Scotch Bonnet

NOVEMBER, 1971

NORTH CAROLINA SHELL CLUB BULLETIN

NUMBER 6

MRS. ELIZABETH TATE MATHEWS (1901 — 1971)

"Her interest in shells what kept her alive in these last years," Robert H. Tate said soon after the funeral of Mrs. Elizabeth Tate Mathews.

Mrs. Mathews, former treasurer of the North Carolina Shell Club and the 1970-71 vice-president, died on March 2, 1971. She suffered a stroke earlier the day before while her daughter was visiting and was rushed to New Hanover Memorial Hospital. (The stroke paralyzed her reflexive breathing mechanism and she died swiftly.)

Lib Mathews, as she was affectionately called by her friends and Shell Club members, was born in Pender County on January 7, 1901. She was the daughter of T. Hunter and Mary Tate. She came from a long line of Presbyterian Church leaders and was a member of First Presbyterian Church in Wilmington, where her funeral was held on March 4th.

Up until her death, she had been a bookkeeper with Horton Iron and Metal Co.

She had a son, Donald E. Mathews of Wilmington; four grandchildren and a great grandchild, who survive, along with Robert H. Tate, her brother.

Her interest in shells started about 1952, according to Miss Elizabeth (Lib) Grady, who lived around the corner from her in Wilmington.

"She was on the beach on weekends and picked up shells", Lib Grady recalls. "She was curious about them and found the books to identify them."

From this interest grew one of the better collections of North Carolina and world wide shells. In just about every contest held by the Shell Club that featured shell displays, one of her exhibits won top recognition.

Apparently having some influence on her reference selection and scientific method of study of her hobby was her next door neighbor in Wilmington, Fred S. (Teddy) Burr. His collection was largely accumulated through the trade and purchase of fine shells from other collectors, although there was some friendly rivalry sometimes between Lib and Teddy on the identity of some of the shells in his displays.

Lib Grady and Lib Matthews pooled their interest in shells and shared the work of collecting, cleaning and identifying the shells. They also spent many hours identifying a collection of shells obtained in the South Pacific by a GI for later distribution to Shell Club members.

Both also had ailing mothers who accompanied them on these shell-collecting trips and Shell Club meetings. Mrs. Tate died a few years ago.

Lib Mathews joined the Shell Club soon after it was formed in 1957, although she was not a charter member. She was elected treasurer in 1964 and re-elected to the post until 1970, when she asked to be relieved of the growing responsibility.

During her tenure in office, the Shell Club grew from a few score members to more than 200. And it remained prosperous on the minimum $1 annual dues - - certainly a tribute to a treasurer.

While the Shell Club and her interest in shells did "keep her alive," as her brother put it, she put into the organization a whole lot more than she took out. Her loss to the Club was a serious one and will be felt for many years.

— Paul Jennewein —

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PRESIDENT'S MESSAGE

Walter Lowry

The NORTH CAROLINA SHELL CLUB continues to grow in membership and in activities. The people who preceded me in the office of president have all been contributors to this growth. Many members who have never held any office other than being on a committee have also been instrumental in the progress of the Club. Other members who have just joined this year are already adding their thoughts and help in making our club more interesting, educational, stimulating, and satisfying.

We are fortunate in having many knowledgeable shell collectors in our club who are more than willing to help with difficult identifications, collecting, cleaning, displaying, and the study of molluscs. There is no better opportunity for beginners to grow in their enjoyment of the hobby of shell collection and study than to join and take part in the activities of the club. Some of our members are quite well known in their professions. Many of our members are in professions that are either actively engaging in the study and research of molluscs or in a profession that includes the study of molluscs. When on field trips or at meetings or shell shows, however, these members seem eager to help those of us who are amateurs and have trouble deciding whether a shell belongs to one sub-species or another.

The common interest we have makes everybody seen related in a special way and adds a friendliness that is lacking in many clubs.

The meetings are relaxed with just the minimum of form that is necessary to keep them from dragging.

Our committees, listed separately in this bulletin, have done an outstanding job this year. Arrangements for all meetings and field trips have been very adequate. Programs have been most interesting and the Shell Show was more than we had hoped for in this first attempt. We were also gratified by the number of visitors at the show. A shell slide program for the use of other groups at their meetings has been established at the State Museum of Natural History.

The North Carolina Shell Club can be worth to you whatever you decide you want it to be worth. The more you take part in the meetings, the field trips, the discussions, committee work, shell shows, programs, and other activities of the club, the more the club will be what you want it to be.

We can get so tied up with our work and routines that like "Jack" we get to be dull boys. You can relieve this bored feeling by getting out with the "In Crowd" The NORTH CAROLINA SHELL CLUB.

A SHELLER'S PRAYER

Walter Lowry

Dear LORD, we thank thee for the beauty of thy creation
For creatures with designs beyond our imagination
For Oceans, reefs, rocky shores, mud flats and beaches
For the beautiful shells within our puny reaches

Help us to overcome our tremendous greed
That we may take only the shells we need
And leave most of your delightful creatures
For others to note their artistic features

We thank thee that some are plentiful and some rare
The harder one is to get the more we seem to care
We thank thee for our insatiable curiosity
And for thy great unlimited generosity

We thank thee for others with whom we can share
The charm of the scallop, the cone, the sea hare,
The cowry, the conch, the auger, the jewel box,
The shells we find on the beach and on the rocks

We thank thee most of all for serenity of the soul
We find on a lonely coast or solitary sandy shoal
Thy goodness and mercy continue without end
Please accept our thanks and humble praise, Amen.

NORTH CAROLINA SHELL CLUB

CONSTITUTION

(As revised to date)

This club shall be called THE NORTH CAROLINA SHELL CLUB.

MEMBERSHIP shall be open to any persons interested in the collection of shells or the study of Malacology. New members may be received by consent of the club at any regular meeting. ANNUAL DUES for Adults shall be $1.50, For JUNIOR MEMBERS, $.50. Junior membership shall include all individuals of grade school age or younger. SUSTAINING MEMBERSHIPS are offered at $5.00 and SPONSORING MEMBERSHIPS at $10.00. Those members three or more years behind in their dues shall have their membership terminated after due notice.

HONORARY MEMBERSHIPS may be granted by a majority vote of the members present at a meeting following recommendation by the executive committee. Honorary members will not be eligible to hold an elected Shell Club office, vote, or be required to pay dues.

The following OFFICERS shall be elected annually, by ballot on the last meeting of the year: President, Vice-President, Secretary, and Treasurer.

An EXECUTIVE COMMITTEE shall consist of the above officers, all past presidents, and one member who shall be elected annually. It shall be the duty of the Executive Committee to arrange programs for the meetings and supervise the affairs of the club.

The constitution may be altered by a majority vote of the total membership at any regular meeting, but written notice shall be given for any proposed change.

NORTH CAROLINA SHELL CLUB BULLETIN , 1971 No. 6

Elizabeth Tate Mathews, Edition

Editor - Hugh J. Porter
Committee: Walter Lowry, Carl and Janet Truckner

	1970 Officers	1971 Officers
President	Mr. Hugh J. Porter	Mr. Walter Lowry
Vice-President	Mr. Walter Lowry	Mrs. Elizabeth T. Mathews
		Dr. Douglas Wolfe
Secretary	Mrs. Ruth S. Dixon	Mrs. Ruth S. Dixon
Treasurer	Mrs. Elizabeth T. Mathews	Mrs. Janet Truckner
Historian	Mrs. Charlotte Johnson	Mrs. Charlotte Johnson
Executive Committee Members at Large		

	1970 Schedule	1971 Schedule
Feb. 20 - 22	Myrtle Beach, S. C.	March 13 Chapel Hill, N. C.
May 22 - 24	Wrightsville Beach, N.C.	May 14-15 Nags Head, N. C.
Sept. 24-26	Atlantic Beach, N. C.	Oct. 1-3 Atlantic Beach, N. C.
Dec.	Raleigh, N. C.	Nov. 12-14 Myrtle Beach, S. C.

Additional Field Trips

April 18	Cape Lookout	May 1	Silverdale Marl Pits
July 25	Lake Waccamaw	Sept. 18	Bear Island (Hammocks Beach State Park)

Editor's Note: On March 2, 1971 the North Carolina Shell Club lost one of its treasured members - Mrs. Elizabeth Tate Mathews. The club, in recognition of her long time interest and service to the club, resolved at its May 15th meeting that this bulletin be dedicated in her memory.

