d'Orb.), Univ. Texas Bull. 2612, 1926, p. 29, pl. 4, fig. 3;—Plummer, Univ. Texas Bull. 3101, 1931, p. 180, pl. 9, fig. 15;—Sandidge, Jour. Pal., vol. 6, 1932, p. 280, pl. 43, fig. 1.

Bulimina obtusa Cushman (*non* d'Orb.), Tenn. Geol. Surv., Bull. 41, 1931, p. 47, pl. 7, figs. 17-18; Jour. Pal., vol. 5, 1931, p. 309, pl. 35, figs. 15a-b.

Bulimina quadrata Cushman and Parker, Contr. Cushman Lab. Foram. Res., vol. 11, 1935, p. 100, pl. 15, figs. 12-16.

Test elongate the greatest width towards the apertural end; initial end rounded, apertural end more so; chambers numerous and slightly inflated, triserial, later sutures distinct and slightly depressed; wall smooth; aperture curved and virguline, bearing in the well preserved specimens a plate-like tooth. Length, 0.55 mm.; width, 0.20 mm.

This form appears to be the same as 13a figured by Cushman and Parker. It also resembles the specimens from the Navarro. There is some variation in the ratio of the length to the height and in the degree of inflation of the chambers.

Navesink; rare in Mt. Laurel.

Bulimina reussi Morrow Pl. 3, fig. 20

Bulimina ovulum Reuss (*non ovula* d'Orb.), Verstein, Bohm. Kreide, pt. 1, 1845, p. 37, pl. 8, fig. 57; pl. 13, fig. 73.
Bulimina murchisoniana Cushman (*non* d'Orb.), Jour. Pal., vol. 5, 1931, p. 309, pl. 35, figs. 14a-b; vol. 6, 1932, p. 340.
Bulimina reussi Morrow, Jour. Pal., vol. 8, 1934, p. 195, pl. 29, fig. 12;—Cushman and Parker, Contr. Cushman Lab. Foram. Res., vol. 11, 1935, p. 99, pl. 15, figs. 8a-b, 10.

Test small, fusiform, initial end pointed, apertural end broadly rounded; about four whorls with three or four chambers to a whorl; surface smooth; sutures distinct, slightly depressed; aperture virguline, situated in a slight depression at the base of the septal face. Length, 0.25 mm.; width, 0.15 mm.

Navesink.

Bulimina referata, n. sp. Pl. 3, figs. 21a-b

Test minute, elongate, triangular in cross-section; four or more whorls, three chambers to a whorl; chambers short; sutures distinct, depressed; wall smooth; aperture virguline and fairly large. Length, from 0.15-0.25 mm.; width, 0.09-0.15 mm.

Mt. Laurel and Navesink. Columbia Univ. Coll. No. M6.

Genus NEOBULIMINA Cushman and Wickenden, 1928

Neobulimina canadensis Cushman and Wickenden Pl. 3, fig. 22

Neobulimina canadensis Cushman and Wickenden, Contr. Cushman Lab. Foram. Res., vol. 4, 1928, p. 13, pl. 1, figs. 1-2;—Cushman, Tenn. Geol. Surv., Bull. 41, 1931, p. 48, pl. 8, figs. 1a-c.

Test small, elongate, about 2½ times as long as wide, early portion triserial, later portion biserial, each part forming about ½ the test; chambers inflated and subglobular, about 12 to 15 chambers in triserial part, 4 in the biserial portion; sutures distinct, depressed; aperture a long V-shaped opening at the base of the apertural face and extending upwards in the plane of biseriality. Length, 0.30 mm.; width, 0.12 mm.

Navesink.

Genus LOXOSTOMA Ehrenberg, 1854

Loxostoma plaitum (Carsey) Pl. 3, fig. 23

Bolivina plaita Carsey, Univ. Texas Bull. 2612, 1926, p. 26, pl. 4, fig. 2.
Proporus plaita Cushman, Contr. Cushman Lab. Foram. Res., vol. 2, p. 89, pl. 12, fig. 7.

Loxostomum plaitum Cushman, Foram. Class., 1928, pl. 37, fig. 9; Tenn. Geol. Surv., Bull. 41, 1931, p. 51, pl. 8, fig. 9.
Loxostoma plaitum Plummer, Univ. Texas Bull. 3101, 1931, p. 182, pl. 10, figs. 5-7.

These New Jersey forms are typical of this species. Length, 0.80 mm.; width, 0.18 mm.

Mt. Laurel and Navesink.

Genus UVIGERINA d'Orbigny, 1826

Uvigerina seligi Cushman Pl. 3, fig. 24

Uvigerina seligi Cushman, Contr. Cushman Lab. Foram. Res., vol. 1, 1925, p. 1, pl. 4, figs. 1a-c.
Uvigerina tenuistriata Carsey (*non* Reuss), Univ. Texas Bull. 2612, 1926, p. 42, pl. 1, fig. 1.
Uvigerina seligi Plummer, Univ. Texas Bull. 3101, 1931, p. 186, pl. 14, fig. 10.

"Test small, average specimen about twice as long as broad, the last two whorls comprising most of the test; chambers marked by two longitudinal and faintly beaded costæ that give the appearance of bicarination to each of the three longitudinal series of chambers which strongly overlap; sutures between later mature chambers depressed, giving a distinctly lobate outline to the test; aperture a short cylindrical neck and phialine lip. Length, 0.30 mm.; width, 0.15 mm."

Mt. Laurel and Navesink.

Family ROTALIIDÆ Reuss, 1860

Genus VALVULINERIA Cushman, 1926

Valvulineria nelsoni (Berry) Pl. 4, figs. 1a-b

Anomalina nelsoni Berry, U. S. Nat. Mus., Pr., vol. 76, art. 19, 1929, p. 14, pl. 2, figs. 19-21.
Anomalina involuta Cushman (*non* Reuss), Tenn. Geol. Surv., Bull. 41, 1931, p. 60, pl. 12, fig. 1.
Valvulineria ripleyensis Sandidge, Jour. Pal., vol. 6, 1932, p. 281, pl. 43, figs. 4-6.
Cibicides nelsoni Plummer, Univ. Texas Bull. 3501, 1936, p. 288, pl. 5, figs. 1-6.

Test subcircular, biconvex, more convex on the ventral than on the dorsal side, periphery broadly rounded, often lobulate; chambers numerous, 6 to 8 in the final whorl, rapidly expanding as added, final 2 to 3 chambers usually inflated; sutures distinct, curved, and later ones impressed; aperture an elongate slit at the base of the final chamber, extending from the periphery to the umbilicus, covered in well preserved specimens by a delicate triangular flap. Diameter, up to 0.53 mm.

These figures were made from two specimens as the umbilical flap is not preserved in good condition in most specimens.

Mt. Laurel and Navesink.

Genus GYROIDINA d'Orbigny, 1826

Gyroidina soldani d'Orbigny Pl. 4, figs. 2a-b

Gyroidina soldani d'Orbigny, Ann. Sci. Nat. VII, 1826, p. 278, fig. 5, Modèle No. 36.
Rotalia soldani Parker, Jones and Brady, Ann. Mag. Nat. Hist., ser. 3, vol. 16, 1865, p. 25, pl. 3, fig. 86.
Gyroidina soldani Galloway and Morrey, Bull., Am. Pal., vol. 15, no. 55, 1929, p. 27, pl. 4, fig. 4.

Test small, subcircular in outline, planoconvex, dorsal side almost flat, ventral side strongly convex with a deep umbilicus; chambers 8 to 10 in the final whorl, spiral suture often deeply depressed; transverse sutures straight; aperture a slit at the base of the final chamber, extending from the periphery to the umbilicus. Diameter, up to 0.40 mm.

Mt. Laurel, Navesink and Hornerstown.

Genus SIPHONINA Reuss, 1850

Siphonina prima Plummer Pl. 4, figs. 3a-b

Siphonina prima Plummer, Texas Univ. Bull. 2644, 1927, p. 148, pl. 12, figs. 4a-c;—Cushman, U. S. Nat. Mus., Pr., vol. 72, art. 20, 1927, p. 2, pl. 2, figs. 4a-c.

Test nearly circular, slightly compressed, almost equally biconvex; periphery sharp, slightly lobulate and serrate; chambers 5 to 6 in the final whorl and very slightly inflated; sutures distinct and curved obliquely on the dorsal side, nearly radial on the ventral, the serrate edges of the chambers are preserved along the sutures in the best material; surface of the test punctate, aperture an elliptical slit-like opening close to the periphery on the ventral side of the final chamber. Diameter, 0.16-0.22 mm.

Navesink.

Family CASSIDULINIDÆ d'Orbigny, 1839

Genus PULVINULINELLA Cushman, 1926

Pulvinulinella exigua (Brady) var. **obtusa** (Barrows and Holland)
Pl. 4, figs. 4a-b

Pulvinulina exigua Brady var. *obtusa* Burrows and Holland, Geol. Assoc., Pr., vol. 15, 1897, p. 49, pl. 2, fig. 25;—Plummer, Univ. Texas Bull. 2644, 1927, p. 151, pl. 11, figs. 2a-c.

Pulvinulinella exigua (Brady) var. *obtusa* (Burrows and Holland) Cushman and Ponton, Contr. Cushman Lab. Foram. Res., vol. 8, pt. 3, 1932, p. 71, pl. 9, figs. 9a-c.

Test subcircular, biconvex, 5 to 6 chambers in final whorl; sutures on dorsal side straight, ventral sutures obliquely radial; aperture found in a depressed area on the septal face; part of the aperture extends in a direction parallel to the place of coiling of the test and just ventral to the periphery, meeting at an angle the second portion of the aperture which extends vertically almost to the umbilical region at the base of the septal face. Length, 0.45 mm.; width, 0.20 mm.

Hornerstown.

Family CHILOSTOMELLIDÆ Brady, 1881

Genus ALLOMORPHINA Reuss, 1850

Allomorphina halli, n. name Pl. 4, figs. 5a-b

Allomorphina trigona Plummer (*non* Reuss), Univ. Texas Bull. 2644, 1927, p. 129, pl. 8, figs. 5a-b.

Test bluntly triangular in outline; biconvex, slightly compressed; periphery broadly rounded, chambers few, 3 or 4 in the final whorl; sutures depressed, shell wall thin, smooth; aperture a slit beneath a flap at the base of final chamber on the ventral side. Diameter, 0.35 mm.; thickness, 0.23 mm.

Hornerstown.

Genus PULLENIA Parker and Jones, 1862

Pullenia quinqueloba (Reuss) Pl. 4, figs. 6a-b

Nonionina quinqueloba Reuss, Zeitschr. deutsch Geol. Gesell., vol. 3, 1851, p. 71, pl. 5, fig. 31.

Pullenia quinqueloba Brady, Challenger Report, vol. 9, 1884, p. 617, pl. 84, figs. 14-15;—Cushman and Church, Cal. Acad. Sci., Pr., ser. 4, vol. 18, 1929, p. 517, pl. 41, figs. 10-11;—Cushman, Tenn. Geol. Surv., Bull. 41, 1931, p. 57, pl. 10, figs. 4a-b; Jour. Pal., vol. 5, 1931, p. 313, pl. 36, figs. 3a-b;—Cushman and Jarvis, U. S. Nat. Mus., Pr., vol. 80, art. 14, 1932, p. 49, pl. 15, figs. 4a-b.

Test planispiral, involute, compressed; periphery rounded, slightly lobulate; usually five chambers in the final whorl, increasing in size as added; sutures distinct, depressed and almost straight; wall smooth; aperture an elongate slit at the base of the last chamber; Mt. Laurel and Navesink. Diameter, 0.25-0.45 mm.; thickness, 0.15-0.25 mm.

Family GLOBIGERINIDÆ Cushman, 1927

Genus GLOBIGERINA d'Orbigny, 1826

Globigerina bulloides d'Orbigny Pl. 4, fig. 7

Globigerina bulloides d'Orbigny, Ann. Sci. Nat., 1826, vol. 7, p. 277, Modèles 17 and 76;—Cushman, U. S. Nat. Mus., Bull. 71, pt. 4, 1914, p. 5, pl. 2, figs. 7-9.

This form with four chambers in the final whorl, an aperture from all the chambers opening into umbilicus, and a reticulated surface, appears to agree with the descriptions and figures as shown by d'Orbigny.

Hornerstown.

Globigerina compressa Plummer Pl. 4, fig. 8

Globigerina compressa Plummer, Univ. Texas Bull. 2644, 1927, p. 135, pl. 8, figs. 11a-c.

Test trochoid, compressed, about equally biconvex; periphery narrowly rounded, lobulate; two whorls visible on the dorsal side, five chambers in the final whorl, somewhat inflated; sutures depressed and curved; aperture extending from periphery to the umbilicus, a narrow flap projects over the aperture. Diameter, 0.35 mm.

Hornerstown.

Globigerina cretacea d'Orbigny Pl. 4, fig. 9

Globigerina cretacea d'Orbigny, Mem. Soc. Geol. France, 1840, p. 34, pl. 3, figs. 12-14;—Cushman, Contr. Cushman Lab. Foram. Res., vol. 7, pt. 2, 1931, p. 44, pl. 6, figs. 6a-c; Tenn. Geol. Surv., Bull. 41, 1931, p. 58, pl. 10, figs. 6-7.

Test low trochoid, subcircular in outline, five chambers in the final whorl; surface spinose; aperture ventral, opening into large umbilical area which is sometimes covered by a thin plate. Diameter, 0.30 mm.

Mt. Laurel and Navesink.

Globigerina triloculinoides Plummer Pl. 4, fig. 10

Globigerina triloba Egger (*non* Reuss), Abh. k. bay. Akad. Wiss. Cl. 2, vol. 21, pt. 1, (1899) 1900, p. 171, pl. 21, fig. 8.

Globigerina triloculinoides Plummer, Univ. Texas Bull. 2644, 1927, p. p. 134, pl. 8, figs. 10a-c.

Test small, trochoid, about 2 to 2½ whorls visible on dorsal side, 3½ chambers to a whorl, chambers strongly inflated and rapidly enlarging, periphery broadly rounded and lobate; shell surface strongly reticulate; aperture extends from near periphery to shallow umbilical depressed area; it is protected by a flap. Diameter, 0.25 mm.

This is a rare form in the Hornerstown, only one whole specimen having been found. It appears to agree with the form that Plummer described from the Midway.

Hornerstown.

Genus GLOBIGERINELLA Cushman, 1927

Globigerinella aspera (Ehrenberg) Pl. 4, fig. 11

Phanerostomum asperum Ehrenberg, Mikrogeologie, 1854, pl. 30, figs. 26a-b; pl. 32, pt. 2, fig. 42.
Globigerina aspera Egger, Abhandl. kon. bay. Akad. Wiss. Munchen, Cl. 2, vol. 21, pt. 1, 1899, p. 170, pl. 21, figs. 18-20.
Globigerinella aspera Carman, Jour. Pal., vol. 3, 1929, p. 315, pl. 34, fig. 6;—Cushman, Tenn. Geol. Surv., Bull. 41, 1931, p. 59, pl. 11, figs. 5a-b.

Test almost planispiral, consisting of from 5 to 7 gradually enlarging chambers in the final whorl; periphery rounded; surface spinose and roughened; aperture an arched slit at the base of the final chamber, embracing the periphery. Diameter, 0.35-0.40 mm.

Mt. Laurel and Navesink.

Globigerinella voluta (White) Pl. 4, fig. 12

Globigerina aequilateralis Chapman, Quart. Jour. Geol. Soc. London, vol. 48, 1892, p. 517, pl. 15, fig. 14;—Chapman (*non* Brady), Quart. Jour. Roy. Micro. Soc. London, 1896, p. 589, pl. 13, fig. 7.
Globigerina voluta White, Jour. Pal., vol. 2, 1928, p. 197, pl. 28, fig. 5.
Globigerinella voluta Sandidge, Jour. Pal., vol. 6, 1932, p. 284, pl. 44, figs. 1-2.

Test almost planispiral, loosely coiled, consisting of about 1½ coils of from 4 to 6 rapidly expanding chambers in the final whorl; chambers inflated, sutures depressed; wall somewhat spinose; aperture an arched slit embracing the periphery at the base of the final chamber. Diameter, 0.35 mm.

The rapidly expanding chambers and their fewer number to a coil, together with the smoother surface serve to separate this form from *G. aspera.*

Mt. Laurel and Navesink.

Family GLOBOROTALIIDÆ Cushman, 1927

Genus GLOBOTRUNCANA Cushman, 1927

Globotruncana fornicata Plummer Pl. 4, fig. 13

Globotruncana fornicata Plummer, Univ. Texas Bull. 3101, 1931, p. 198, pl. 13, figs. 4-6.

A few forms with narrower chambers and more strongly curved dorsal sutures than those found in *Globotruncana arca* occur in the Mt. Laurel. These forms seem to be the same as those described by Mrs. Plummer as *Globotruncana fornicata.* Diameter, 0.35 mm.

Mt. Laurel.

Globotruncana arca (Cushman) Pl. 4, figs. 14a-b

Globigerina canaliculata Egger (*non* Reuss), Abh. k. bayer. Akad. Wiss. Cl. 2, vol. 21, 1899, p. 172, pl. 21, figs. 24-26.
Globigerina rosetta Carsey, Univ. Texas Bull. 2612, 1926, p. 44, pl. 5, fig. 3;—Plummer, Univ. Texas Bull. 2644, 1927, p. 172, pl. 2, fig. 9.
Pulvinulina arca Cushman, Contr. Cushman Lab. Foram. Res., vol. 2, 1926, p. 23, pl. 3, fig. 1.
Globotruncana arca Moreman, Jour. Pal., vol. 1, 1927, p. 100, pl. 16, figs. 16-17.
Globotruncana rosetta White, Jour. Pal., vol. 2, 1928, p. 286, pl. 39, fig. 1.
Globotruncana arca Plummer, Univ. Texas Bull. 3101, 1931, p. 195, pl. 13, figs. 7-9, 11.

Typical of the species. Diameter, 0.70 mm.

Mt. Laurel and Navesink.

Family ANOMALINIDÆ Cushman, 1927

Genus ANOMALINA d'Orbigny, 1826

Anomalina pinguis, n. name Pl. 5, fig. 1

Anomalina grosserugosa Plummer, Univ. Texas Bull. 3101, 1931, p. 201, pl. 14, fig. 9.

Test nearly equally biconvex, ventral face slightly more convex, coarsely punctate, completely involute on ventral, almost so on dorsal, periphery broadly rounded, chambers 8 to 9 in final whorl, later chambers distinctly inflated, suture depressed between last few chambers, limbate in early chambers; sutures slightly curved; aperture at base of septal face embracing the margin.

Diameter, 0.50 mm.; thickness, 0.25 mm.

This form differs from the type in being less compressed and less lobulate.

Mt. Laurel and Navesink.

Anomalina clementiana (d'Orbigny) Pl. 5, figs. 2a-c

Rosalina clementiana d'Orbigny, Mem. Soc. Geol. France, ser. 1, vol. 4, 1840, p. 37, pl. 3, figs. 23-25.

Anomalina clementiana Franke, Abhandl. Geol. Pal. Instit. Univ. Greifswald, vol. 6, 1925, p. 85, pl. 7, figs. 12a-c.

Anomalina tennesseensis Berry, Berry and Kelly, U. S. Nat. Mus., Pr., vol. 76, art. 19, 1929, p. 13, pl. 2, figs. 13-15.

Anomalina clementiana Cushman, Tenn. Geol. Surv., Bull. 41, 1931, p. 61, pl. 13, figs. 1a-c.

Test tending towards the planispiral, strongly compressed, periphery narrowly rounded; chambers distinct, generally from 7 to 9 in final whorl, few forms with 10 chambers; dorsal side slightly arched, ventral side depressed towards the center; sutures strongly limbate, curved, and raised on the dorsal side, in some few forms the final suture may be depressed between the last chambers; on the ventral side the sutures are depressed and curved, the inner ends of the chambers raised between them; aperture peripheral and extending onto the ventral side. Diameter, 0.25-0.37 mm.; thickness, 0.10-0.12 mm.

Mt. Laurel.

Genus CIBICIDES Montfort 1808

Cibicides mortoni (Reuss) Pl. 5, figs. 3a-c

Rotalia mortoni Reuss, Sitz. Akad. Wiss. Wien, vol. 44, (1861) 1862, p. 337, pl. 8, figs. 1a-c.

Test subcircular, biconvex, dorsal surface usually less convex than ventral, dorsal surface shows a considerable growth of secondary tissue in the center; the ventral surface is slightly umbilicate in some specimens; periphery bluntly angled; chambers 9 to 10 in the final whorl in mature forms; the early chambers may be masked by the growth of tissue on the dorsal side; early sutures on the dorsal side flush and inclined to be a little limbate, later sutures simple and depressed in the mature forms; sutures on the ventral curved and depressed; wall puncate; aperture an arched opening embracing the periphery and extending along the spiral suture below the final chamber or last two chambers; sometimes the aperture may carry a small lip. Diameter, up to 1 mm.; thickness, up to 0.35 mm.

This appears to be the same form that Reuss illustrated from New Jersey. It is one of the commonest forms in the Hornerstown formation.

Hornerstown.

Cibicides neelyi, n. sp. Pl. 5, figs. 4a-c.

Test planoconvex, dorsal side flat to slightly depressed, ventral side convex with an umbo of clear shell material; periphery narrowly rounded; 8 to 9 chambers in the final whorl which is strongly embracing; sutures on the dorsal side curved, limbate, and raised in the earlier part of the whorl, becoming simple and depressed in the later chambers; sutures on the ventral side are curved and limbate in the earlier part of the whorl, becoming simple and depressed in the later part as do the dorsal sutures; the earlier sutures are often masked by growth of secondary tissue; surface of the test strongly punctate; aperture an arched opening embracing the periphery and extending dorsally beneath the final chamber. Diameter, up to 0.65 mm.; thickness, up to 0.25 mm.

This is a very variable species in outline and in the behavior of the sutures, some of which in the earlier part of the whorl do not reach the periphery.

Hornerstown. Columbia University Coll. No. M10.

Cibicides burlingtonensis, n. sp. Pl. 5, figs. 5a-c

Test planoconvex, compressed, dorsal flat to slightly concave, ventral side convex, test completely embracing on ventral side and almost so on dorsal; chambers 5 to 6 in the final whorl, rapidly enlarging, sutures depressed and strongly curved, curvature increasing towards periphery; surface perforate; aperture an arched slit at the periphery extending onto the dorsal side below the first chamber. Diameter, 0.37 mm.; thickness, 0.10 mm.

Hornerstown. Columbia University Coll. No. M9.

Cibicides padella, n. sp. Pl. 5, figs. 6a-b.

Test planoconvex, dorsal side flat or very slightly arched; only last whorl visible, early whorls concealed by thickening of secondary tissue at center; ventral side convex, almost conical with loss of clear shell material at the center, periphery acute, usually formed by blunt keel; chambers 10 to 12 in the final whorl, gradually increasing in size as added; sutures on the dorsal distinct, limbate and curved, fusing on the periphery to form the keel; on the ventral the sutures, especially the later ones, are depressed; surface coarsely perforate, aperture peripheral, extending on the dorsal side and backward along the spiral suture for the length of one or two chambers. Diameter, 0.22-0.32 mm.; thickness, 0.11-0.16 mm.

Navesink. Columbia University Coll. No. M8.

Order OSTRACODA Latreille

Suborder PLATYCOPA Sars

Family CYTHERELLIDÆ Sars, 1865

Genus CYTHERELLA Jones, 1849

Cytherella moremani Alexander Pl. 6, fig. 1

Cytherella moremani Alexander, Univ. Texas Bull. 2907, 1929, p. 53, pl. 1, figs. 4-5.

Carapace ovate, inequivalved; greatest height at or close to the middle; dorsal margin arched with the anterior slope flatter and straighter than the posterior; anterior end broadly and evenly rounded; ventral margin evenly convex; posterior margin more narrowly rounded than the anterior and obscurely angled at about the center.

Right valve overlaps the left on the entire contact; overlap greater at center of the dorsal margin and along the ventral border; overlap of the posterior margin less than the anterior margin.

Maximum thickness of the males located slightly posterior to the center, in the females close to the posterior margin. Length, 0.77 mm.; height, 0.51 mm.; thickness, 0.35 mm.

This form, though generally smaller than the form described by Alexander, preserves the same proportions and in other respects resembles the forms that were obtained from the Navarro.

Navesink.

Genus CYTHERELLOIDEA Alexander, 1929

Cytherelloidea monmouthensis, n. sp. Pl. 6, fig. 4

Carapace small, compressed, oblong, ovate in lateral view; dorsal margin straight; anterior margin broadly rounded; ventral margin gently convex to almost straight; posterior margin more narrowly rounded than anterior.

A narrow ridge parallels the entire margin; it is most strongly developed on the anterior margin, and is well developed on the dorsal and posterior margins; on the ventral margin the development of the ridge weakens from the anterior towards the posterior margins until it almost disappears at the posterior ventral contact. Two ridges emerge from the curvature of the valves, one opposite the antero-ventral contact and another opposite the antero-dorsal, and each extends posteriorly parallel to its adjacent dorsal or ventral margins and close to the marginal ridge; the dorsal ridge merges with the curvature of the valve and the ventral ridge ends in a tubercle. A broad shallow pit is located just ventral to the center of the valves between the two inner ridges, and is so close to the ventral one of these that it appears to bend around it. Length, 0.47 mm.; height, 0.30 mm.; thickness, 0.18 mm.

This form differs from *C. williamsoniana* in having but one tubercle and a complete marginal ridge.

Navesink. Columbia University Coll. No. M17.

Cytherelloidea navesinkensis, n. sp. Pl. 6, fig. 3

Test small, suboblong, compressed; dorsal margin gently arched; anterior margin broadly rounded; ventral margin straight; posterior margin more narrowly rounded than anterior.

A ridge parallels the anterior margin at a short distance from the contact, dying out dorsally and ventrally; a deep groove lies just posterior to and parallel with the anterior marginal ridge; a heavy undular ridge runs subparallel to the posterior margin being in contact with it at its dorsal and ventral extremities and leaving a narrow flattened area at the center. A curved ridge extends about parallel to the ventral border from opposite the anterior to opposite the posterior ventral contact. A curved groove on the dorsal side of this ridge separates it from a roughly oval bifurcating ridge, enclosing a broad shallow oval pit located just dorsal to the center; the dorsal half of this ridge curves close to the dorsal margin in the mid part of its course, swinging in a ventral direction to meet the ventral part of the ridge and dying out in the anterior region. Length, 0.50 mm.; height, 0.27 mm.; thickness, 0.12 mm.

Navesink. Columbia University Coll. No. M18.

Cytherelloidea spiralia, n. sp. Pl. 6, fig. 2

Carapace compressed, small, inequivalved, subovate in lateral view; dorsal margin gently arched; anterior margin broadly rounded; ventral margin slightly concave; posterior margin less broadly rounded than anterior.

On the right valve a marginal ridge starts at the posterior dorsal contact, and running anteriorly, passes round the dorsal, anterior, ventral, and posterior margins; on reaching the posterior dorsal angle the ridge curves inwards and extends in an anterior direction within the marginal ridge, dying out in the anterior dorsal region. A broad shallow pit is located dorsally to the center; posteriorly the pit narrows and joins the groove extending around the carapace inside the marginal ridge; just ventral to the center a shallow groove parallels the ventral border which is succeeded ventrally by a low ridge which is terminated by and separated from the marginal ridge by the marginal groove.

The left valve differs from the right in that the marginal ridge starts at the anterior dorsal contact instead of the posterior dorsal contact and, extending round the anterior ventral and posterior margins, curves inward at the posterior dorsal angle and passes anteriorly along the hinge margin terminating near the anterior dorsal contact. The right valve is larger than the left. The overlap consists only of that part of the marginal ridge that extends from the anterior to the posterior dorsal contact. Length, 0.53 mm.; height, 0.31 mm.; thickness, 0.16 mm.

Mt. Laurel and Navesink. Columbia University Coll. No. M19.

Cytherelloidea williamsoniana (Jones) Pl. 6, fig. 5

Cytherella williamsoniana Jones, Mono. Cret. Entom. Eng. Paleontog. Soc. London. 1849, p. 31, pl. 7, figs. 26a-i.
Cypridina leioptycha Reuss. Haid. Natur. Abhand., vol. 4, pt. 1, 1851, p. 49, pl. 6, fig. 11.
Cytherelloidea williamsoniana Alexander, Univ. Texas Bull. 2907, 1929, p. 55, pl. 2, fig. 12.

Carapace subquadrangular, small, compressed; dorsal margin straight; ventral margin straight to slightly convex; anterior and posterior margins evenly rounded. Anterior margin bordered by a low ridge that dies out on the anterior portion of the dorsal and ventral margins. Two longitudinal ridges start opposite the anterior dorsal and ventral contacts and, extending posteriorly parallel to the dorsal and ventral margins, terminate in large tubercles which are connected by a small ridge. Length, 0.72 mm.; height, 0.42 mm.; thickness, 0.28 mm.

Mt. Laurel.

Suborder PODACOPA Sars

Family BAIRDIIDÆ Sars, 1887

Genus BAIRDOPPILATA Coryell, Sample and Jennings, 1935

Genotype.—*Bairdoppilata viticula* Coryell, Sample and Jennings, Amer. Mus. Nat. Hist., Nov., No. 777, 1935, p. 4, figs. 3-4.

Carapace medium in size, generally more than 1 mm. in length; bairdioid in lateral view; inequivalved, left valve larger than the right, overlap developed on all margins but strongest on the dorsal and mid-ventral contacts; surface smooth or finely punctate, ventral margin may carry a small frill.

The hingement of the left valve consists of a groove and an adjacent ridge on the straight dorsal contact which die out at or on the anterior and postal slopes. Just dorsal of the anterior and posterior angulations and beneath the curved overlap margin a short series of transverse teeth and sockets supported on a small platform are found.

The hingement of the right valve consists of a bar-like ridge with a groove along its dorsal side which engages with the groove and bar on the dorsal contact of the left valve. A series of crenulate teeth occurs on the edge of the valve, which engage with the teeth found in the left valve.

The presence of the teeth separates this form from *Bairdia.* Material from the Navarro in Texas shows that the form described by Alexander as *Bairdia magna* should be assigned to *Bairdoppilata.*

Bairdoppilata viticula Coryell, Sample and Jennings Pl. 6, figs. 6a-c

Bairdoppilata viticula Coryell, Sample and Jennings, Amer. Mus. Nat. Hist., Nov., No. 777, 1935, p. 4, figs. 3-4.

Carapace short, bairdioid in lateral view; dorsal margin highly arched and angulated at the crest; the dorsal contact is angulated at the crest and again near the mid-posterior slope. The posterior acuteness lies below the line of midheight; and the anterior angulation projects forward at the line of midheight. The surface is strongly convex, with the greatest thickness of the specimen near the center. It is finely punctate with the punctæ scarcely showing along the crest of the convexity but conspicuously and closely spaced on the anterior half of the valve and somewhat more widely spaced on the posterior part of the valve.

A delicate, narrow, radially grooved and scalloped frill extends along the contact of the valves from the anterior and posterior angulations towards the center of the ventral margin. The maximum development is found on the ventral contact towards the anterior and posterior terminations, the frill tending to die out in the center of the ventral contact and towards the anterior and posterior angulations.

The dorsal articulating ridge and groove are typical; the construction of the platform bearing the teeth is lunate in outline and is better developed at the anterior than at the posterior. Length, 1.13 mm.; height, 0.75 mm.

Mt. Laurel.