NORTH CAROLINA SHELL CLUB

1971

COMMITTEES AND ASSIGNED RESPONSIBILITIES

PROGRAMS

Hugh J. Porter, Chairman
Miss Marguerite Thomas

MEETING ARRANGMENTS

Mrs. Cornelia G. McInnes, Chairman
Paul Jennewein
James Wadsworth

FIELD TRIPS

Dr. Douglas A. Wolfe, Chairman
William L. Hammnet
Mrs. Dorothy Beetle
Miss Phoebe Meadows
Edward McGowen

JUNIOR MEMBER ACTIVITIES

Mrs. Douglas (Sally) Nunnally, Chairman
Mrs. Hugh J. (PINKY) Porter
Mrs. C. W. (Janet) Truckner
C. W. Truckner

PUBLICATIONS

Hugh J. Porter, Chairman
C. W. Truckner, Editor
James Wadsworth
Mrs. Ruth Dixon

EDUCATION

Dr. John H. Ferguson, Chairman
Dr. Jack B. Upchurch
William L. Hammnet

PUBLICITY

Paul Jennewein, Chairman
Mrs. E. H. (Lucy) Piper
Mrs. K. L. (Charlotte) Johnson

MEETING REGISTRATION

Mrs. W. G. (Nelle) Lowry, Chairman
Mrs. F. L. (Lucille) Crawford

SHELL SHOW

Mrs. K. L. (Charlotte) Johnson
Wade G. Brown

SHELL AUCTION

James Wadsworth, Chairman
Mrs. H. G. (Pinky) Porter
Wm. Roger McLean

PHOTOGRAPHER - Paul Jennewein

HISTORIAL - Mrs. K.L.(Charlotte) Johnson

LITERATURE - Miss Marguerite Thomas

DOOR PRIZES - Wade G. Brown

North Carolina Shell Club

Financial Statement

May 14, 1971 - October 1, 1971

BALANCE ON HAND May 14, 1971	$ 766.72	
Dues Collected 5/14/71-10-1/71	87.00	
Total Receipts		$ 853.72
DISBURSEMENTS:		
Guest Speaker- Nags Head	$ 8.24	
Stamps - roll 500	40.00	
Total Disbursements		$ 48.24
BALANCE ON HAND		$ 805.48

North Carolina National Bank	$ 795.73
Cash on hand	9.75
Balance	$ 805.48

Respectfully submitted,

Mrs. Janet Truckner
Treasurer

NORTH CAROLINA SHELL CLUB ACTIVITIES - 1969 - 1971

The following new officers assumed their duties at the Spring meeting in 1969: Hugh J. Porter, President, Walter Lowry, Vice-President, Elizabeth Mathews, Treasurer, and Ruth Dixon, Secretary.

The meetings for the year were: Spring session, March 14-16th, at the Chesterfield Motel, Myrtle Beach, South Carolina; Summer, May 23-25, at Wrightsville Beach, North Carolina; Fall, October 17-19, at the Oceana Motel at Atlantic Beach, and the Winter meeting, December 6th at the North Carolina Museum of Natural History in Raleigh. The President, Hugh Porter, scheduled an extra outing with no formal meeting on March 29th. This early Spring boat trip on the Diamond City to Cape Lookout was attended by about 40 shellers who braved the chilly weather.

During the year Dr. John Ferguson held Work-Shops, assisted by Dr. Jack Upchurch, who illustrated with slides covering the Families, Trochidae (Top Shells), Stroma-tellidae (Wide-mouth shells), Turbinidae (Turban, Star and Lictid Wheel shells), Skeneidae and Orbitestellidae. These families were represented by shell displays.

The Club was honored to have the following speakers for the year: March: Mr. Richard Petit who spoke on his 10-day research in the British Museum describing the manner in which the museum displayed shells, "The Role for Amateur Plays", and "Current Literature." May: Mr. Mike Vaughn, Conservation Commissioner, spoke on Conservation of our marshlands and of our State purchasing such areas as Masonboro Island. He suggested preserving the marshlands and making this area a State Park. Carl Withrow, a member who has retired to Florida, brought information from the St. Petersburg Shell Show suggesting that we begin on a small scale in having our first shell show. Carl had just received First Place in the category, "Best display of any one Genus for his Lambis exhibit (Strombidae-spider conchs) and honorable mention in the Smithsonian Award (the Show's top award). Slides of a Nova Scotia trip were shown by Nell and Walter Lowry and of a Virgin Island trip by Nancy and Wade Brown. December meeting: Charlotte Hilton Green, staff member of North Carolina Wild Life Magazine, spoke on "Her trip with a group of scientists on the ship, Romantica, to the Galapagos Islands. Her talks was illustrated with slides and shells from that area. Mr. Bill Hamnett, Head of the North Carolina Museum of Natural History, and a Shell Club member, described a new plan for displaying North Carolina shells that will be completed soon in the Museum.

Miss Marguerite Thomas, Chairman of Current Literature, discussed and displayed the following new shell books: "She Sells Seashells" by Veronica P. Johns, "Oceans Magazine" and the "Japanese Shell Book", "Marine Shells of South Africa for Beginners", 'Mollusks" by Paul Bartch" and the "National Georgraphic" shell issue.

The first Shell Auction was held at the October meeting at Atlantic Beach with Walter Lowry serving as Auctioneer and netting $210.75. The Treasury was not only swelled, but the members had a good time and also required some new shells to add to their collections.

During the year, the members voted Life Memberships to Charter Members: Rev. Scott Turner, who was the first President and also to Mrs. J. E. Rice (Sada) who is 89 years old.

Also, a Junior member, Diane Truckner, told of an interesting project in which she and Jimmy, her brother, donated 37 different specimen shells to the Brodgen Junior High School Library (North Carolina Library) and helped correct some of the erroneous identifications.

With the rising costs of postage and etc., it was voted at the October meetint to increase the dues for adults to $1.50 with no change in Junior memberships. Two new classes of memberships were established as follows: Sponsoring Membership, $10,00 and Sustaining Membership $5.00

Field trips were included at the Spring, Summer and Fall meetings to Masonboro Island, Fossil beds at Myrtle Beach, S. C., Cape Lookout and Radio Island. Shell door prizes were given to the lucky winners at each meeting.

At the Annual meeting in December it was voted to have the same slate of officers for 1970.

In 1970, the President, Hugh Porter, along with the officers and commitees, continued to make the meetings enjoyable and educational.

The Spring meeting was held at Myrtle Beach, South Carolina on February 20-21 instead of March due to competition with the Canadian golfers; the Summer meeting at Wrightsville Beach, May 20-21; the Fall meeting at Atlantic Beach at the Oceanana Motel, September 25-26 and the Winter meeting at the North Carolina Museum of Natural History in Raleigh, December 3, 1970.

Dr. John Ferguson held a Workshop in February which was a Slide-Illustrated Shell Quiz, and in December his program was on the Family Neritidae and Littorinidae (the Periwinkles).

The following persons spoke at our meetings in 1970: Mr. Abue spoke briefly on his Fossil Treasures which he displayed. He had found these at Myrtle Beach, Wyoming, Florida, and other areas. Ann McCyary, University of North Carolina at Wilmington, spoke on "Invertebrates". She was a very enthusiastic and interesting speaker and had a group of living marine animals she had collected to illustrate her talk. Mr. Charles W. Kellog, doctoral candidate at the Duke University Marine Laboratory at Beaufort, spoke on "Hermit Crabs and Sea Shells."

Wade Brown showed slides of Key West, Florida and the Florida Keys, nature trails, Everglades National Park, etc. Hugh Porter also showed slides taken at the American Malacological Union meeting in Key West, Florida, and Ruth Dixon spoke on her trip to Grand Cayman Island, illustrated with slides and displays.

In connection with each meeting, field trips were made to the Fossil Beds and Murrel's Inlet at Myrtle Beach, S. C., Masonboro Island at Wrightsville Beach, Cape Lookout, Radio Island and Scallop piles.

In July following the A.M.U. and under the leadership of Dr. David Stansbury from Ohio, the members traveled to Lake Waccamaw for the best Fresh Water shelling trip that we have ever had. Dr. Stansbury described to the shellers exactly what type of shells would be found. Lake Waccamaw has the largest number of Niad species in North America.

Another Shell Auction was held in September netting the club Treasury $122.00.