Bairdoppilata delicatula, n. sp. Pl. 6, fig. 7

Carapace large, inequivalved, elongate and subtriangular in lateral view; dorsal margin arched, dorsal contact slightly curved; anterior margin broadly rounded; posterior margin slightly produced; ventral margin convex. Left valve overlaps the right throughout the entire margin, overlap slightly greater on the ventral margin. Greatest height central; greatest length slightly ventral of the center; greatest thickness central. Hingement typical of the genus. Length, 1.50 mm.; height 0.85 mm.; thickness, 0.60 mm.

Hornerstown. Columbia University Coll. No. M31.

Bairdoppilata pondera, n. sp. Pl. 6, fig. 9

Test large, inequivalved, subtriangular in lateral view; dorsal margin strongly arched; anterior margin broadly and obliquely rounded; ventral margin convex; posterior margin obtusely angulated. Left valve overlaps the right over the entire margin, overlap stronger on the dorsal and ventral margins. Greatest height central; greatest length slightly ventral of center; greatest thickness central. Hingement typical of the genus. Length, 1.15 mm.; height, 0.82 mm.; thickness, 0.70 mm.

This form resembles *Bairdoppilata magna* (Alexander) but has longer ventral and postal slopes and a stronger dorsal overlap.
Navesink and Mt. Laurel. Columbia University Coll. No. M32.

Genus BYTHOCYPRIS Brady, 1880

Bythocypris parilis Ulrich Pl. 6, fig. 8.

Bythocypris parilis Ulrich, Maryland Geol. Surv., Eocene, 1901, p. 117, pl. 16, figs. 5-8.

Carapace small, reniform; dorsal margin arched; anterior and posterior margins nearly equally rounded, the anterior end being very slightly more sharply rounded than the posterior; ventral margin straight to slightly concave; dorsal view subelliptical; left valve overlaps the right on the dorsal and the ventral margins; surface smooth. Length, 0.90 mm.; height, 0.45 mm.

Hornerstown.

Genus ANTIBYTHOCYPRIS, n. gen.

Genotype.—*Antibythocypris gooberi,* n. sp.

Test subreniform, inequivalved, right valve overlapping left; dorsal margin arched, posterior margin higher and more broadly rounded than the anterior; margin of the anterior dorsal slope of right valve is grooved and corresponding margin of left bears a small ridge; otherwise hingement is simple; surface of valves may be reticulated and ridged.

Antibythocypris gooberi, n. sp. Pl. 6, figs. 10a-e.

Test subreniform, inequivalved, dorsal margin arched, anterior margin rounded, ventral margin straight to slightly concave, posterior margin higher and more broadly rounded than the anterior; right valve overlaps the left on the dorsal, anterior, and ventral margins, the overlap is strongest on the dorsal and the ventral margins; the inner margin of the valves is separated from the margin on the anterior and the posterior by a fairly wide marginal area, the inner margin projects beyond the line of concrescence at the posterior end and coincides on the anterior end; the marginal areas die out dorsally and ventrally; the margin of the anterior slope of the right valve is grooved and the corresponding slope on the left valve has a small ridge which fits the groove; otherwise the hinge is simple. The posterior margin is bordered by a sharp ridge which dies out at the dorsal and ventral contacts; the surface of the valve is covered with coarse reticulations. Length, 0.70 mm.; width, 0.40 mm.; height, 0.43 mm.

Mt. Laurel and Navesink. Columbia University Coll. No. M30.

Family CYTHERIDÆ Baird, 1850

Genus BRACHYCYTHERE Alexander, 1933

Brachycythere alata (Bosquet) Pl. 6, figs. 11a-b

Cypridina alata Bosquet, Mem. Soc. Roy. Sci. Liège, vol. 4, 1847, p. 369, pl. 4, figs. 1a-d.

Cythere alata Bosquet, Mem. Comm. Carte Geol. Neerlande, vol. 2, 1854, p. 117, pl. 9, figs. 10a-d.

Cytheropteron alatum Jones and Hinde, Suppl. Mongr. Cret. Entom. Eng., Irel., Paleontogr. Soc. London. 1889, p. 34.

Cytheropteron saratogana Israelsky, Arkansas, Geol. Surv., Bull. 2, 1929, p. 10, pl. 2A, figs. 4a-c.
Cythere cornuta (F. A. Roemer) var. *gulfensis* Alexander, Univ. Texas Bull. 2907, 1929, p. 85, pl. 8, figs. 1, 2, 6.
Brachycythere alata Alexander, Jour. Pal. vol. 7, 1933, p. 207, pl. 25, figs. 15a-b; pl. 27, fig. 18.

Carapace in side view oblong, subquadrate, highest in front; height equal to about half the length; dorsal margin slightly convex to straight; ventral margin straight; dorsal and ventral margins converge slightly posteriorly; anterior margin broadly rounded, compressed, with a narrow flat marginal rim; it carries six or more teeth of varying degree of development; posterior end more narrowly rounded than anterior and obliquely truncated in the dorsal half; it carries five or more teeth that vary in their degree of development from specimen to specimen; valves bear strongly projecting, compressed, alaeform, lateral expansions on the ventral margins; the outer margin is nearly straight, the postal margin concave and the angle between the postal and lateral margins bears a spine. Hingement typical. Surface of valves smooth. Length, 1.0 mm.; width, 1.0 mm.; height, 0.52 mm.

Hornerstown and Navesink.

Brachycythere betzi, n. sp. Pl. 6, figs. 12a-c

Carapace large, inequivalved, subovate; dorsal margin straight; anterior margin broadly and obliquely rounded, the ventral portion being produced and irregularly spinose; ventral margin weakly convex, maximum convexity slightly posterior to the center; ventral portion of the posterior margin rounded, dorsal portion straight, truncating the curvature of the ventral part and forming an obscure angulation at about the center; the curved ventral part carries 3 to 4 stubby spines. Left valve overlaps the right distinctly on the anterior dorsal and posterior margins; anterior margin bordered by an irregular ridge bearing a few short spines and paralleled posteriorly by a shallow depressed area, both of which die out at the dorsal and ventral contacts; the posterior margin is bordered by a compressed almost flange-like area which also dies out dorsally and ventrally. The valves are very convex, the maximum convexity being reached in the posterior ventral region, forming a flat ventral surface and giving a pyriform outline to the dorsal view and a triangular outline in anterior view. The surface of the valves is reticulate, especially the tumid portion, with the reticulations irregularly arranged over the surface; the flat ventral surface is ornamented with a number of longitudinal ridges. Length, 1.23 mm.; height, 0.95 mm.; thickness, 0.95 mm.

Hornerstown. Columbia University Coll. No. M33.

Brachycythere harlani, n. sp. Pl. 6, fig. 13

Carapace large, inequivalved, elongate, ovate in lateral view; maximum height well anterior to the center; dorsal margin arched and slightly truncate along the posterior slope; anterior margin broadly rounded; ventral margin faintly convex; posterior margin narrowly rounded and obscurely truncated in its dorsal part; left valve overlaps right on the entire margin about equally; convexity of the valves increases from the dorsal towards the ventral margin and from the anterior and posterior ends towards the center, giving a subtriangular end view. Anterior and posterior ends compressed; the maximum compression of the right valve is parallel to and a little posterior of the anterior contact, the actual contact forming an indistinct ridge around the anterior margin; surface of the valves minutely punctate. Length, 1.35 mm.; height, 0.70 mm.; thickness, 0.72 mm.

This form differs from *Brachycythere ovata* (Berry) in being more elongate, and from the other forms assigned to this genus in having a less arched dorsal margin.

Hornerstown. Columbia University Coll. No. M34.

Brachycythere jerseyensis, n. sp. Pl. 6, figs. 14a-b

Carapace small, inequivalved, subtriangular in lateral view and triangular in cross section; greatest height anterior to the center; dorsal margin arched and obscurely angulated; anterior margin broadly rounded; ventral margin slightly convex, maximum convexity posterior to the center; posterior margin narrowly rounded and obliquely truncated through the dorsal half, ventral half ornamented with a few short spines; left valve overlaps right on the entire contact; anterior end of carapace compressed, maximum anterior compression in the right valve posterior and parallel to the contact, forming a low ridge round the anterior contact of the valves; posterior end of the carapace strongly compressed; convexity of the valves increases from the dorsal towards the ventral margin in lateral view and from the anterior and posterior ends towards the center; the maximum convexity is reached at the ventral margin slightly posterior to the center. The tumid ventral margin of the valves is ornamented with a low rounded ridge that tends to merge with the curvature of the valves anteriorly and is sharply cut off posteriorly. Surface of the valves ornamented with a number of irregularly placed pits. Length, 0.85 mm.; height, 0.51 mm.; thickness 0.60 mm.

Navesink. Columbia University Coll. No. M 35.

Brachycythere ledaforma (Israelsky) Pl. 6, fig. 15

Cytheropteron ledaforma Israelsky, Arkansas, Geol. Surv., Bull. 2, 1929, p. 8, pl. 1a, figs. 5-7.
Cythere acutocaudata Alexander, Univ. Texas Bull. 2907, 1929, p. 87, pl. 7, figs. 5-6.
Brachycythere ledaforma Alexander, Jour. Pal. 7, 1933, p. 206, pl. 25, fig. 9; pl. 27, fig. 20.

Carapace small, subovate, inequivalved; greatest height anterior to the center; dorsal margin arched, angled and nearly straight along the hinge contact; anterior margin is broadly rounded; ventral margin slightly convex; posterior margin acutely angled and obliquely truncated; anterior and posterior ends of carapace strongly compressed; convexity of the valves increases towards the center of the ventral margin, maximum convexity projects beyond the ventral contact in some specimens; surface of the valves smooth except for the ventral surface formed by the tumidity of the valves, this is ornamented with a series of longitudinal ridges, the furrows between the ridges have small pits in them in well preserved specimens. Hingement is typical of the genus. Length, 0.65 mm.; height, 0.37 mm.; thickness, 0.40 mm.

Mt. Laurel and Navesink.

Brachycythere ovata (Berry) Pl. 6, figs. 16a-b.

Cythereis ovatus Berry, Am. Jour. Sci. ser. 5, vol. 9, 1925, p. 484, fig. 15.
Cythere ovata Alexander, Univ. Texas, Bull. 2907, 1929, p. 87, pl. 7, figs. 10 and 13.
Brachycythere ovata Scott, Geol. Soc. Am., Bull vol. 45, 1934, p. 1153 (list).

Carapace large, inequivalved, elongate, ovate in lateral view; dorsal margin evenly arched; ventral margin convex; anterior margin broadly rounded and minutely spinose; posterior margin narrowly rounded and obliquely truncated. Surface of the valves strongly convex; posterior and anterior ends compressed; convexity increases from the dorsal to the ventral border and from the anterior and posterior ends towards the central portion of the ventral margin giving triangular cross-section to carapace; tumid central portion of the valves projects below the ventral contact of the valves; surface of the valve appears to be minutely punctate. Hingement typical of the genus. Length, 1.10 mm.; height, 0.65 mm.; thickness, 0.65 mm.

The form, though smaller than the ones described by Alexander, appears to agree in all other respects.

Navesink.

Brachycythere pseudovata, n. sp. Pl. 6, figs. 17a-b

Carapace large (1.10 mm.), inequivalved, elongate, ovate in lateral view and subtriangular in cross-section, greatest height almost central; dorsal margin arched and slightly angulated at the greatest height; anterior margin broadly rounded; ventral margin gently convex, maximum convexity slightly posterior to the center; posterior margin narrowly rounded and obliquely truncated through the dorsal half; anterior and posterior ends compressed; maximum compression of the anterior end of right valve posterior to the contact, forming a low ridge round the anterior contact; convexity of the valves increases from the dorsal to the ventral margin and from the anterior and posterior ends towards the center; the tumid center of the ventral margin projects below the contact of the valves; the left valve overlaps the right on the entire contact; maximum overlap on the dorsal margin near the center. Length, 1.10 mm.; height, 0.66 mm.;

thickness, 0.62 mm.

This form differs from *Brachycythere ovata* (Berry) in the central location of the greatest height and the angulation there; also the overlap is not uniform throughout the dorsal margin as in *B. ovata*.

Navesink. Columbia University Coll. No. M36.

Genus CYTHEREIS Jones, 1849

Cythereis bassleri Ulrich Pl. 7, figs. 1a-b

Cythereis bassleri Ulrich, Md. Geol. Surv., Eocene, 1901, p. 120, pl. 16, figs. 19-21;—Weller, Geol. Surv., New Jersey, Paleontology, vol. 4, 1907, p. 843, pl. 110, figs. 1-3;—Alexander, Jour. Pal., vol. 8, 1934, p. 219.

Carapace suboblong, greatest height at the anterior dorsal contact; posterior end compressed; dorsal margin straight; anterior margin broadly and slightly obliquely rounded and bearing fine spines; ventral margin straight; posterior margin more narrowly rounded than anterior and obliquely truncated in the dorsal half, ventral half carries 2-4 small spines; anterior margin bordered by a wide rounded ridge that tends to become obsolescent as it proceeds posteriorly from the anterior dorsal contact; the anterior dorsal contact is marked by a well developed node; a ridge starts at the anterior ventral contact and, curving slightly dorsally, parallels the ventral margin, increasing in size until it is abruptly terminated by the posterior compressed area; a less developed ridge rises at or near the anterior dorsal contact, and, running parallel to the dorsal margin, is also terminated by the posterior depressed area; the posterior ends of these ridges turn at an abrupt angle towards the center forming a J-shaped hook at the end of the ridge; the depressed area at the end of the carapace is bordered by a thickened rim which terminates against the raised portion of the valves; a strongly developed sub-central tubercle is present and the surface of the valves is covered with pits or reticulations, the spaces between which sometimes coalesce into raised sharp ridges especially near the center of the valves. Length, 0.85 mm.; height, 0.42 mm.; thickness, 0.40 mm.

Mt. Laurel and Navesink.

Cythereis bassleri var. **lata,** n. var. Pl. 7, figs. 2a-b

This form differs from the typical in that it is much shorter in relation to its height than *Cythereis bassleri.* Length, 0.75 mm.; height, 0.40 mm.; thickness, 0.42 mm.

Navesink. Columbia University Coll. No. M20.

Cythereis communis Israelsky Pl. 7, fig. 3

Cythereis communis Israelsky, Arkansas Geol. Surv., Bull. 2, 1929, p. 14, pl. 3a, figs. 9-13.
Cythereis communis Alexander, Univ. Texas Bull. 2907, 1929, p. 101, pl. 9, fig. 18.
Cythereis communis Scott, Geol. Soc. Am., Bull. 45, 1934, p. 1153 (list).

Carapace small, elongate, suboblong in lateral view, anterior end slightly higher than posterior; dorsal margin irregularly straight; anterior margin obliquely and broadly rounded, coarsely spinose on ventral third; ventral margin straight; posterior margin narrowly rounded and truncated obliquely on the dorsal half, ventral half ornamented with three or four coarse spines; posterior end of carapace compressed; anterior margin bears a broad rounded peripheral ridge which extends posteriorly along the dorsal and ventral margins; these ridges are abruptly terminated by the compressed posterior end; the ventral of these ridges attains a stronger development than does the dorsal and projects beyond the surface of the valves in an almost alate extension before it is terminated by the compressed posterior region. A third broad, less well defined ridge extends from the posterior compression along the mid-line of the valves dying out in the anterior quarter of the valves. The surface of the valves is sparsely punctate. Hingement typical of the genus. Length, 0.76 mm.; height, 0.38 mm.; thickness, 0.37 mm.

Mt. Laurel and Navesink.

Cythereis curta, n. sp. Pl. 7, figs. 4a-b

Test small, subrhomboidal, inequivalved, left valve larger than the right, overlap shows only at the anterior dorsal contact; dorsal margin straight; anterior margin broadly and obliquely rounded; ventral margin straight to very slightly convex; posterior margin angulated at about mid-point, ventral half curved, dorsal half straight, truncating the curvature, curved portion bears a few small spines; posterior portion of valves strongly compressed. A ridge starting in the anterior ventral part of the valves curves outward to the ventral margin and extends in a posterior direction to the posterior ventral contact where it is terminated by the compressed area of the posterior portion of the carapace. A very poorly developed ridge borders the dorsal half of the anterior margin and extends to the dorsal posterior contact where it is terminated by the depressed area. An irregular, almost dendritic, oblique ridge occupies most of the center of the valves. It extends from the anterior ventral to the posterior dorsal region of the valves. The hingement is typical of the genus. Length, 0.55 mm.; height, 0.34 mm.; thickness, 0.34 mm.

Navesink. Columbia University Coll. No. M21.

Cythereis huntensis (Alexander) Pl. 7, fig. 5

Cythere huntensis Alexander, Univ. Texas, Bull. 2907, 1929, p. 88, pl. 6, fig. 12.
Cythereis huntensis Alexander, Jour. Pal. vol. 8, 1934, p. 236.

Carapace small, ovate, highest anteriorly; dorsal margin straight, sloping posteriorly; anterior margin broadly rounded and ornamented with spines on the ventral half; ventral margin very slightly convex; posterior margin narrowly rounded, denticulate, and slightly angulated.

The entire margin is surrounded by a rim that is most strongly developed round the anterior border. A sharp ridge rises near the anterior dorsal contact and curves ventrally and posteriorly, finally forming a longitudinal ridge that lies just dorsal to the median line. A second ridge rises near the anterior ventral contact and curving dorsally joins the median ridge; a third ridge rises near the anterior ventral contact, and curving upwards, extends posteriorly finally joining the dorsal longitudinal ridge; a fourth ridge starts at the posterior ventral contact and, extending anteriorly, forms the anterior marginal ridge for about 1/3 of the length and then curves dorsally to join the ventral longitudinal ridge. These ridges are joined by cross ridges that give a fenestrated appearance to the surface of the valves. Length, 0.55 mm.; height, 0.32 mm.

Navesink.

Cythereis pulchra, n. sp. Pl. 7, fig. 6

Carapace subrectangular, inequivalved, compressed; greatest height at the anterior dorsal contact; dorsal margin straight; anterior margin broadly rounded, spinose, and slightly produced; ventral margin straight, the dorsal and the ventral margins converge posteriorly; posterior margin narrowly rounded and truncated in the dorsal half, three or four well developed spines on the ventral portion; posterior end compressed.

A marginal rim extends round the periphery; the anterior rim, sharp and well developed, is paralleled posteriorly by a depressed area containing two rows of strong oblong reticulations running parallel to the margin; at the anterior dorsal contact, the ridges between the rows of reticulations fuse with the marginal ridge, which extends posteriorly along the dorsal margin to the posterior dorsal contact; at this point the ridge divides, one part forming a J-shaped hook towards the center of the valves, the other part forming a low ridge round the posterior margin; the ventral marginal ridge is poorly developed and in some of the forms almost obsolete, amounting to but little more than a slight thickening of the edge of the valves; another ridge starts opposite the anterior ventral contact and, curving slightly dorsally in the first quarter of its length, runs parallel to the ventral margin and is terminated by the depressed area at the posterior end; the surface of the valves is coarsely punctate with the exception of the rows of reticulations round the anterior end. A round node is located at the center of the valves. Length, 0.76 mm.; height, 0.40 mm.; thickness, 0.35 mm.

Mt. Laurel and Navesink. Columbia University Coll. No. M22.

Cythereis wrighti Jones and Hinde Pl. 7, fig. 7

Cythereis wrighti Jones and Hinde, Suppl. Mon. Cret. Entom. of Eng. and Irel., Paleont. Soc. (1889) 1890, p. 25, pl. 4, fig. 18.

Carapace small, subtriangular; greatest height at anterior dorsal contact; dorsal margin straight; anterior margin broadly rounded; ventral margin straight; posterior margin more narrowly rounded than is the anterior and obliquely truncated through the dorsal half; ventral part bears 3-4 small spines; posterior part of the carapace compressed; anterior margin bordered by a ridge which is sharp at the ventral contact but which expands to a rounded swelling at the dorsal contact; ventrally a ridge parallels the margin, the anterior end merges into the curvature of the valve; posteriorly it is sharply terminated by the compressed part of the valves. The dorsal margin is paralleled by a ridge bearing 3-4 low rounded tubercles and, as in the ventral ridge, it is terminated abruptly at the posterior end by the compression of the valves and anteriorly by the curvature of the valves. Hingement typical for the genus. A distinct tubercle is located almost centrally, otherwise the surface of the valves is smooth. Length, 0.4 mm.; height, 0.35 mm. No complete specimens were found, and though the form differs from Jones' drawings in that the ventral ridge is smooth and not tuberculated, it agrees in other respects and is therefore referred to this species.

Mt. Laurel and Navesink.

Genus PARACYTHEREIS, n. gen.

Genotype.—*Paracythereis typicalis*, n. sp.

Carapace small, subquadrate, inequivalved. Left valve larger than the right; dorsal and ventral margins straight; anterior margin broadly rounded and spinose; posterior margin narrowly rounded and often truncate on the dorsal half; posterior end usually strongly compressed.

Surface of the valves ornamented with pits or reticulations, and ridges. Subcentral tubercle generally present.

Hingement in the right valve consists of a linear crenulate tooth at the anterior dorsal contact, a fine crenulate groove extends along the margin from the anterior tooth to the posterior dorsal contact; a large crenulate tooth is developed on the posterior margin at the posterior dorsal contact. The anterior margin carries a groove, the inner margin of which developes on the ventral margin into a thin ridge over which the left valve fits.

The hingement of the left valve consists of anterior and posterior sockets connected by a finely crenulate bar. A small ridge on the anterior margin fits the groove in the anterior of the right valve; the central portion of the ventral margin of the left valve laps over the ridge of the ventral portion of the right valve forming an internal overlap.

These forms have an outline resembling *Cythereis* but the difference in hingement sets them apart.

Paracythereis typicalis, n. sp. Pl. 7, figs. 8a-c

Carapace small, subquadrate, inequivalved; left valve larger than right; overlap conspicuous at anterior dorsal contact; anterior margin broadly rounded, posterior margin more narrowly rounded; both anterior and posterior margins finely spinose; posterior end of carapace compressed; surface ornamented with reticulations and a sharp subcentral node; hingement typical of genus. Length, 0.5 mm.; height, 0.35 mm.

Navesink. Columbia University Coll. No. M28.

Genus PSEUDOCYTHEREIS, n gen.

Genotype—**Pseudocythereis reticulata**, n. sp.

Carapace small, subquadrate, inequivalved; right valve overlaps the left on dorsal margin; strongest development in center of dorsal region; left valve overlaps right on ventral margin, strongest near center. The genus has a pyriform outline in dorsal view and the surface is strongly reticulate. The shell material is heavy. The line of concrescence and the inner margin coincide throughout. The marginal zone shows only at the anterior and posterior ends.

The hingement consists, as in *Cythereis,* of a knoblike anterior and posterior tooth, in the right valve. A well developed socket is located immediately posterior to the anterior tooth, and a shallow groove connects the anterior socket and posterior tooth. Corresponding to the anterior tooth and post-adjacent socket of the right valve, the left valve carries an anterior socket and a post-adjacent knoblike tooth. The anterior tooth lies below but is attached to the dorsal edge of the valve. The dorsal edge is elevated to form a ridge connecting the anterior tooth with a posterior socket corresponding to the posterior tooth of the right valve.

The hingement is typical of *Cythereis*, but the outline especially of the pyriform dorsal view and the overlap features separate this genus from the forms assigned to *Cythereis*. It appears to the author that strong differences in outline and overlap are as valid generic distinctions as are hinge characters.

Pseudocythereis reticulata, n. sp. Pl. 7, figs. 10a-d

Carapace small, subquadrate, inequivalved; greatest height at the dorsal contact; dorsal margin slightly arched and obscurely angled at the center; anterior margin broadly rounded and finely spinose; ventral margin faintly convex; posterior margin is finely spinose and more narrowly rounded than the anterior; the maximum thickness of the valves is located posterior and ventral to the center of the valves. The surface tapers uniformly from the thickest point to the dorsal and anterior margins but is very steep in the posterior and ventral directions. The posterior end is compressed in such a fashion as to form a narrow flat border round the posterior margin. An indistinct oblique sulcus extends from the anterior ventral region to the posterior dorsal, the degree of development of this feature varies in the different specimens. Surface of the valves strongly reticulated; anterior and posterior margins paralleled by rows of oblong reticulations, two rows on the anterior and one row on the posterior end; the strongest development of the reticulations is found on the area of maximum thickness. Right valve overlaps the left on the dorsal margin; strongest development of the overlap near center. Left valve overlaps right on the ventral margin especially near the center. Hingement of the left valve consists of an anterior socket, a well developed tooth just posterior to the socket, a bar formed from the edge of the valve, and a posterior socket in the left valve. The right valve has an anterior tooth, a post-adjacent socket, and a posterior tooth connected with the anterior hingement by a groove. Length, 0.70 mm.; height, 0.35 mm.; thickness, 0.40 mm.

This form differs from the usual *Cythereis* form in outline but the hingement is the same. For that reason it is assigned to the above new genus.

Mt. Laurel and Navesink. Columbia University Coll. No. M29.

Genus CYTHERIDEA Bosquet, 1852

Cytheridea pinochii, n. sp. Pl. 7, fig. 9

Carapace small, inequivalved, subovate in lateral view; greatest height slightly anterior to the center; dorsal margin arched and obscurely angulated; anterior margin broadly rounded, sparsely and obscurely denticulated; ventral margin slightly convex in the center and slightly sinuous in the posterior third; posterior end narrowly rounded and truncated in the dorsal half; left valve overlaps the right on the entire margin, overlap slightly stronger on the dorsal margin; surface of the valves punctate, the strongest punctations arranged in a row slightly posterior to the center in a pronounced furrow. Length, 0.70 mm.; height, 0.45 mm.; thickness, 0.37 mm.

This form differs from *Cytheridea monmouthensis* in that the posterior end is not as acute as the one Berry describes and the wing on the posterior ventral margin is missing. Forms that resemble this were described by Alexander from the Cretaceous of Texas but they were even more angular at the posterior contact than were the forms illustrated by Berry.

Mt. Laurel. Columbia University Coll. No. M23.

Cytheridea punctilifera, n. sp. Pl. 7, fig. 11

Carapace small, inequivalved, subtriangular in lateral view; greatest height slightly anterior to the center; dorsal margin strongly arched; anterior margin broadly rounded; ventral margin straight; posterior margin narrowly rounded. Left valve overlaps the right on the entire periphery, overlap the least on the ventral margin, about equal on the others. Surface punctate; punctations in center of the valve arranged in two or three vertical grooves. Hingement typical. Length, 0.47 mm.; height, 0.30 mm.; thickness, 0.24 mm.

This form resembles *Cytheridea plummeri* Alexander but it is spineless and much more punctate.

Mt. Laurel and Navesink. Columbia University Coll. No. M24.

Cytheridea sepulchra, n. sp. Pl. 7, fig. 12

Carapace small, subovate, inequivalved; greatest height central; dorsal margin strongly arched; anterior margin broadly rounded; ventral margin gently convex; posterior margin narrowly rounded and truncated; greatest thickness ventral to the center. Left valve overlaps the right on entire margin, greatest on the dorsal and ventral margins. Surface irregularly punctate, the punctations in the center of the valves arranged vertically in two grooves with 6-7 to a groove. Length, 0.45 mm.; height, 0.35 mm.; thickness, 0.26 mm.

Mt. Laurel and Navesink. Columbia University Coll. No. M26

Genus LOXOCONCHA Sars, 1865

Loxoconcha minuta, n. sp. Pl. 7, figs. 13a-b

Carapace small, subquadrate, convex; dorsal margin straight, dorsal contact slightly depressed; anterior margin broadly and obliquely rounded, being slightly produced in the ventral part; ventral margin somewhat convex just anterior to the center, and curving upwards to the posterior contact; posterior margin rounded with only a slight development of the typical caudal process.

Valves strongly convex, greatest thickness ventral of the center; convexity of the valves projects below the ventral contact; anterior and posterior margins bordered by compressed areas. Convex portions of the valves reticulate; the reticulations are irregularly arranged in the central portion of the valves, marginal reticulations are arranged in rows parallel to the margins of the convexity of the valves. Length, 0.32 mm.; height, 0.23 mm.; thickness, 0.20 mm.

Mt. Laurel and Navesink. Columbia University Coll. No. M 27.

RANGE CHART

FORAMINIFERA	Mt. Laurel	Navesink	Hornerstown
Allomorphina halli			x
Anomalina clementiana	x		
Anomalina pinguis	x	x	
Arenobulimina malkinae			x
Arenobulimina cuskleyae			x
Arenobulimina footei	x		
Arenobulimina haffi	x		
Bolivinita crawfordensis			x
Bulimina referata	x	x	
Bulimina quadrata	R	x	
Bulimina reussi		x	
Buliminella fusiforma		x	
Cibicides mortoni			x
Cibicides padella		x	
Cibicides burlingtonensis			x
Cibicides neelyi			x
Clavulina insignis		x	
Dentalina communis	x	x	
Dentalina granti	x		
Dentalina confluens		x	
Dentalina legumen var. spirans	x		
Dentalina nana	x		
Dentalina raristriata		x	
Dorothia bulletta	x	x	
Elphidium cynicalis			x
Eouvigerina hispida	x		
Flabellina reticulata		x	
Frondicularia archiaciana		x	
Frondicularia clarki		x	
Frondicularia cuspidata	x		
Frondicularia lanceola	x	x	
Gaudryina rugosa	x	x	
Globigerina bulloides			x
Globigerina compressa			x
Globigerina cretacea	x	x	
Globigerina triloculinoides			x
Globigerinella aspera	x	x	
Globigerinella voluta	x	x	
Globotruncana arca	x	x	
Globotruncana fornicata	x		
Globulina lacrima var. subsphaerica	x		
Gumbelina globulosa	x	x	
Gumbelina tessera		x	
Gumbelina ultimatumida	x		
Gumbelitria cretacea	x	x	

(*Foraminifera*)	Mt. Laurel	Navesink	Hornerstown
Guttulina hantkeni	x	x	
Gyroidina soldani	x	x	x
Hemicristellaria ensis	x		
Hemicristellaria rancocasensis			x
Lagena hispida			x
Lagena sulcata var, semiinterrupta	x	x	
Lagena rostra	x	x	
Lagena adepta	x		
Lenticulina degolyeri		x	
Loxostoma plaitum	x	x	
Marginulina bullata	x		
Marginulina costata	x	x	
Marssonella oxycona	x	x	
Neobulimina canadensis		x	
Nodogenerina sagrinensis			x
Nodosaria fissicostata			x
Nodosaria latejugata var. carolinensis			x
Nodosaria paupercula	x		
Nodosaria radicula	x'		
Nodosaria zippei		x	
Nonionella cretacea	x		
Polymorphina subrhombica			x
Pseudouvigerina triangularis			x
Pullenia quinqueloba	x	x	
Pulvinulinella exigua var. obtusa			x
Robulus aldrichi	x	x	
Robulus convergens	x		
Robulus navarroensis	x	x	
Robulus hookerae			x
Saracenaria acutauricularis	x		
Siphonina prima		x	
Spiroplectammina laevis var. cretosa	x	x	
Spiroplectoides rosula		x	
Spiroplectoides emmendorferi			x
Textularia cf. dibollensis			x
Uvigerina seligi	x	x	
Vaginulina gracilis var. cretacea		x	
Vaginulina webbervillensis	R	x	
Valvulineria nelsoni	x	x	
Ventilabrella carseyae	x	x	
Verneuilina bronni		x	
Verneuilina kurti		x	