Current Literature Chairman, Marguerite Thomas, reviewed and displayed the following books: "Olive Shells of the World" by Zeigler, "Rare Shells of the World", "Chitons of the West Coast" by Glenn and Laura Burghardt, "Shell Life and Shell Collecting" by Sonia B. Murrary, "Life and Death of the Salt Marsh", by John and Mildred Teal, "Atlantic Monthly Press Board",by Little & Brown Co,, "The Beachcombers Handbook","Florida Marine Shells", "Collecting Seashells",by Kathleen Johnson, "Spanish Seashell Book," "The Remarkable Creature - the Snail for Juniors," "The Shell," by Hugh and Margaret Stix and R. Tucker Abbott, and "The Living Volute."

At the December meeting in Raleigh, the Upchurch Memorial Shell Collection donated by the members of the N. C. Shell Club, was viewed by many of the club members.

This being the Annual meeting, the following officers were elected to serve in 1971: President, Walter Lowry; Vice-President, Mrs. Elizabeth Mathews; Treasurer, Mrs. Janet Truckner, and Secretary, Mrs. Ruth S. Dixon. The Executive Committee consists of the present officers, Past Presidents, Bill Hamnett and Dr. John Ferguson.

There were approximately a hundred new members added to the roll this year as a result of the article by Charlotte Hilton Green in the N. C. Wildlife Magazine.

March 13, 1971 in Chapel Hill, the new officers assumed their duties under the leadership of Walter Lowry, President. The members of the Club had been saddened since the December meeting by the death of the Vice President, Mrs. Elizabeth Mathews.

Dr. John Ferguson held a Workshop describing and illustrating the Families, Architellidae or Solarlidae (Sundails), Mathildidae and Turritellidae (Screw or worm shells). Shells were on display representing the families studied. Dr. Frank Thomas from the N. C. State University at Raleigh, N. C., spoke on his Sabbatical leave which he spent in Hawaii to set up a new Seafood Program. His talk was illustrated with slides of the beautiful Hawaian Islands. Dr. Douglas Wolfe had charge of a fresh-water field trip to the University Lake. Many members braved the cold temperature of the weather and water.

The Carl Truckner family presented to the Club stationary that he had designed and printed with a Scotch Bonnett.

A Fossil Field Trip preceded the Summer meeting to Silverdale, N. C. where several rare fossils were found.

The Summer meeting was held at Nags Head, May 14-15, 1971. Dr. Vince Bellis, Professor of Marine Science at the East Carolina University, spoke at the dinner on Saturday evening. He described the Marine Science program at Manteo and the work that was being done there. Dr. John Ferguson held a Workshop and spoke on the Families, Nuculidae (including Nut shells) and Solemyacidae (Awning shells). This was illustrated with slides and the display of shells. A presentation was also made by Hugh Porter.

Dr. Doug Wolfe led a Field Trip to Bear Island off Swansboro, N. C. on September 18th. The members had a delightful time.

About 57 members attended the Fall meeting, October 1,2,3, in spite of Hurricane Ginger which had just gone through the Morehead area.

Our First Shell Show was held on Saturday afternoon at the N. C. Institute of Marine Sciences. Fifty-four registered at this event. The details are given in another report.

Mr. Dale Stingley, Volunteer Executive Advisor, spoke at the Saturday evening meeting on his trip to Sumatra, Indonesia, and around the world, but mainly Sumatra. He was handicapped in his shell collecting by the poisonous sea snakes. He managed to collect quite a few specimens, some of which he donated to our Shell Auction.

We had another spirited Shell Auction which netted the Club $125.00.

We feel that our Club is on the move and increasing in membership and knowledge.

PHYLUM BRACHIOPODA (LAMP SHELLS)

Marguerite Thomas

The Brachiopoda are marine animals living within two approximately equal calcareous shells. They are usually attached to some object by a muscular stalk called the peduncle. Because of their shell they were long regarded as mollusks. The valves of the shell, however, are dorsal and ventral instead of lateral as in the bivalve mollusks. The name "lamp shell" refers to the resemblance of the shells to the oil lamps of the early Romans.

The name brachiopod (from the Greek, "arm-foot") was first proposed by A.M.C. Dumeril in 1806 when he assumed that the brachia were locomotive organs like the molluscan foot.

These little marine animals are found throughout the oceans of the world but are much more rare today than in the past. In Japan and the Philippines some species are used for food. Several species are known in American waters, the majority being shallow water dwellers but some range into deep water.

Lingula (from the Latin, "lingula" a little tongue) which is found in the Pacific and Indian Oceans is the oldest living genus of animals and has come down thought the ages with practically no change. Of the 30,000 fossil species of brachiopods which have been described perhaps about 245 representing 73 genera are living species today. All are marine and are remnants of a great population occurring literally by the millions as preserved fossils in rocks of many ages dating from Cambrian times to the present and very useful to geologists in determining the age of certain strata.

Brachiopods are of two main types; the articulates, in which the two shells are hinged together: and the inarticulates, in which the hinge is absent. Within the shell is a conspicuous structure, the lophophore, which consists of two coiled ridges called arms. These arms have ciliated tentacles through which food is drawn into the mouth.

The species Glottidia albida (from the Greek, "glottikos" of the tongue) is found on both shores of North America and is a sand-dwelling form that lives in vertical burrows with the peduncle extending downward for several inches.It moves by wriggling the peduncle and feeds on planktonic material. This is a hinged species. Posteriorly the shell tapers to a beak with the swollen umbo in front of the beak. The mantle secretes the shell by successive additions at the anterior margin.

Several members of the North Carolina Shell Club found Glottidia albida alive in shallow water near the rocks at Myrtle Beach, South Carolina on February 21, 1970. These were preserved in alcohol.

1. Life: an Introduction to Biology. George G. Simpson. 2nd ed. Harcourt.1965
2. Encyclopedia Britannica 1970

AN INTRODUCTION TO THE BIVALVES

Dr. John H. Ferguson

University of North Carolina, Chapel Hill

In 1758, Carl Linnaeus introduced the Latin term *Bivalvia* (English: Bivalves) for Mollusks whose shell comes in two pieces, namely, a right and a left valve, respectively. Based on the priority of Linne's name, the term Bivalvia is being revived for this big class of Mollusca, although a majority of of modern scientists have long preferred Goldfuss' 1820 term Pelecypoda (meaning: 'the hatchetfooted ones'). Others use de Blainville's 1824 name Lamellibranchiata (that is, 'with layered gills'), and a few refer to them as Acephala or 'the headless ones." Each of these names is based on some significant common feature, but none of them is entirely satisfactory. Even the two-valve idea is not wholly unique to this class. There is a two-part shell on the snail like Japanese *Julia (Prasina) japonica* Kuroda. Family (319) *Juliidae* and the special Super family (LXXXIV) *Juliacea* are now put in the class *Gastropoda* (Gastropods, or 'the belly-footed ones') and are wholly removed from the Pelecypods. Obviously, we must take the whole animal, not just its shell, into account. In true *Bivalvia*, it is the way in which the valves are formed and joined together which is of the utmost imprtance, and this will be detailed later. The name Pelecypoda refers to the typical hatchet-shaped digging foot, which is nicely illustrated in the little live Carolina coquinas (*Donax (Serrula) variabilis* Say). Exposed at the edge of a receding wave, they quickly burrow back into the sand. At their rear end are two siphons, to which we'll return later. At the front end and below (*ventrally*), the sharpened hatchet edge of the foot helps to displace the sand. By outward wriggling of the edges and with a sudden inrush of blood into the foot, the advancing end swells up to anchor itself in the substratum (sand, mud, etc.). Finally, the foot muscle contracts rapidly, and, since the end is anchored, this pulls down the body and shell over the buried part of the foot. By quickly burying itself in this way, bivalves escape from many enemies (including shell-collectors!) Shallow burrowing also helps it to find food. The food of the Nut Clams (which will be in the systematics covered in this article) is expanded and flattened at the end, but this is not for crawling, and is merely to help in digging, as we have described. A bivalve must not remain completely buried, since it needs to pass water through the MANTLE CAVITY in order to breathe and to feed. The MANTLE is the membrane which manufactures the shell, besides doing other important things. It was mentioned in previous Bulletin articles (1966, No. 3, p. 13; 1968, No.5, p.10). It lines a large MANTLE CAVITY between the two valves of pelecypod mollusk. The popular word *Clam* is widely used for Bivalves, sometimes more-or-less specifically, as in the Nut Clams and the Awning Clams, which are covered in the present article. Among other examples, we could mention Surf Clams, Soft Clams, Hard Clams, the Pismo Clam, and many others, all needing the descriptive adjective. At other times, the term Clam is used in a very general sense, based on the way in which a living bivalve 'clams up', or clamps shut, by pulling the two hinged valves together. How this comes about, through the action of the ADDUCTOR MUSCLES, will be explained later.