OSTRACODES	Mt. Laurel	Navesink	Hornerstown
Cytherella moremani		x	
Cytherelloidea monmouthensis		x	
Cytherelloidea navesinkensis		x	
Cytherelloidea spiralia	x	x	
Cytherelloidea williamsoniana	x		
Cythereis bassleri	x	x	
Cythereis bassleri var. lata		x	
Cythereis communis	x	x	
Cythereis curta		x	
Cythereis huntensis		x	
Cythereis pulchra	x	x	
Cythereis wrighti	x	x	
Cytheridea pinochii	x		
Cytheridea punctilifera	x	x	
Cytheridea sepulchra	x	x	
Loxoconcha minuta	x	x	
Paracythereis typicalis		x	
Pseudocythereis reticulata	x	x	
Antibythocypris gooberi	x	x	
Bairdoppilata delicatula			x
Bairdoppilata pondera	x	x	
Bairdoppilata viticula	x		
Brachycythere alata		x	x
Brachycythere betzi			x
Brachycythere harlani			x
Brachycythere jerseyensis		x	
Brachycythere ledaforma	x	x	
Brachycythere ovata		x	
Brachycythere pseudovata		x	
Bythocypris parilis			x

PLATES

PLATE I

EXPLANATION OF PLATE I (28)

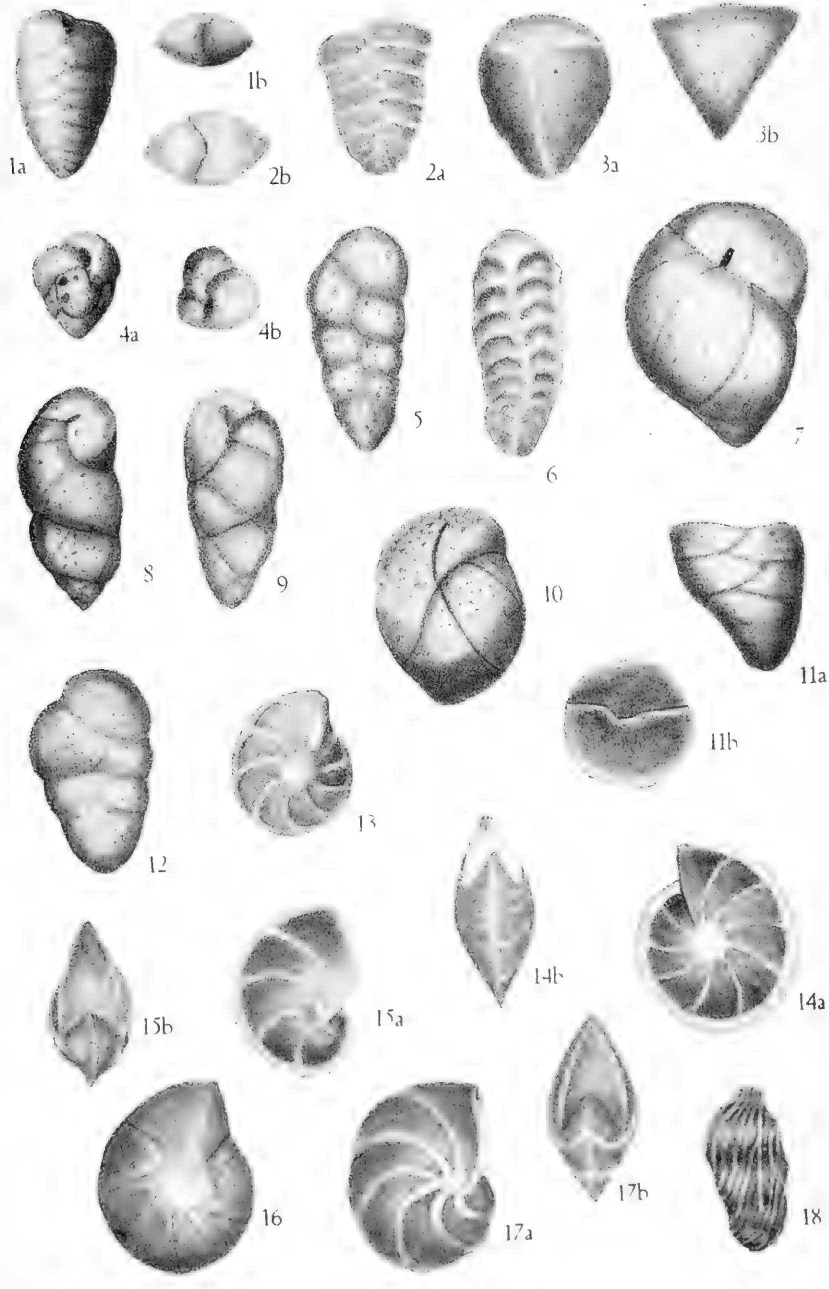
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PLATE II

EXPLANATION OF PLATE II (30)

Figure		Page
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2.	**Hemicristellaria rancocasensis,** n. sp., X 30	17
3.	**Hemicristellaria ensis** (Reuss), X 35	17
4.	**Dentalina communis** (d'Orb.), X 80	17
5.	**Dentalina confluens** Reuss, X 50	18
6.	**Dentalina granti** (Plummer), X 50	18
7.	**Dentalina legumen** (Reuss) var. **spirans** Cushman, X 55	18
8.	**Dentalina nana** Reuss, X 40	18
9.	**Nodosaria fissicostata** (Gumbel), X 50	19
10.	**Nodosaria latejugata** Gumbel var. **carolinensis** Cushman, X 20	19
11.	**Nodosaria paupercula** Reuss, X 30	19
12.	**Nodosaria radicula** (Linné), X 60	20
13.	**Nodosaria zippei** Reuss, X 25	20
14.	**Saracenaria acutauricularis** (Fichtel & Moll), X 60 a. Side view, b. apertural view	20
15.	**Vaginulina webbervillensis** Carsey, X 10	21
16.	**Vaginulina gracilis** var. **cretacea** Plummer, X 20	21
17.	**Flabellina reticulata** Reuss, X 20	22
18.	**Frondicularia archiaciana** d'Orb., X 20 a. Microspheric; b. Macrospheric	22
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20.	**Frondicularia lanceola** Reuss, X 20	23
21.	**Frondicularia clarki** Bagg, X 30	22
22.	**Lagena hispida** Reuss, X 200	23
23.	**Lagena sulcata** var. **semiinterrupta** Berry, X 100	23

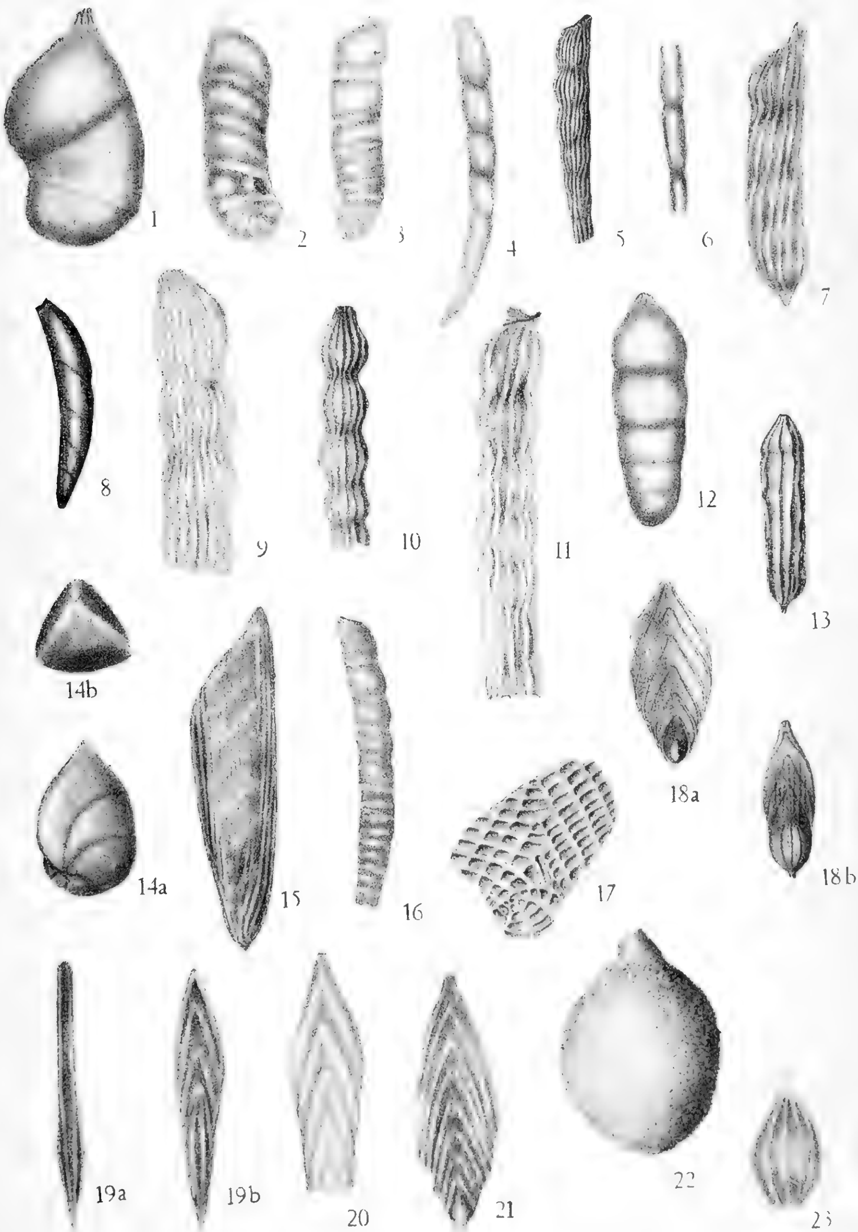
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PLATE III

EXPLANATION OF PLATE III (30)

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7.	**Polymorphina subrhombica** Reuss, X 25	25
8.	**Spiroplectoides emmendorferi,** n. sp., X 150	26
9.	**Gumbelina globulosa** (Ehrenberg), X 100	27
10.	**Gumbelina tessera** (Ehrenberg), X 135 a. Side view, b. apertural view	27
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12.	**Gumbelitria cretacea** Cushman, X 110 a. Side view, b. apertural view	28
13.	**Ventilabrella carseyae** Plummer, X 50 a. Microspheric; b. Macrospheric	28
14.	**Bolivinita crawfordensis,** n. sp., X 140	28
15.	**Eouvigerina hispida** Cushman, X 120	29
16.	**Pseudouvigerina triangularis,** n. sp., X 75 a. Side view, b. apertural view	29
17.	**Nodogenerina sagrinensis** (Bagg), X 50	29
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19.	**Bulimina quadrata** Plummer, X 65	30
20.	**Bulimina reussi** Morrow, X 140	31
21.	**Bulimina referata,** n. sp., X 150 a. Side view, b. apertural view	31
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23.	**Loxostoma plaitum** (Carsey), X 60	31
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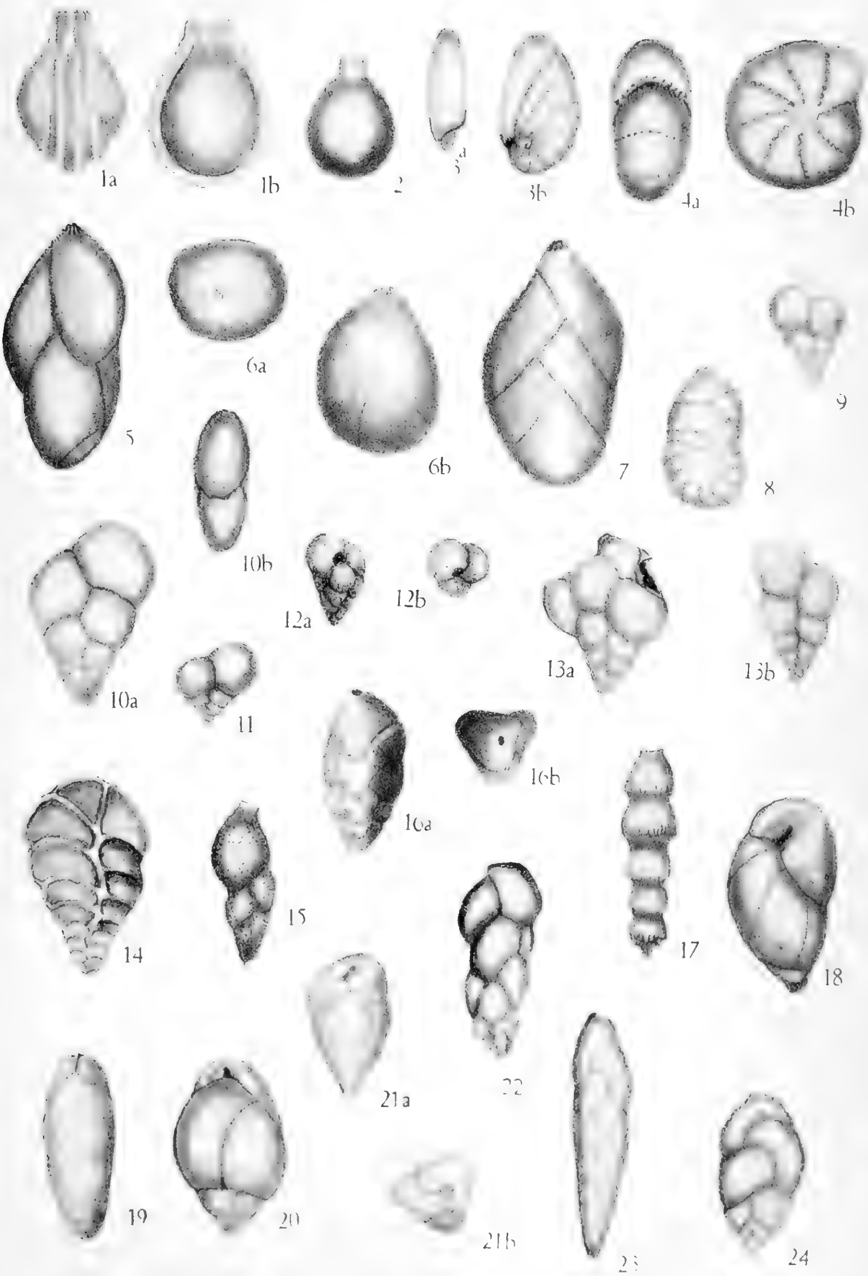
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PLATE IV

EXPLANATION OF PLATE IV (31)

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11.	**Globigerinella aspera** (Ehrenberg), X 100	36
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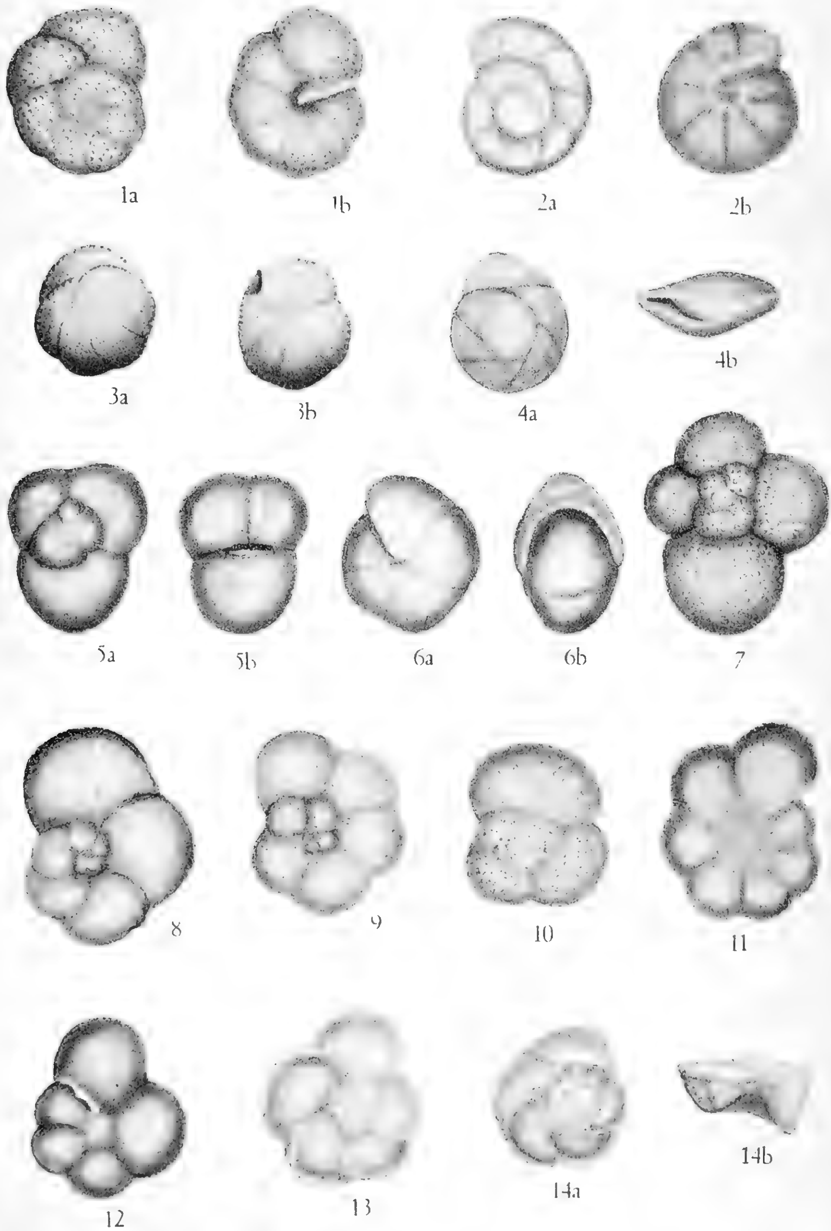
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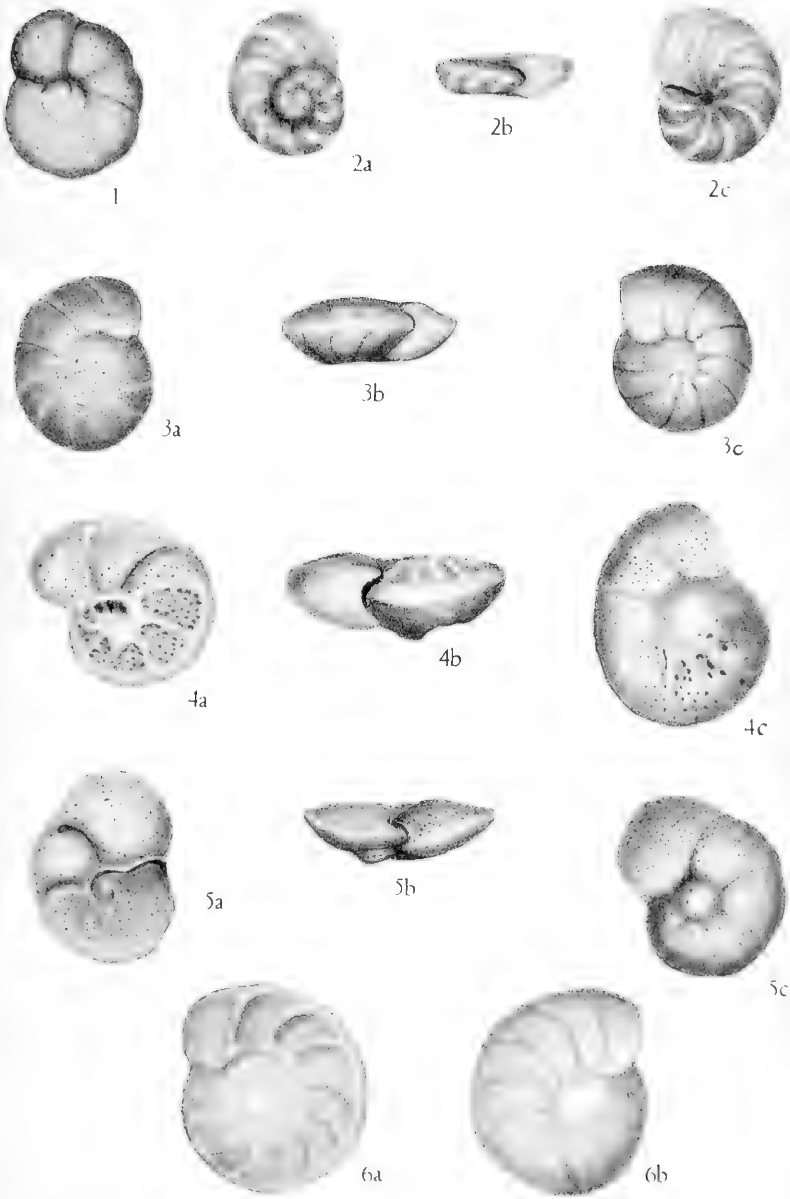
PLATE V

EXPLANATION OF PLATE V (32)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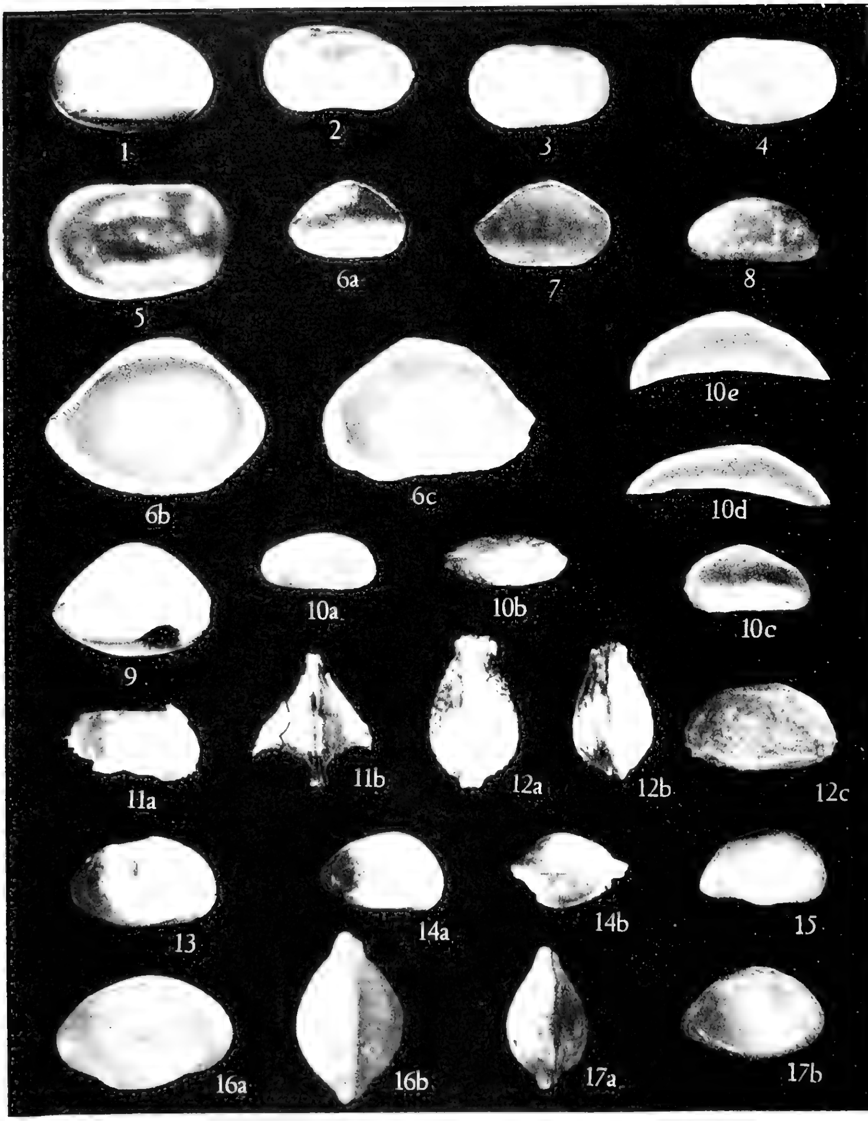
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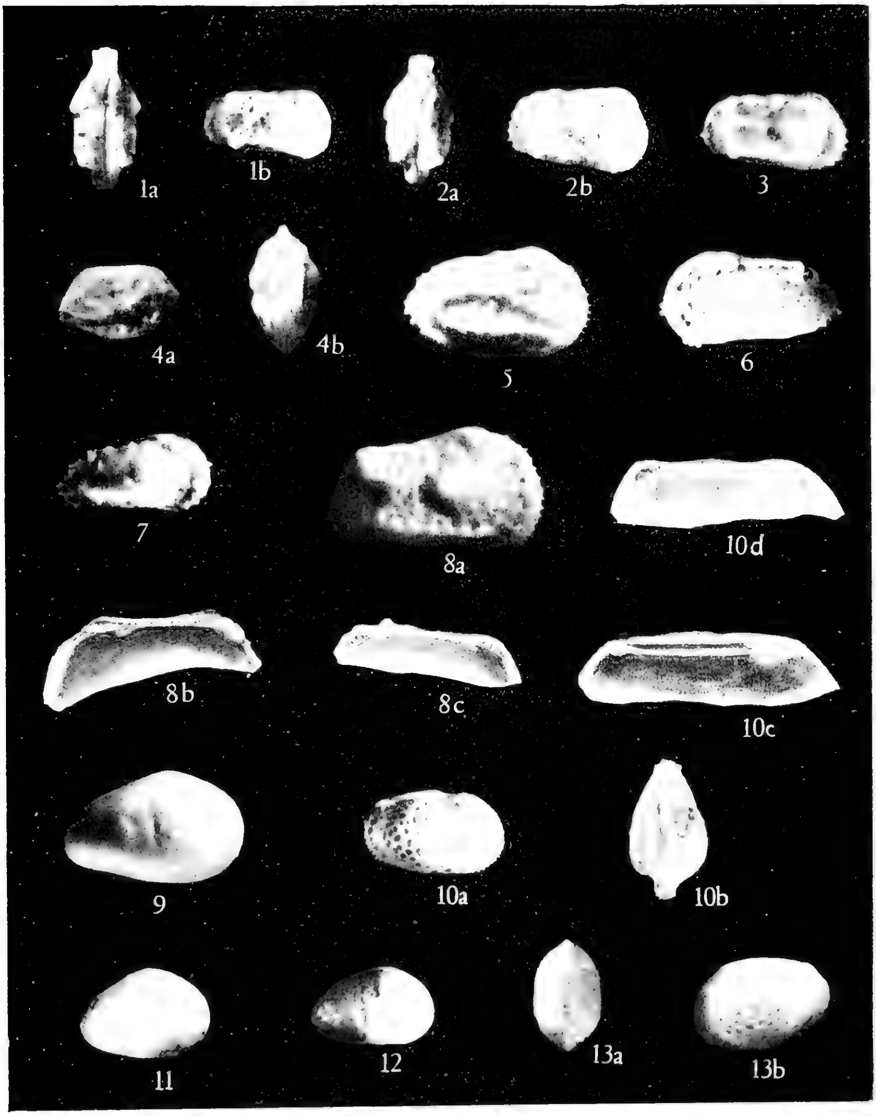

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Vol. 23

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No. 79

Coral Studies:

Part I, Two New Species of Fossil Corals

Part II, Five New Genera of the Madreporaria

By

John W. Wells

PALÆONTOLOGICAL RESEARCH INSTITUTION

FOUNDED 1932

March 15, 1937

Ithaca, New York,

U. S. A.

CORAL STUDIES

by

John W. Wells

Part I

TWO NEW SPECIES OF FOSSIL CORALS

A NEW SPECIES OF *TURBINOLIA* FROM *PERU*

Specimens of several species of corals were collected by A. Olsson during 1932 from beds of Oligocene age in northern Peru and were turned over to the writer for examination. Among them were several specimens of a new species of *Turbinolia,* especially interesting because they are the first, with one exception, to be noted from outside North America and northwestern Europe[1].

Turbinolia olssoni, n. sp. Plate 1, figs. 1, 2

Description.—Corallum elongate, conical. Costæ 24 in number at the margin of the calice, high, narrower than the interspaces, with smooth sharp edges and fluted sides. In the larger specimens there are 24 additional smaller costæ not representing septa. Those corresponding to the first cycle of septa alone extend to the base and are of uniform height throughout their length. The secondary costæ equal the primaries but do not extend quite to the tip. The third cycle extends downward about five-sixths of the distance to the tip. The intercostal spaces are marked by a double row of pits on either side of the septate costæ which may pass through the wall. When the fourth cycle of costæ is present the pits form single rows. The septa are slightly exsert, laterally granulated, arranged in three complete cycles. Those of the first cycle are fused to the columella, slightly swollen at the junction with it so that the columella appears more or less hexagonal or stellate. The septa of second cycle extend near-

[1]There are in the British Museum (N. H.) specimens of two undescribed species of this genus from the upper Eocene of southern Nigeria, mentioned by Newton (*Bull. Geol. Surv. Nigeria*, No. 3, 1922, p. 8). They are, however, distinct from all other known species of the genus and probably represent a new subgeneric group.

ly but not quite to the columella; those of the third cycle extend less than a third of the distance, and all free along their inner edges. The columella, hexagonal below the calice, extends above the margins of the septa as a blunt obtuse rod ornamented by small granulations.

Dimensions.—

	Height	Max. Diam.	Ratio, H:D
Paratype	9.0 mm.	3.75	40:100
Holotype	8.5	3.5	41:100
Paratype	7.0	3.5	50:100

Type Locality.—Middle Oligocene, Mamore formation (Mirador facies, Juc, Charand, Northern Peru.

Type Specimens.—Paleontological Research Institution, Ithaca, New York.

Remarks.—This species belongs to the group marked by the styliform columella which is represented in the North American Oligocene by *T. insignifica* Vaughan[2] of the Red Bluff clay (lower Oligocene) of Mississippi. From this species it is distinguished by the non-interruption of the costae of the second cycle near the base, by its three complete cycles of septa, and the free inner edges of the septa. Three other Oligocene species are known, all from the lower Oligocene (Lattorfian) of northern Germany. *T. laminifera* Keferstein[3] has a strongly compressed columella but the septa are non-uniting, as in *T. olssoni.* *T. attenuata* Keferstein[4] is a much more elaborate form with a very thin styliform columella and the third cycle of costæ inserted at varying distances from the tip. *T. pygmaea* Roemer[5] is much smaller, with only 18 septa, those of the third cycle being incomplete.

Quayle[6] has recently divided the species of *Turbinolia* into two main groups, one marked by a styliform columella, the other characterized by a stellate columella. The former group flour-

[2]Vaughan, T. W. Eocene and Lower Oligocene Coral Faunas of the Southeastern United States. *Mon. U. S. Geol. Surv., XXXIX,* 1900, 91, pl. 6, figs. 17, 18.

[3]Keferstein, W. Die Korallen der norddeutschen Tertiärgebilde. *Zeitschr. d. geol. Ges.,* XI, 1859. 357, pl. 14, fig. 1.

[4]Id., op. cit., 356, pl. 14, fig. 1.

[5]Roemer, F. A. Die Polyparien des Norddeutsche Tertiär-Gebrige. *Palæontographica,* IX, 1863, 235, pl. 38, fig. 17.

[6]Quayle, E. H. Fossil Corals of the Genus Turbinolia from the Eocene of California. *Trans. San Diego Soc. Nat. Hist.,* VII, 1932, 106.

ished during the Eocene in Europe, the latter at the same time in North America. During the early Oligocene the styliform type reached the United States in the form of *T. insignifica*. *T. olssoni* further extends the range of this group into South America, and is, with the exception of *T. corbicula* Pourtalès[7], a recent species,[8] the latest representative of the genus now known. (See Pl. 1, figs. 5, 6.)

A NEW SPECIES OF *KIONOTROCHUS* DENNANT

In 1933, while the writer was studying the recent and fossil hexacorals in the collections of the British Museum (N. H.) he noted a small lot of caryophyllid corals from the Belgian Miocene which he was unable to place generically at the time. Later, in 1934, he found in the Museum für Naturkunde in Berlin a lot of 21 specimens (No. 5018) of *Kionotrochus suteri* Dennant, collected by Suter from a depth of 38 fathoms at Cuvier Island (New Zealand), which proved to belong to the same genus as the Belgian specimens. Through the kindness of Dr. H. Dighton Thomas of the British Museum (N. H.) photographs have been made of the latter which are described below as a new species.