How did bivalves evolve? In general, Bivalves are basically similar, especially in their main shell features. For this and other reasons it is difficult to work out evolutionary pathways, such as those for many gastropods, for instance. Many bivalve features seem to have appeared, disappeared, and reappeared, perhaps many times, in the course of what scientists call 'convergent' evolution. When no fossil remnants remain, we can only guess what evolutionary stages and intermediates (or 'missing links'), if indeed there were any. Many categories of FOSSIL bivalves were well-developed by the time of their first appearance in the geological record. We must presume, therefore, that the vanished precursor forms lacked any hard shell, and, of course, we wouldn't expect that the soft parts could have survived over the millions of intervening years. It's a good scientific guess that bivalves evolved, hundreds of million years ago, from some primitive molluscan ancestor, probably of a 'limpest'-like form, but without any calcified shell. It would, no doubt, have had a fleshy

MANTLE (or PALLIUM), able to secrete a cap-shaped forerunner of a 'shell', but made of soft CONCHIOLIN (see Bulletin No. 3, p. 13, 1966). To the underside of this would be attached the animal body, in a central mass, composed of a muscular (digging) foot, with certain supports for the various internal organs or viscera. VISCERA would include reproductive organs, a digestive tract, maybe a primitive heart and blood vessels, a nervous system, and gill-type water breathing structures, for which the scientific name is CTENIDIA (plural of CTENIDIUM, one for each side). CTENOS is Greek for a comb. Quite unlike the Gastropod Limpets (which were the subject of one of the N. C. Shell Club's earlier Workshops), our hypothetical Bivalve 'ancestor' particularly developed a special PALLIAL MUSCLE, consisting of a thin band of muscle fibers at the edge of the mantlefold, close to where the shell is secreted. In a typical modern bivalve, like the Warty Venus Clam (*Venus (Venus) verrucosa* Linne'), the PALLIAL LINE, for attachment of the pallial muscle, can be seen on the inside of each valve a short distance away from the ventral (or lower) shell margin. It runs in a curve between two embossed areas, which are the oval 'scars' for the attachments of the ANTERIOR (or front) and POSTERIOR (or back) ADDUCTOR MUSCLES. The MANTLE ISTHMUS is the central part, above (or dorsal to) the region where the mebrane reflects away from the foot and viscera. The mantle isthmus is concerned in the development both of the HINGE and of the ADDUCTOR muscles. Here, as we may appreciate, the pallial muscle runs across from one side of the original conchiolin shell to the other. By thickening and blending fibers together, the pallial muscle here comes to form two bands, one in front and the other behind the visceral mass at the mantle isthmus. These are the ANTERIOR and POSTERIOR ADDUCTOR MUSCLES, respectively. Since a bivalve lacks a well-defined head region, we may have a little difficulty in deciding which is 'front' (or anterior) and which is posterior (that is, to the 'back' or 'rear'). There are clear scientific clues in the anatomical details, however, as well as in some shell features (see Bulletin No. 5, p. 9, 1968). Returning to evolution, it is easy to visualize how a sustained contraction of the adductor muscles would cause the soft 'cape-like' shell to fold over sideways, from top to bottom (that is, dorso-ventrally) along a horizontal (or antero-posterior) axis, which will thus become the HINGE LINE. As the two valves are pulled together from the sides (or laterally), they enclose and compress the foot and central visceral mass. It now only requires lime deposition (or calcification) to occur separately in the two lateral areas of the primitive conchiolin to create the two VALVES (or half-shells) of the typical bivalve, as we know it in RECENT and FOSSIL forms. If we take the well-known Southern Hard Clam (*Mercenaria campechiensis* Gmelin), looked at from above, we see how the mid-dorsal ridge of conchiolin is left uncalcified and thus forms the HINGE LIGAMENT. When it can be seen from the outside of the closed shell, it is called the EXTERNAL (part of the) LIGAMENT, and this is typically located behind the central BEAK or UMBO (the plural is UMBONES). When just an INTERNAL LIGAMENT is present, it cannot be seen from the outside of the closed shell. Most of the internal ligament is specially secreted by the mantle ISTHMUS and, in some cases, it forms a separate bundle of more resilient (or elastic) conchiolin, which is called the RESILIUM. This is,well illustrated on the inside of a Soft Clam (*Mya (Arenomya)* arenaria Linne), where the resilium can be seen to occupy a special little spoon-like hollow called the CHRONDROPORE, which is centrally located just below the beak or umbo. Incidentally, the UMBO, in some (not all) cases, retains the embryonic 'first' shell, which is called the PRODISSOCONCH in bivalves and which corresponds to the PROTOCONCH in a gastropod. The chardropore and the resilium are present in some primitive present-day bivalves, like the Nut Clams (see below). They are not necessarily primitive structures, however, but have reappeared, much later in evolution, in such shells as the Surf Clams, the Spoon Clams, and again in the Soft Clam which we've just illustrated. Before going into the way in which the hinge works, we'll say something about the other soft parts, especially those concerned with breathing and with feeding. These two physiological functions, in bivalves, for the most part depend on water-currents which are produced by the lashings of myriad miscroscope hair cells are CILIA.

The anatomical features of a typical Nut Clam are simply illustrated in Fig. 14, p. 36, Vol. I of Wilbur and Yonge's "Physiology of the Mollusca." The FOOT extends down (ventrally and anteriorly) from the central body mass, between the ANTERIOR and POSTERIOR ADDUCTOR MUSCLES. Above it is the mouth (entry to the digestive tract) surrounded by special PALPS (or feelers). Projecting backwards into the upper and posterior part of the MANTLE CAVITY is the CTENIDIUM (or gill) on the right and on the left side. Ciliary water currents keep the gills and mouth from being clogged up by undesirable sediment, while moving water over the vital surfaces. Incurrent water comes in when the valves open (especially ventrally) and it flows up over the gill surfaces, so that oxygen can be taken in and waste carbon dioxide excreted into it as it passes upwards and outwards with the excurrent stream exit at the upper rear. The end of the digestive tract and openings for watery excretions and discharge of the reproductive cells are located near the exit region. Sorting ceiliary currents in primitive bivalves, like the Nut Clams, also carry selected food materials over the surfaces of palp feelers and over some of the gill filaments in order to pass into the mouth and digestive tract. All water breathing mollusks exchange oxygen and carbon dioxide via the special surfaces of gills and, in part, via other mantle surfaces. If we think about our own red blood and its iron-rich oxygen-carrying pigment hemoglobin, contained in special red blood corpuscles circulated all over the body, we may be interested to learn that some lowly bivalves, among which we may mention the Blood Ark (*Anadara (Lunarca) ovalis* Bruguiere) and its distant cousin the Ponderous Ark (*Noetia (Eontia) ponderosa* (Say) , also have red blood, although their red blood cells retain the nucleus which is lost in higher animals like ourselves. Some molluscs lack any repsiratory pigments,others have hemoglobin in solution in the fluid part of the blood (called 'hemolymph' or plasma'). A copper-containing blue pigment is found in some mollusks (and other invertebrates), but does not occur in bivalves, and, if present, it is simply dissolved in the hemolymph. Special provisions for separating the incurrent (or inhalant) and the excurrent (or exhalant) water streams are present in many bivalves. This may be illustrated by returning to our little live Coquinas (or Wedge Shells) and noting their INHALANT and EXHALANT SIPHONS. Siphons are made by a folding over of the mantle margins at the rear. They develop muscle coats which help them to extend and to retract, and the two tubes may come to be surrounded by a single muscle coat in some cases. Clearly, the siphons are most useful to enable the animal to breathe and feed while the main part of the body and shell are buried and concealed beneath the surface of the substratum, whether this be mud or sand or pebbles. We may return to the Soft Clam illustration for study of a large combined SIPHON, and if we again look at the markings on the interior of each valve, we may note that the pallial line of the mantle attachment must make a big bend to get around the siphon as this exits from the rear. This is what forms the so-called PALLIAL SINUS or bend in the pallial line, which because of the way in which it forms is obviously open posteriorly. The sinus opening, therefore, is a useful feature in orienting the shell valve, when a siphon is present. Whilst we are talking about orientation, we may also recall that the UMBO or beak, in a great many instances, tends to point forward (or ANTERIORLY). Of course, the HINGE LINE is dorsal (or upward) and the free edges of the valves open ventrally.