[7]Pourtalès, L. F. Report on the Crinoids and Corals (Dredging operations of the "Blake"). *Bull. Mus. Comp. Zool. Harvard*, v, no. 9, 1879, 203, pl. 1, figs. 12, 13.

[8]In May, 1936, the writer was enabled through the courtesy of Dr. H. L. Clark to examine the types of Pourtalès's deep-sea corals in the Museum of Comparative Zoology at Harvard. Among those studied was *T. corbicula*. There are three paratypes (M. C. Z. No. 5602) from a depth of 220 fathoms off Havana, and another specimen (M. C. Z. No. 5603) from 310 near the same locality. All are relatively unworn and in good condition. The species is quite distinct from all others of the genus *Turbinolia* and is here made the type of a new subgenus, *Batotrochus*, distinguished from *Turbinolia s. s.* by the strongly and regularly perforated wall consisting of stout granulose or subspinose bars between the septa, the strongly granulated or hispid costæ, and septa with upper margins faintly beaded or lacerate with one or two inner notches near the columella. The subgenotype, *T. corbicula* Pourt., is distinguished by the low thick columella to which are united all the septa (12), and by a third cycle of 12 nonseptate costæ. (Pl. 1, figs. 3, 4.) *Batotrochus* in general appearance resembles *Trematotrochus* (Oligocene-Recent) which is a derivative of *Conocyathus*, (Pl. 1, fig. 7, 8.) but generically distinct beause of the reduced columella and irregularly developed pali before the *second* cycle of septa.

Kionotrochus lecomptei[9] **n. sp.** Plate 1, figs. 9-13

Discotrochus duncani Krejci 1926 (non Reuss 1871). *Jahrb. Preuss. Geol. Landes.*, xlvi, 488.

Description.—Corallum simple, small, discoidal, relatively thick, free. Wall horizontal until ephebic stage, then vertical, septothecal. Exterior with strong, subacute, irregularly granulated costae corresponding in position and number with all septa, thicker over the base. Septa in three complete hexameral cycles, the first two extending to the columella, the third short, uniting to the second, all laterally granulose, upper margins entire. Columella, parietal, spongy, well-developed, about one-third diameter of corallum. No pali. Diameter of figured holotype, 4 mm., height 1.4 mm.

Type locality.—Miocene (Bolderian), Edeghem, near Antwerp, Belgium. *Other localities.*—Anversian, Antwerp, Belgium; Dingden, Westphalia; Langenfelde, Schleswig-Holstein; Rothenburgsort, Hamburg; Hemmoor (Krejci).

Type specimens.—4 cotypes, British Museum (N. H.) Nos. R-14633-36; figured holotype No. R-14636 (A. S. Piret Collection).

Remarks.—The genus *Kionotrochus* is very close to *Discotrochus,* the only differences being that the former is smaller and has a vertical continuation of the horizontal wall of the latter. (Senile individuals of *Discotrochus* occasionally have a low vertical wall). *Discotrochus* is definitely known only from the type species, *D. orbignianus* E. & H.[10] of the middle Eocene (lower Claibornian) of the southeastern United States. (Pl. 1, figs. 19, 20, 21, 22.) Five other species have been described as belonging to *Discotro-*

[9]For Dr. Marius Lecompte, Royal Museum of Natural History, Brussels.
[10]Vaughan, T. W. Eocene and Lower Oligocene Coral Faunas of the United States . . . *U. S. Geol. Surv. Mon.* xxxix, 1900. 79, pl. 5, figs. 13 19b.

chus: *D.* ? *alternans* Sokolow[11] from the lower Oligocene of Ekaterinoslav, Russia, imperfectly known; *D. michelotti* Edwards & Haime[12] from "Miocene; Colline de Turin", inadequately described, not figured, and apparently not noticed since[13], *D. investigatoris* Alcock[14] and *D. dentatus* A.,[15] both living in the Malaysian region, forms with dentate septa probably referable to *Anthemiphyllia* Pourtalès; and *D. duncani* Reuss[16] of the middle Miocene (Vindobonian) of the Vienna basin, which is another species of *Kionotrochus*.

Krejci, in the work referred to above, noted that *K. duncani* differed from the Belgian and north German specimens but was disinclined to separate them[17]. *K. duncani* differs from *K. lecomptei* by its relatively taller corallum, basal costae rounded and broad with low fine granulations, lateral costae thinner with acute, regular granules (pl. 1, figs. 14, 15, 16). The genotype of *Kionotrochus*, *K. suteri* Dennant[18] differs from both by its rounded or bowl-shaped form (pl. 1, figs. 17, 18).

[11]Sokolow, L. Die unteroligocäne Fauna der Glauconitsande bei der Eisenbahnbrücke von Jekaterinoslaw. *Mém. du Com. Géol.* (Russia), vol. ix, 1894.

[12]Edwards, H. M. & Haime, J. Hist. Nat. Corall., ii, 1857. 76.

[13]A. Portis (*Bol. R. Com. Geol. d'Italia*, xvii, 197, 199. 1886) lists a species of *Discotrochus*, "*Discotrochus veronensis* (*denominazione di Pell. et Pizz.*" from the Gassino limestone (M. Eocene-Lutetian). The name appears to be a *nomen nudum*, but may have been applied to specimens of *S. michelottii* which may not be a Miocene species.

[14]Alcock, A. Some newly recorded corals from the Indian Seas. *Journ. Asiatic Soc. Bengal*, lxii, 1893. 142, pl. 5, figs. 5, 5a.

[15]Alcock, A. Deep-Sea Madreporaria. *Siboga-Expeditie*, xvia, 1902. 27, pl. 4, figs. 26, 26a.

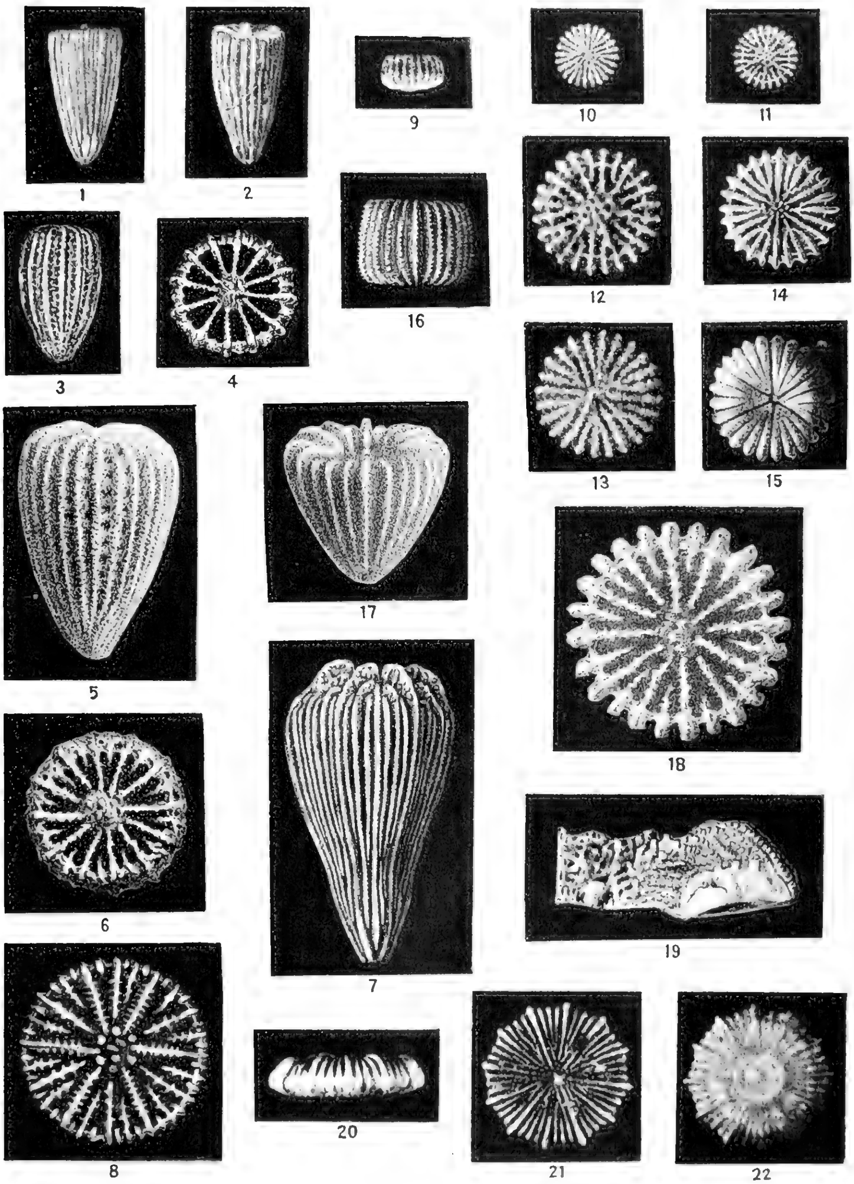
[16]Reuss, A. E. Die foss. Korallen des Oesterr.-Ungarn. Miocäns. *Denkschr. Ak. Wiss. Wien. M.-N. Kl.*, xxxi, 1871. 225, pl. 3, fig. 13, pl. 4, fig. 1, 2.

[17]Różkowska (*Polnisch. Geol. Ges., Jahr.* viii, 1932, 45, pl. 5, fig. 6) figured a specimen as *D. duncani* from the Miocene of Poland which appears to be *K. lecomptei*.

[18]Dennant, J. Madreporaria from the Australian and New Zealand Coasts. *Trans. Roy. Soc. South Australia*, xxx, 1906. 154, pl. 5, figs. 5a, b..

Explanation of Plate I

Figure		Page
1.	*Turbinolia olssoni* n. sp. Holotype; Middle Oligocene, Mamore Formation; Juc, northern Peru, x2. (Paleontological Research Institution).	3
2.	*T. olssoni* n. sp. Paratype. x2; (Pal. Res. Inst.)	3
3, 4.	*Turbinolia* (*Batotrochus*) *corbicula* Pourtalès 1879 Recent, 220 fms; off Havana, x7, x10, (Pourtalès)	5
5, 6.	*Trematotrochus hedleyi* Dennant 1906 Recent; 250 fms., 20 mi. N. E. of Port Jackson, New So. Wales x6. (Dennant).	5
7, 8.	*Conocyathus turbinoloides* (Reuss) 1856 Lower Oligocene; Crefeld, Germany; x7½. (Reuss)	5
9, 10, 11.	*Kionotrochus lecomptei* n. sp. Holotype; Middle Miocene; Edeghem, Belgium; x4; (British Museum N. H. No. R 14636)	6
12, 13.	*K. lecomptei* n. sp. Holotype; x8.	6
14, 15, 16.	*K. duncani* (Reuss) 1872 Middle Miocene; Porzteich, Czechoslovakia; x8. (Reuss)	7
17, 18.	*K. suteri* Dennant 1906 Recent; 110 fms; off Great Barrier Island, New Zealand; x7, x8; (Dennant).	7
19.	*Discotrochus orbignianus* Edwards & Haime 1848 Middle Eocene (Claibornian); Southeastern United States. Vertical section of one-half diameter of corallum; x6; (Vaughan).	6
20, 21, 22.	*D. orbignianus* E. & H. M. Eocene; Smithville, Bastrop County, Texas; x2; (Pal. Res. Inst.).	6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PART II

PART II

FIVE NEW GENERA OF THE MADREPORARIA

ACANTHOPHYLLIA, gen. nov.

Genotype.—Caryophyllia deshayesiana Michelin 1850. Recent. Locality unknown, but probably East Indies. (Holotype in the Collection Michelin, Museum National d'Histoire Naturelle Paris).

Diagnosis.—Large solitary mussoid, turbinate, slightly compressed, with small basal pedicel. Wall costate, non-epithecate, parathecal, thick. Costæ prominent, with large, lobulate, finely granulated dentations which decrease in size toward the columella Columella trabecular, compact, elongate, well-developed. Endotheca sparse; exotheca absent.

Remarks.—C. deshayesiana was described by Michelin in 1850[1], and the species was evidently overlooked by Edwards and Haime in preparing their great revision of the corals. The holotype in the Paris Museum is labelled "*Caryophyllia grandiflora* Michelin". The writer has not been able to trace this latter name and comparison with Michelin's fine figures of his specimen leaves no doubt that it is the type of *C. deshayesiana.* Later workers have not mentioned the species, but fortunately there are four specimens of it in the United States National Museum. These were collected February 24, 1908, during the Philippine Expedition of the U. S. Bureau of Fisheries Steamer "Albatross" from a depth of 9 fathoms on coral bottom near Sanguisiapo Island (4° 58′ 20″ N. lat., 119° 50′ 30″ E. long.) in the Sulu Archipelago. One specimen is figured in the present paper (Plate 2). The dimensions of the five specimens now known are as follows:

	Height	Diameters
Michelin's holotype	6.0 cm.	8.7 x 7.8 cm.
U. S. Nat. Mus. (fig'd.)	7.2	11.7 x 9.5
"	7.8	11.0 x 12.3
"	6.3	10.0 x 11.0
"	6.0	13.0 x 10.5

[1] *Rev. et Mag. Zool.,* (2), ii, 238-239, 1 plate.

The internal structure, especially of the parathecal wall, is shown in text figure 1, taken from the holotype.

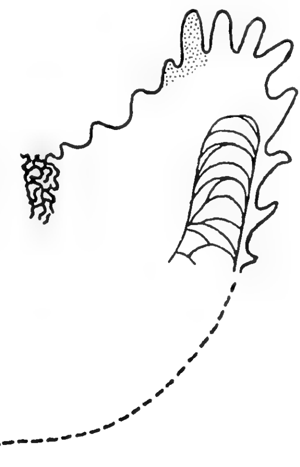


Figure 1. *Acanthophyllia deshayensiana* (Mich.)
A vertical section across a radius of the shorter diameter, showing paratheca. x1.

Another species of *Acanthophyllia* is *Lithophyllia ampla* Reuss[2] of the Miocene of Lapugy (Roumania). Reuss's figure shows shreds of an epitheca encircling the corallum, as do also the recent specimens from the Philippines, but no continuous epithecal deposit, such as is found in *Antilla*, was formed.

Several names have been applied to solitary mussoid corals, but most of them have been based upon the monostomatous stage of colonial forms. *Scolymia* Haime 1852[3] (*Lithophyllia* Edwards & Haime 1857)[4] includes the early stages of the West Indian colonial genus *Mussa*. *Antillia* Duncan 1863[5], the genotype of which is *A. dentata* Duncan of the West Indian Miocene (selected by de Fromentel in 1867), was almost certainly the direct predecessor of *Mussa* and a strictly solitary form with much smaller septal teeth than *Acanthophyllia* and a well-developed epitheca. *Syzygophyllia* Reuss 1860[6], based upon a species (*S. brevis*) from

[2] *Denk. Ak. Wiss. Wien.*, xxxi, 231, pl. 6, f. 2, 2a. 1871.
[3] *Mém. Soc. géol. France*, iv, 279 (footnote).
[4] Hist. Nat. Corall., ii, 290.
[5] *Quart. Jour. Geol. Soc. London*, xx, 28.
[6] *Sitz. Ak. Wiss. Wien.*, xxxix, 216.

the Miocene of central Europe, was much smaller than the forms previously mentioned, and from specimens of the genotype from the Miocene of the Bordeaux Basin the writer concluded that it formed small fasciculate colonies. *Sclerophyllia* Klunzinger 1879[7] is probably the monostomatous stage of *Symphyllia,* a living Indo-Pacific genus. *Cynarina* Brueggemann 1877[8], like *Sclerophyllia,* has an epitheca, a feeble columella, and the septal teeth on the most exsert portion of the septa fused into a large single or double lobe. *Homophyllia* Brueggemann 1877[9] has slightly smaller and more regular dentations, a strong columella, and is evidently the early stage of *Lobophyllia* (Indo-Pacific). *Rhodocyathus* Bourne 1905[10], founded upon a single specimen from Trincomalee, Ceylon, has all the characters of *Cynarina,* except that an epitheca is not developed. Bourne's holotype (in the Herdman Collection, Liverpool University) is abnormal in that it became detached from its basal attachment early in life and the edge-zone extended the costæ over the broken part. The writer has seen other specimens of *R. ceylonensis* (in the British Museum, from a depth of 44 fms., Macclesfield Bank, China Sea) which had remained fixed. *Protolobophyllia* Yabe and Sugiyama 1935[11] was recently created to include solitary mussoids of fairly large size resembling *Acanthophyllia* but subcylindrical with a broad basal attachment, well-developed epitheca, and smaller septal teeth, evidently the monostomatous stage of *Lobophyllia.*

Summarizing the genera of the mussoids dealt with above we have:

Solitary:

Antillia Duncan. Miocene, West Indies.