Let us now look into the hinge arrangements. The typical arrangement of the HINGE LIGAMENT in a Bivalve is such that, when the adductor muscles close the shell, this compresses the internal ligament, especially the elastic resilium, and often, when an external ligament is present, also stretches this. In both cases, the effect of any relaxation of the adductors is to cause the valves to gape open ventrally and at the front and rear ends. Not only does this happen during feeding and breathing, in life, but it also results when the adductors relax in death. If you are lucky enough to find both valves hinged together in a beach bivalve, therefore, you'll usually see that the valves are gaping to some extent. Much depends on the exact way in which the valves are brought together along the dorsal margin at what is technically termed the CARDINAL LINE. Here, in addition to the conchiolin hinge, a great many bivalves have developed some from or other of shelly HINGE TEETH. These

'teeth' are simply shelly ridges, alternating with hollows (dental sockets) into which fit the teeth of the opposing valve when the shell is closed. The patterns of hinge-teeth arrangements are among the best ways in which to classify bivalves scientifically. Since teeth are permanent shell features, these also apply to fossils, which, of course is not the case with some soft-part feature, like the gill-arrangements, for instance. Thus, the most primitive recent bivalves, which we'll systematize a little later, jave long been classified as PROTOBRANCHIA or with 'first' (in evolution) forms of 'gills'. Most recently, however, they are being grouped as PALEO TAXODONTA. 'Paleo" means ancient (in evolutionary lineage) and 'taxodont' means with similarly arranged teeth. As may be seen in the Nut Clams and their relatives, the 'taxodont' feature represents a series of teeth of more-or-less similar appearance all along the CARDINAL LINE, both behind and in front of a central CHONDROPORE in these particular bivalves. The PALEO-prefix serves to separate the 'ancient' group from more recently evolved bivalves, such as the Arks and Bittersweets, etc., in which the TAXODONT feature reappears. Just to anticipate later studies on bivalves, we may mention the widespread group with teeth that are individually 'different', or HETERODONT. Any of the Venus Clams can be used as illustrations, and we might select the Californian Frilled Venus, Chione (*Chionopsis*) *gnidia* (Broderip and Sowerbly). In the center are the two short CARDINAL TEETH, set at an angle, like an inverted v. On either side, are the lateral teeth, with the ANTERIOR LATERAL, in front, and the POSTERIOR LATERAL, behind. These are elongated and follow the dorsal margins. These are corresponding dental sockets in the opposing valves, but these are so arranged that the basic pattern of cardinals and laterals is repeated in each valve. The cardinals are located below and a bit in front of the umbo. Because a lot of shell growth goes into the formation of these cardinal teeth, a certain area of the dorsal shell margin will have a slower rate of lime deposition and will show a somewhat different surface pattern than the shell which is formed around it. The result is a rather conspicuous depression, which is somewhat heart-shaped when you combine the little 'half-moons' on the two sides. The scientific term is the LUNULE (lit. 'little moon') and it is located in front of the beaks or umbones. Again, the Venus Clams serve to illustrate this shell feature and we may select the Chinese Venus, *Callista* (*Callista*) *chinensis* (Linne). Don't confuse the lunule, in front, with the so-called ESCUTCHEON, behind. The escutcheon is the elongated hollow behind the umbones and is to accommodate the external ligament. It is not only interesting and instructive to observe and to account for all these shell features but, when learned, they'll prove very useful in orienting a bivalve and in the exact identification of a great many general and species.

Now leaving these general considerations and proceeding to a systematic study of bivalve classification (Taxonomy), we'll include, in the present article, a brief introduction to the Nut Clams and some other PALEO TAXODONTS (or PROTOBRANCHS). The first (1) SUPER-FAMILY: NUCULACEA starts with a fossil FAMILY (1): CTENODONTIDAE (which we'll omit), followed by the recently represented FAMILY (2): NUCULIDAE, for the true Nut Clams. NUCULA is Latin for 'little nut' and is Lamarck's (1899), Genus name, based on the strict type-species *Nucula* (*Nucula nucleus* (Linne), the common Nut Shell of Europe, Close to it is our common North Carolina Atlantic Nut Shell, or Near Nut Clam, *Nucula* (*Nucula*) *proxima* Say. Either this shell or the Italian Grooved Nut Clam, *Nucula* (*Nucula*) *sulcata* Bronn, may be used to exemplify typical Nut Clam features. First note the thin greenish-yellow protective covering or PERIOSTRACUM, which gets worn off in beach specimens. The shell shape is obliquely ovate, like a tilted triangle with well-rounded corners. The umbones (beaks) are near the middle of the dorsal (upper) margin and point forward a bit. The margin slopes down in front, and even more so behind. The cardinal line on the inside shows a series of similarly-arranged (=taxodont) hinge teeth, with a somewhat irregular chondropore, located in the center, between the anterior and the posterior teeth series. The pearly nut clam interior is called 'nacre' (mother-of-pearl) and is a primitive form of layered shell structure in which the calcium crystallizes as apatite. (When calcite is the crystal form, in other shell types, the interior layer is called calcitostracum) Other North Carolina Nut Clams include: (a) *Nucula* (*Nucula*) *crenulata* A. Adams, the Atlantic Crenulated Nut Clam; (b) *Nucula* (*Nucula*) *dephinodonta* Mighels, the Dolphin-tooth Nut Clam; and (c) *Nucula* (*Nucula*) *verrilli* Dall, Verrill's Triangular Nut Clam. Of several other sub-genera of Nucula, we may just mention *Leionucula*, which was founded on a fossil species, but is probably the senior synonym for *Ennucula*. *Nucula* (*Leionucula or ? Ennucula*) *tennis* (Montagu), the Smooth Nut Clam, is widespread in Northern Oceans and may reach down to N. Carolina. It is also found in Japan, where it must be distinguished from *Nucula* (*Ennucula* or ? *Leinucula*) *cyrenoides* Kuroda.

The large Acilos represent a separate Nut Clam Genus, based on the Japanese Divaricate Nut Clam, *Acila* (*Acila*) *divaricata* (Hinds), whose name indicates the typical befurcating surface-ridge patterns. It is beautifully pearly inside. There is a sub-species, A. (A.) *divaricata vigilia* Schrenck, and a very closely related form, A. (A.) *mirabilis* Adams & Reeve. The much smaller American Divaricate Nut Clam, from California, is put in another sub-genus: *Acila* (*Truncacila castrensis* (Hinds).

SUPER-FAMILY (11): NUCULANACEA, and FAMILY (3): NUCULANIDAE (Syn.=Ledidae) are for the 'littler' Nut Clams, which differ from the NUCULA clams so markedly that they rate a separate super-family. The original separation of the two groups was based on the finding of Nuculanas with an 'external' hinge, whereas the ligament is wholly 'internal' in Nuculas. This feature is inconstant, however, and a somewhat more reliable finding is that nuculanas tend to develop definite SIPHONS (see above), projecting from the rear end of the shell. It is to accommodate for these siphons that the posterior dorsal margin of Nuculanas is prolonged, often to form a definite "ROSTRUM' (the Latin term for the prow of ancient fighting ships). This tends to give the whole shell a comma-like appearance. The popular name of the European shell, which serves as the strict type species of NUCULANA (Syn. *Leda*) is the Rostrate Nut Clam, based on the Latin '*rostrata*', used by Chemnity, whose species name is invalid. The correct prior name of the European shell is *Nuculana* (*Nuculana*) *pernula* Muller. A very similar shell from the Carolinas is *Nuculana* (*Nuculana*) *carpenteri* Dall, Carpenter's Nut Clam. It is not quite as common as the Pointed Nut Clam, *Nuculana* (*Sacella*) *acuta* (Conrad), in a separate sub-genus, for which Woodring's name (Sacella) seems to be correct. Another Carolina sub-genus and representative is the Messaneau Nut Clam, *Nuculana* (*Ledella*) *messanegnsis* Seguenza, with a very short and slightly pinched 'rostrum' at the rear. Among other nuculanas (and sub-genera) may be mentioned: (a) *Nuculana* (*Thestyla*) *hamata* Carpenter, the Californian Hammer-shaped (=Harnate) Nut Clam, and (b) *Nuculana* (*Robaia*) *robai* Kuroda, which is less rostrate and rather large for a Nuculana. It comes from Japan.

Genus: YOLDIA also belongs in Family: Nuculanidae. The Yoldias are much larger shells, composed of smooth fragile valves, which, in life, are covered with a glistening brownish-yellow periostracum. The shell is elongated posteriorly and both ends gape slightly, even when the valves are closed. The comb-like, similarly-arranged (='taxodont') hinge teeth, on either side of a chondropore, are conspicuous and are basically like those in other Nuculanas and Nuculas.