Acanthophyllia Wells. Miocene, Europe. Recent. Philippines.

[7]Korallenth. Roth. Meer., iii, 4.
[8]*Ann. Mag. Nat. Hist.*, xx, 305.
[9]*Op. cit.*, 310.
[10]Report on the Solitary Corals. *Roy. Soc. Rep. Pearl Oyster Fishing*, iv, 191.
[11]*Jour. Geol. Soc. Japan*, xlii, 382.

Colonial:

Syzygophyllia Reuss. Miocene, Europe.

Mussa Oken. Recent, West Indies. Monostomatous stage: *Scolymia* Haime (*Lithophyllia* E. & H.).

Lobophyllia de Blainville. Recent, Indo-Pacific. Monostomatous stage: *Protolobophyllia* Y. & S. *Homophyllia* Brueggemann. Neogene-Recent. Indo-Pacific.

Symphyllia E. & H. Recent, Indo-Pacific. Monostomatous stage: *Sclerophyllia* Klunzinger, *Cynarina* Brueggemann, *Rhodocyathus* Bourne. Recent, Indo-Pacific.

ANTILLOCYATHUS, gen nov.

Placocyathus Duncan 1863. *Q. J. G. S.*, xix, 437.
Placocyathus Duncan 1864. *Q. J. G. S.*, xx, 22-25.
Placocyathus Vaughan 1925. *Bull. M. C. Z.*, lxvii, 317-320.
Placocyathus Vaughan 1926. *Carnegie Inst. Wash., Pub.* 344, 114.
non Placotrochus Edwards & Haime 1848. *Ann Sci. Nat. Paris*, (3), ix, 327.
non Placotrochus Duncan 1863. *Q. J. G. S.*, xix, 438.
non Placotrochus Edwards & Haime 1848. *Ann Sci. Nat. Paris*, (3), ix, 282.

Genotype.—*Placocyathus maoensis* Vaughan 1925. (*op. cit.*, 317, pl. 1, figs. 3-10). Miocene, Cercado de Mao, Dominican Republic. (Holotype, U. S. Nat. Mus., No. 353644).

Diagnosis.—Like *Caryophyllia*, but with the longer axis of the calice considerably extended with subsequent compression and elongation of the columella which appears sublamellar.

Remarks.—The genotype of *Placocyathus* Edwards & Haime is *P. apertus* E. & H.[12], selected by the original authors in 1850[13].

The holotype of *P. apertus* is in the Collection Edwards of the Museum National d'Histoire Naturelle (Paris) where it was examined by the writer in 1934. It is a badly preserved specimen of a recent coral without definite locality, appearing as described by Edwards & Haime but lacking pali (a few broken

[12] *Ann. Sci. Nat. Paris*, (3), ix, 327, pl. 10, fig. 10. 1848.
[13] *Brit. Foss. Cor., Introd.*, xvi. 1850.

fragments of the septa look like pali). The columella is a laminar sheet attached to the inner ends of the septa by processes. In every respect it is identical with the type species of *Sphenophyllia* Moseley,[14] *S. flabellum,* the holotype of which is in the British Museum (N. H.) (No. 80. 11, 25.104), and which is also from an unknown locality. Both of these type species, the writer concluded after comparison, are based upon young monostomatous specimens of the well-known Caribbean coral *Meandrina meandrites* (Linn.),[15] the earliest stages of which very strongly resemble the adult form of the late Cretaceous and Paleogene genus *Placosmilia,* with which *Meandrina* is associated in the family *Pachygyridae.*

Of the other West Indian Tertiary forms placed in *Placocyathus* by later authors, some are *Antillocyathus* while others are in all likelihood species of *Meandrina.* Those certainly belonging to the former are *P. variabilis* Duncan,[16] *P. cristatus* Vaughan[17] and *P. trinitatis* Vaughan[18].

Two species which probably belong in *Meandrina* are *P. barretti* and *P. costatus* Duncan.[19]

Another genus which has been incorrectly identified as occurring in the West Indian Tertiaries is *Placotrochus,* the type species of which is *P. laevis* Edwards & Haime, a recent form from the Indo-Pacific differing from *Flabellum* only by the presence[20] of a lamellar columella. Duncan's *Placotrochus alveolus* of the Jamaican Miocene is definitely a species of *Meandrina.*

[14]Moseley, H. N. "Challenger" Zool., ii, 182. 1881.

[15]Another species which is probably the young of *Meandrina brasiliensis* (E. & H.) is *Flabellum braziliense* Pourtalès 1874 (*Cat. Mus. Comp. Zool. Harvard,* viii, 38, pl. 6, figs. 16, 17).

[16]Duncan, P. M. *Q. J. G. S., xx,* 22, pl. 2, figs. 1a-1c. 1864.

[17]Vaughan, T. W. & Hoffmeister, J. E. *Bull. Mus. Comp. Zool.,* lxvii (8), 319, pl. 1, figs. 11-14. 1925.

[18]Ibid. *Carnegie Inst. Wash. Pub.* 344, 114, pl. 1, figs. 3, 4, pl. 2, fig. 9. 1926.

[19]Duncan, P. M. *Q. J. G. S.,* xix, 438, pl. 16, figs. 1a-1c. 1863. Duncan, P. M. *Q. J. G. S.,* xx, 24, pl. 2, figs. 3a, 3b. 1864.

[20]*Op cit.,* 1863, 438, pl. 16, fig. 2a, 2b.

ARCTANGIA, gen. nov.

Genotype.—*Thecocyathus nathorsti* Lindstroem 1900[20]. Lower Cretaceous (Neocomian). King Charles Island, east of Spitzbergen.

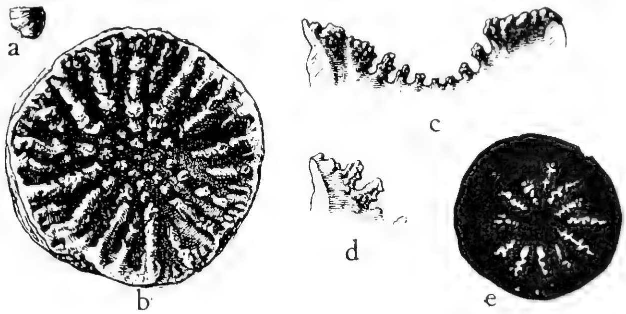


Figure 2. *Arctangia nathorsti* (Lindstr.)
a. Corallum, x1. b. Calice, x8. c. Vertical section along a primary septum, x8. d. Tertiary septum, x8. e. Transverse section near base, x8 (After Lindstroem).

Diagnosis.—Simple astrangid, irregularly turbinate, small, fixed by a small base. Wall epithecal, non-costate, internally thickened by stereoplasm. Septa non-exsert, uniting, all irregularly dentate, the dentations subspinose. Columella parietal, formed by inner ends of the septa, upper surface composed of papillae merging with inner septal dentations. Endotheca present but sparse.

Remarks.—The members of the Astrangiidae as a rule form reptoid, cerioid or plocoid colonies, and the new genus is the only one, so far as it is known at present, that is strictly solitary in habit. Its nearest relationships are with *Rhizangia,* a genus ranging from the Upper Cretaceous into the Miocene of Europe. *Rhizangia,* however, formed reptoid colonies of low corallites united by permanent calcareous stolon-like expansions of the edge-zone under which the epitheca was lost. *Cryptangia* (Miocene-Pliocene, Europe) is another genus which may be related to *Arctangia,* but although the individual corallites closely resemble

[20]Lindstroem, G. On Thecocyathus nathorsti n. sp., a Neocomian coral from King Charles Land. *Kongl. Vetenskaps-Akad. Förhandl.* 1900. No. 1, 7-12, text figs. 1-8. Stockholm. 1900.

those of the latter, they are always imbedded in a mass of the bryozoan *Cellepora.* Individual corallites of the living Indo-Pacific genus *Culicia* resemble those of *Arctangia* in size and shape, but the septa of the first cycle have smooth, non-dentate margins.

Arctangia is the oldest genus of the Astrangiidæ now known and represents the simple type, probably of thecocyathid origin, from which the later colony-forming members of the family, through *Rhizangia,* arose as a result of the development of a more or less permanent edge-zone.

DOMINICOTROCHUS, nov. gen.

Genotype.—*Smilotrochus* ? *dominicensis* Vaughan 1925. Miocene. Dominican Republic. (Holotype, Mus. Comp. Zool., Harvard, No. 9266, Gabb Coll.).

Diagnosis.—Small, cuneiform, free. Wall septothecal, solid, costate, non-epithecate, the basal costæ of the longer calicular axis alately expanded. Septa thin, non-uniting, slightly exsert. Columella absent. No endotheca.

Remarks.—Vaughan in his description of *S.* ? *dominicensis*[21] noted that the generic identity of this coral was doubtful. The genotype of *Smilotrochus, S. tuberosus* Edwards & Haime, from the Albian greensand of Blackdown, Devonshire, resembles the Dominican species somewhat in shape, but is larger, with more septa, more acute costæ and no alate costæ, and with more or less endotheca. *Smilotrochus* belongs to the sub-family *Parasmiliinæ,* whereas the present form is undoubtedly a turbinolid closely related to *Platytrochus* and *Sphenotrochus* but lacking the well-developed columella of these genera.

Flabellum ? *merriami* Nomland[22] of the Tejon Eocene of California is certainly no flabellid, as evidenced by the costæ and septotheca, and may prove to be a second species of *Dominicotrochus.*

[21]Vaughan, T. W. & Hoffmeister, J. E. New Species of Corals from the Dominican Republic. *Bull. Mus. Comp. Zool.,* lxvii (8), 316, pl. 1, figs. 1, 2. 1925.

[22]Nomland, J. O. Corals from the Cretaceous and Tertiary of California and Oregon. *Univ. Cal. Pub., Geol.,* ix, 62, pl. 3, figs. 1-4, pl. 4, fig. 17. 1916.

NEFOPHYLLIA, nom. nov.

Platysmilia Felix 1899. *Zeitschr. deutsch. geol. Ges.*, li, 387.
non Platysmilia Toula 1889. *Denk. Ak. Wiss. Wien.*, lv, 83.

Genotype.—*Placosmilia angusta* Reuss 1854. Upper Cretaceous (Turonian). Gosau (Upper Austria), Austria.

Diagnosis.—Like *Placosmilia* but forming subphaceloid colonies by extratentacular budding.

Remarks.—The new *Nefophyllia* (from the Nefgraben, in the Gosau district) is proposed to replace *Platysmilia* Felix which was preoccupied by *Platysmilia* Toula[23], the latter being applied to a stylinid coral probably identical with *Stylina.* The name *Platysmilia* was first used by de Fromentel in 1873 for a hypothetical genus[24], but this usage was invalid and Toula's name has priority.

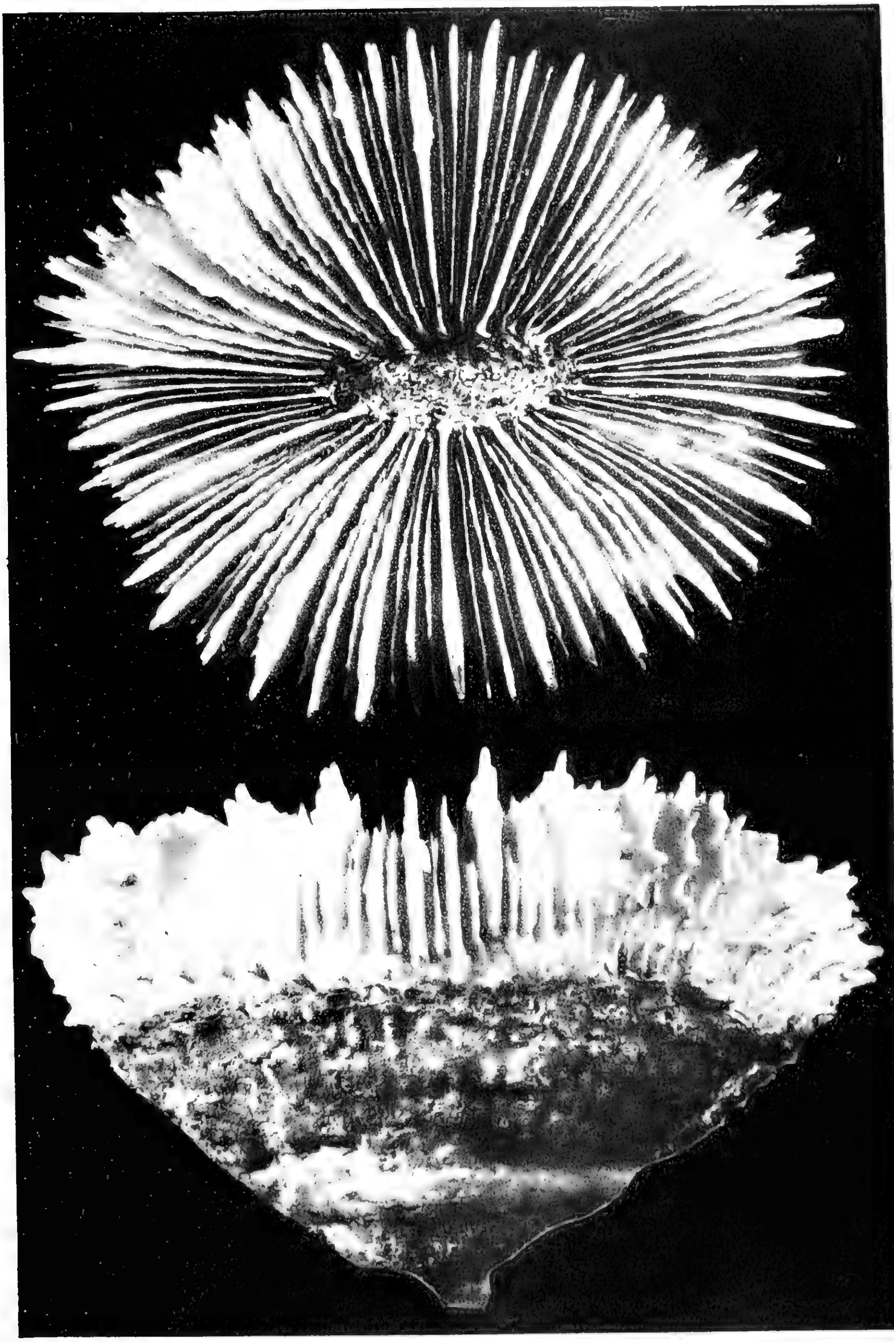
Nefophyllia is the only genus of the Pachygyridæ, with the exception of the solitary forms *Placosmilia* and *Flabellosmilia,* that did not form elongate or meandroid corallite series by intramural intratentacular budding.

[23]Toula, F., *Denk, Ak. Wiss. Wien,* lv, 83, 1889.
[24]Pal. franc., Terr. crét., viii, 418.

EXPLANATION OF PLATE 2

Acanthophyllia deshayesiana (Michelin) 1850. Page 8

Calicular and lateral views of homeotype specimen in the United States National Museum from Sanguisiapo I., Sulu Archipelago, 9 fathoms depth, 9/10 natural size.



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