Yoldia (*Yoldia*) *limatula* Say, the File Yoldia, is a rare find on the Carolina coast, but is quite common from New England to New Jersey. *Yoldia* (*Yoldia*) *hyperborea* (Loven), the Subarctic Yoldia, is the strict type-species and it has a sub-species _____ limatoides , much resembling ___ _____ limatula. Two other species have been reported from off North Carolina. *Yoldia* (*Yoldia*) *sapotilla* Gould is the Short Yoldia, with a blunted posterior end and very numerous hinge teeth.

Yoldia (*Megayoldia*) *thraceiformis* Stover, the Broad Yoldia, is a large form with a squarish upturned end and a rib-like edge running from the beak to the posteroventral margin. It can be found in fishes' stomachs. Three JapaneseYoldias are *Y.* (*Y.*) *smilis* Kuroda and Habe; *Y.* (*Y.*) *glauca* Kuroda and Habe; *Y.* (*Y.*) *naganumi* Yokoyama. *Yoldia* (*Cnesterium*) *scissurata* Dall, the Scissors Yoldia from California, is a small and uncommon species.

FAMILY (4): MALLETIIDAE, for the Malletias, is also in Superfamily: Nuculanacea. This group is based on the Chile an Malletia, *Malletia (Malletia) chilensis* Desmoulins. The Malletias are thin-shelled, with a periostracum similar to that of Yoldias, etc. They are rather swollen (inflated), with a small central beak, from which the posterior dorsal border is straight and then curves sharply down at the end. Percy Morris lists three species from deep waters off our Eastern Seaboard, with some records off N. Carolina. *Malletia (Malletia) obtusa* Sars is the Blunt Malletia; *Malletia (Malletia) dilatata* Philippi is the Dilated Malletia. *Tindara amabilis* Dall, the Lovely Malletia (or Tindara), represents another Malletid Genus. From Japan we have *Malletia (Malletia) inequilateralis* Habe, the Unequal-sided Malletia; and *Malletia (Neilo) carinifera* Habe, the Keel-bearing Malletia.

SUPER-FAMILY (III): SOLEMYACEA and FAMILY (5): SOLEMYIDAE (or Solemyacidae) are a special group for the Awning Clams. It is thought that the primitive characters of these bivalves are not necessarily because of ther ancient lineage, but, rather, may be the result of regression due to a very simple way of living. Awning clams live mostly in shallow muddy water and they have been observed to leap up and dart about for some time before dropping to the bottom and digging down into the mud. These peculiar swimming movements are due to jet-propulsion as they rapidly clamp the valves together and thus eject a water stream from the gaping shell ends. Other bivalves that can 'swim' by jet-propulsion include the Razor (Jackknife) Clams, exceptionally, and, quite commonly, many of the Scallops and File Shells.

The Solemyas are put in a separate sub-class: CRYPTODONTA, meaning 'hidden (hinge-) teeth! Actually, there are no visible hinge teeth, but there is a chondropore about two-thirds of the way toward the rear end. The adductor muscle scars are well impressed. The siphon opening is to the rear and is markedby tubercles or tentacles, varying with the different species.

Genus: *Solemya* Lamarck, the Australian awning Clam. The Aussies call it the "Southern Date Shell," which may be misleading, since it isn't at all related to the Date Mussels (which form Genus: Lithophaga, in the much more advanced Family (26): MYTILIDAE). In the word 'Solemya', MYA means 'mussel', and is based broadly upon the superficial resemblance to the *date*-mussels. 'Sol' is Latin for Sun and is used because of the way in which the characteristic over-extended (awning-like) periostracum dires out in dead specimens and then separates into triangular sheaves, somewhat suggestive of sun's rays in appearance. *Solemya (Solemya) panamensis* Dall, from fairly deep water off the Pacific coast of Central America (to Mexico) is another representative of the strict subgenus. There are several awning clams to be found off our East Coast, with some extending to the West Indies. These all belong to another subgenus and include: (a) *Solemya (Petrasma) borealis* Totten, the Boreal (or Arctic) Awning Clam, which is about 2-3 inches long and rarely found to the South of Connecticut. *Solemya (Petrasma) velum* Say, the Common Awning Clam occurs in shallow water on the North Carolina coast, especially in Bogue Sound and down to Swansboro Inlet. It is about 1/2 - 1 inch long and is distinguished from a young - *borealis*, when alive, by features around the siphoral opening. *Solemya (Petrasma) occidentalis* Dall, the West Indian Awning Clam, is tiny (only 1/4 inch long) and with just one slender ridge or rib bordering on the chondropore. It extends to the West Coast of Florida and can be found in the stomach of the Bonefish (*Albula vulpes*).

We have by no means covered all the genera in the bivalve groups we have systematized in this article. The little shells of these groups are not much to look at, but they do introduce us to the bivalves, and many of their life-stories can be very interesting.

REFLECTIONS ON SHELL FORM AND DEVELOPMENT IN THE CASSIDIDAE

- or -

HOW THE SCOTCH BONNET GOT THAT WAY

by

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All seasoned shell collectors have seen specimens arranged in what is called a "growth series". In a recent advertisement, I noted for sale a "growth series of 10 scotch bonnets" *Phalium granulatum* Born, and I was prompted to reflect on growth in gastropods, and on the effects of such growth on the form and development of the shell. One readily can imagine the "growth series" mentioned above ---it consists of 10 scotch bonnets, neatly arranged in order of increasing dimensions - an appealing geometric progression of similarly - appearing shells, each with its pustulose parietal shield, and thickened outer lip. Only the very smallest one or two specimens might be without the parietal shield and would have a thin, growing edge on the outer lip of the aperture. One can scarcely imagine, however, how a single living scotch bonnet might progress through each of the stages of the growth series. The thickened outer lip of *Phalium* almost certainly represents a resting stage of the growth process, and a sized series of resting stages would therefore represent very poorly the nature of an active growth process.

I would liken the scotch bonnet "growth series" to an arrangement of 30-year old man, progressing at 3-inch height intervals from a 36-inch dwarf to a 7-foot basketball player. Here would be a geometrically ordered progression, which would contain 17 individuals of various heights, but which would tell nothing about the development of an individual from a height of 36 inches at approximately 2 1/2 years through childhood and adolescence to the average adult height of 5'9".

Growth and development are very poorly known for scotch bonnets -indeed for most molluscs. Average growth rates are known for only a few gastropods, and these tend to be the more densely populated species of commercial importance like *Strombus gigas*, *Haliotis*, and *Urosalpinx*. Direct observation and adequate sampling of *Phalium* is seriously hampered by the offshore habitat of the populations and probably also by the secretive habits of the species. On the basis of shell specimens alone, however, not only of *Phalium granulatum*, but also other species of *Phalium* and the related cassids, one can deduce likely schemes for the development of the shell during growth. Let us now consider some of the alternatives.

Hypothesis # 1. After metamorphosing from the pelagic larval (veliger) stage the tiny scotch bonnet continuously adds shell material to the thin growing outer lip of the shell. This process continues uninterrupted until the shell attains maximum size, and then the animal thickens the outer lip and deposits the parietal shield, never to grow again. Circumstantial evidence, however, invalidates this hypothesis. Mature adult *Phalium* may be over 3 inches long, yet specimens of intermediate size but with unthickened lips are not found, whereas much smaller mature specimens are common. It is possible that an individual grows to its maximum size in a very short time period or grows only while buried deeply in a burrow, and growing individuals simply are not found, but it is highly improbable that the animal could hide out long enough to complete growth and avoid occasional capture.

Hypothesis # 2. The animal adds shell material to a thin, growing outer lip until it reachs maturity at some intermediate size. It then thickens the outer lip and deposits its parietal shield. Further growth of the shell involves a continuous addition of shell to the leading edge of the thick outer lip and removal of shell from the trailing edge, coupled with a continuous readjustment of the parietal shield. This hypothesis is implied by the standard "growth series" and must be rejected on the basis of the general physiological implausibility of recycling so much shell material, as well as the occurrence of an intact previous varix on some specimens of *P. granulatum*. Approximately 240 degree of body whorl usually separates the outer lip from the previous varix in these specimens. This angular interval between varices is typical of many cassids (Wrigley 1934). In some species of *Phalium*, retention of previous varices is the rule rather than the exception, and in *Cassis*, previous varices are retained throughout the development of the shell, but are covered internally by a new deposit, so that only the portion of the varix on the spire remains visible. These latter observations suggest the next hypothesis, i.e. that *P. granulatum* constructs several successive outer lips (varices) during its growth, but unlike *Cassis*, removes old varices after construction

of the next one.

Hypothesis # 3. As in hypothesis # 2, the scotch bonnet thickens its outer lip and deposits the parietal shield after a juvenile stage with a thin growing outer lip. This first thickening process probably occurs when the shell is about 20 mm long (Figure, stage A) (below this size shells with thin lips are found; above it shells generally have the appearance of mature specimens). After the development of mature shell characteristics, shell deposition ceases, or is restricted to the area of the parietal shield. During this "resting phase" the animal continues to grow inside the shell and to store calcium in its tissues for future shell generation. Then at some time, the animal goes into seclusion, (perhaps burrowing more deeply into sand or into crevices), where in a short time, a burst of shell deposition occurs. The parietal area is cleared of excess material and smoothed over with additional shell deposits, and an extension of the body whorl is deposited past the existing outer lip, and about 240 degrees around the previous body whorl. At this point, whorl deposition ceases again, the outer lip is thickened, and parietal material is deposited. The *Phalium* now has a thickened outer lip and a single former varix which is located adjacent to the edge of the new parietal shield (Figure, states B and C).

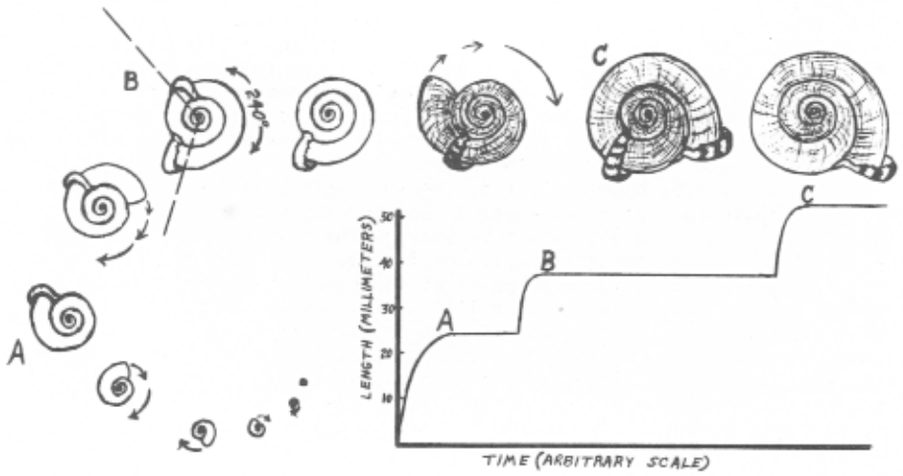
During the process of constructing the new body whorl, the new shell material is very fragile so that it would likely be broken off if the shell were dredged or trawled during this period. I have one broken specimen from the scallop trawlers which seems to have been in this phase of growth. After the new lip is completed, the new whorl is thickened from the inside and the shell becomes less fragile. Based on my gatherings of *Phalium granulatum* from scallop shell piles, the proportion of shells with 2 varices appears to be about 5 percent. Active growth phases alternate with resting phases throughout the life span of the individual, but most of the life of an individual would be spent in the various resting phases, so nearly all specimens collected have the typical appearance. The active growth phase would represent a rare form of the scotch bonnet, whereas the 2-varix form would be less rare in collections because the animal remains in that phase longer and because in this stage the shell is no more fragile than the typical form.

If as suggested by hypothesis # 3, the form with 2-varices actually represents a typical phase of routine growth and development, *P. granulatum* necessarily must have the facility for removing the main portion of the previous varix soon after the construction of the new body whorl and outer lip. This requisite represents the weak point of the hypothesis, for although many gastropods are equipped with the capability for removing shell, the process has been studied mainly in reference to the drilling or boring activities of predatory gastropods. Furthermore, careful scrutiny of the pertinent region on the typical shell of *Phalium* fails to suggest the former presence of another varix. Axial growth lines are not noticable on the surface of the shell, but their distribution appears random and does not support the development of varices at intervals of approximately 240 degrees. Perhaps *P. granulatum* is so good at its craft that it leaves no visual evidence of former varices; and we will have to resort to more refined techniques, such as x-ray diffraction, in order to determine the ultimate validity of hypothesis # 3. An alternative, of course, would be direct observation of a growing *Phalium*. When marine organisms are contained, however, they frequently do not grow; and if not contained, they frequently defy continuous observation - an interesting enigma.

The symmetry and beauty of mollusc shells long have attracted man's attention. Too often, however, we tend to regard the shell as a static object, and overlook both the animal and the biological processes which produced the shell. In fossil beds and in conchological cabinets, the shell is a static object, but when housing a mollusc, the shell is a dynamic structure which may undergo several successive changes as the animal grows. Although the mollusc may produce its shell as part of a regular routine, the actual process is nevertheless very complex. The next time you examine a scotch bonnet, or any other shell, stop for a moment to ponder the mollusc's problem of making such an object. And be wary of growth series - or at least consider their biological validity.

Wrigley, A. 1934. English Eocene and Oligocene Cassididae with notes on the nomenclature and morphology of the family. Proc. Malacological Soc. London 21 (2): 108 -130, pls. 15-17.

Growth of *Phalium* according to hypothesis # 3. Explanation in text.



THE RISE AND FALL OF SCAPHELLA

Wade G. Brown

These comments have been inspired by the recent publication of *The Living Volutes* by Weaver and duPont. This is not a "book review." I also wish to state emphatically that I consider this book very valuable addition to the shell collector's library, a very beautiful work and one that, in the words of Dr. Abbott in his Foreword to the book, does indeed "bridge the gap between the ivory-towered scientist and the ardent private collector."!

My comments are concerned with the relatively brusque and "disinterested" treatment of our western Atlantic Volutes. Granted, our native Volutes are limited in number of species, and that they cannot "compete" with the number of species, or brilliance and variety of the Volutes of the vast warm water reaches of the Pacific, but we ought to be most interested in our own native shells. After all, Juno's Volute (*Scaphella junonia, Lamarck, 1804*) was one of the first Volutes to be named and sought after. And by the way, who was Juno? According to Webster: "the queen of heaven in Roman mythology". To make a pun, the old-timers must have thought very highly of this shell!

Now to the point of these remarks: The authors state " that there are only three or possibly four valid volute species in *Scaphella*." The authors place junonia (*Lamarck, 1804*) and neptunia (*Clench and Aguayo, 1940*) in the subgenus Scaphella; ie., Scaphella (*Scaphella*), and cast doubt about the validity of neptunia because it is known from only a single juvenile specimen, with animal and radula unknown.

In the subgenus *Clenchina* Pilsbryand Olsson, 1953, ie., *Scaphella (Clenchina)*, the authors recognize *only* the species *dohrni*, and have nelegated to the synonymy the following species that have been considered true species: *gouldiana* Dall, 1887; *robusta* Dall, 1889; *bermudezi* Clench and Aguayo, 1940; *florida* Clench and Aguayo, 1940; *atlantis* Clench, 1946; and *cuba* Clench, 1946! These later species are said to be "isolated population variants."

In the subgenus *Aurinia* H. and A. Adams, 1853, ie., *Scaphella (Aurinia)*, the authors recognize *only* the species *dubia* and have discarded to synonymy the following species: *Kieneri* Clench, 1946; *schmitti* Bartsch, 1931; and *georgiana* Clench, 1946.

So, at one blow, the authors would eliminate 9 species of Western Atlantic Volutes which are recognized as valid in all popular current references including *Johnsonia*, and all of Dr. R. Tucker Abbott's publications. These Volute species, or non-species, are also being sold as valid species by most, if not all shell dealers, many of these species at high prices.

I am not qualified to argue with the authors' conclusions, but I feel very strongly that*Scaphella* has been very summarily dealt with. It is obvious to me that the authors' first love and intimate knowledge are the Volutes of the Pacific. Their conclusions are based (see Remarks, p. 140, 144, 145) on such statements as these: "Hundreds of dredging operations conducted by the Fish and Wildlife Service during the 1960's off Florida and in the Gulf of Mexico have proved that the isolated population variants, which Clench (1946) thought to be valid species, are variants of a single species..."; and "Several hundred dredging operations conducted by the U. S. Fish and Wildlife Service in the 1960's, between North Carolina and the Yucatan Channel in Mexico, have shown that ... are all the same species."; further, "In a letter to Dr. R. Tucker Abbott in 1965, Mr. Harvey R. Bullis, Jr., base director of the Fish and Wildlife Service at Pascagoula, Mississippi, stated that these zoogeographic gradients beautifully exemplify clinal variation."

The conclusions of the authors appear to be based on the statements quoted. Their conclusions may be valid, but we are not informed by any supporting evidence how these conclusions have been"proved". Have qualified malacologists had statistically sound sampling and examined the animals and radula of the various species and non-species? If so, we are not informed. I feel that shell collectors and shell dealers are due scientific proof of the authors' conclusions. Until this is done, all collectors should regard all Scaphella with a very large question mark.

THE NORTH CAROLINA SCALLOP FISHERY - A Bonanza to Shell Collectors?

Hugh J. Porter

U.N.C. Institute of Marine Sciences

About fourteen different kinds of scallops are known from North Carolina waters and of these, three-the Bay Scallop, the Calico Scallop and the Atlantic Deep-sea Scallop make up North Carolina's scallop fishery.

Normally, only the giant muscle which closes the valves of a scallop is utilized on our coast as food; actually the rest of the scallop meat is quite edible. A gallon of muscles or shucked scallops is worth $16.00 - $18.00 on the present (Oct. 1971) wholesale market; 1 1/2 to 2 1/2 bushels of Calico Scallops are generally required to yield one gallon (8 lbs) of shucked scallops.

The Atlantic Deep-sea Scallop (*Placopecten magellanicus* (Gmelin), fishery off North Carolina occurs north of Cape Hatteras in waters over 150 ft. depth. The fishery, fished mainly by boats out of the Norfolk area, is small - yearly production for North Carolina in 1968 to 1970 = 0 to 92,000 lbs. Shell material from this fishery should be of interest to collectors, when available, since it contains examples of the more northern shells rarely found on North Carolina beaches. Mrs. Lucy Piper (Gloucester, N. C.) has several large "Striate Cup-and Saucer" shells which she collected from a Deep-sea Scallop fishing trawler out of Atlantic, N. C.

The Bay Scallop, (*Argopecten irradians* (Lamarck)), fishery is found exclusively in the bays, sounds and inlets of North Carolina and other Atlantic Coast states. The fishery until recent years was the basic scallop fishery for the state (yearly production in 1968 to 1970 = 130 to 639 thousand lbs) and occurred primarily in Bogue Sound. Scallops are caught by hand rake in shallow water or by small scallop dredges in subtidal areas. Catches generally are quite clean and contain little material (shells) other than what is attached to the scallop. Shell species which might be brought up by the dredge are: Atlantic Wing Oyster, Giant Atlantic Cockle, Northern Quahog, Disk Dosinia, Atlantic Moon Snail, Chestnut Turban, Florida Cerith, Lightning Whelk, Knobbed Whelk, Channeled Whelk, Banded Tulip, Lettered Olive and Atlantic Auger.

The Calico Scallop, (*Argopecten gibbus* (Linne)), fishery in North Carolina waters (near 60-120 ft. depths) has been utilized only recently. In 1965 - 1967 (production in 1968 = 1,857,000 lbs) it was found primarily southwest of Cape Lookout; in 1968 - 1969 few scallops were found; in early 1970 to mid 1971 (production in 1970 = 1,574,000 lbs) the fishery was primarily northeast of Cape Lookout; late in 1971 few adult scallops could be found - fishing is now stopped but is expected to be resumed early in 1972. Reasons for the sporadic nature of the fishery are not known but are being studied. The scallop is caught locally by offshore commercial trawlers using shrimp-type nets or trawls and it is not unusual to see vessels returning after a single day of fishing with their decks piled high with scallops (800 to 1000 bushels). Scallops are generally unloaded at docks on the Morehead - Beaufort causeway, in Beaufort or Broad Creek. Some of the best collecting is done at these docks; however, it is best to secure permission before doing so. At first all scallops were shucked by hand in the numberous small shucking houses and private homes throughout Carteret County. The piles of scallop shells and debris that accumulated at these houses were excellent collecting spots for shell collectors. Most shucking is now done in licensed and certified hand shucking houses in Broad Creek, Harkers Island, Morehead City and Salterpath. Gradually these houses are being replaced by automated shucking houses as occur in Beaufort, Broad Creek (?), Salterpath and Williston. Collecting at the latter house, (Willis Bros. Inc.), which is the original of these, should be done with caution since shells there may not all be from North Carolina but may also be from Florida. Collecting from the shucking house scallop piles for the large spectacular shells is not as profitable as it once was since personnel in these houses and on the trawlers frequently collect for themselves or to sell to professional shell dealers. They do miss many small mollusks such as: Reticulated Wentletrap, Smith's Nutmeg, Krebs' Triton, Caribbean Coral Shell, Thin-ribbed Murex, several small Turrids - *Cerodrillia simpsoni* (Dall) and *Syntomodrillia moseri* (Dall) which are found at the bottom of shell piles, particularly if the pile is near enough to salt water to be partly covered during high tide.

Some of the larger mollusks which have been collected from trawler decks or shell piles are: Cut-ribbed Ark, Ravenel's Scallop, Lion's Paw, Gibbs' Clam, Giant Atlantic Cockle, Calico Clam, Imperial Venus, Lady-in-waiting Venus, Florida Fighting Conch, Atlantic Moon Snail, Colorful Atlantic Natica, Maculated Baby's Ear, Scotch Bonnet, Emperor Helmet, Atlantic Distorsio, Poulsen's and von Salis' Tritons, Chestnut Frog Shell, Giant Tun, Common Fig Shell, Giant Atlantic and Apple Murexes, at least four Whelk species, Florida Horse Conch, True and Banded Tulips, Lettered Olive and Sozon's Cone. Papers in press by myself and Dr. Doug Wolfe list 187 different large-sized molluscan species as being found in North Carolina's Calico Scallop beds.

For those persons willing to collect with a magnifying glass, stomachs of the common and very pretty seastar *Astropecten articulatus* (Say) are sometimes loaded with small mollusks. Commonly found in stomach samples are: Lightning Venus, Contracted Corbula, Glassy Lyonsia, occasional Vitrinellids, and Wentletraps, Southern Miniature Natica, various Dove Shells, Olivellas, occasional Turrids, Adam's Baby Bubble and Half-smooth Odostome. In a paper in press, I record over 102 different molluscan species found in stomachs of this dark blue (outlined in orange color) seastar taken from our Calico Scallop fishery.

A total of 241 molluscan species is now known to have been collected from North Carolina's Calico Scallop beds. This plus the fact that the Tritons and the Sozon's Cone, which were previously almost unknown from off our coast and now seem common at times in the scallop hauls along with the Murexes, the Scotch Bonnet and the Emperor Helmet shells, makes the Calico Scallop beds truely a North Carolina Shell Collector's bonanza.

* *

Publication Notice:

"Sea Shells common to North Carolina" by Hugh J. Porter and Jim Tyler. 1971. Information Series of the North Carolina Department of Conservation and Development, Division of Commercial and Sports Fisheries. 36 pages, 129 figures.

This illustrated and free booklet will be available sometime before January 1st, 1972. It is hoped that it will be of some help to those interested in our marine waters. About 175 mollusks are described. A limited number of copies are being printed. Copies may be secured from either the U. N. C. Institute of Marine Sciences, Morehead City, N. C. or the Div. of Comm. and Sports Fish., North Carolina Dept. Cons. and Devel., Morehead City, N. C. 28557.

CAYMAN ISLANDS

WEST INDIES

Ruth S. Dixon

Back in the 1920's the National Geographic Magazine referred to the Cayman Islands as the Islands that Time Forgot," but they are losing their old nickname. Many tourists are finding these unspoiled Edens of sunshine, fresh air (not polluted), the clearest waters in the world, and a friendly independent population who look you straight in the eye and smile. There is no poverty, begging or ragged clothing here. The population is about 10,000 mostly British, Scottish and Irish descent, about 20% European origin, 20% of African descent and the balance, mixed racial stock. The official language is English with a delightful accent, a pleasing mixture of English and West Indian. This is a British Colony. The people are friendly and courteous and keep their island and their homes clean and well landscaped with beautiful tropical flowers.

Two friends and I visited Grand Cayman last year and added Cayman Brac to our itinerary this August. We rented a car and I enjoyed cruising over both of the islands in spite of having to drive on the left side. It is necessary to have a car in order to see the places of interest. The islands have many tropical flowers blooming everywhere, but Cayman Brac is less "citified". Cayman Brac has a huge bluff rising from sea level to a height of 140 feet.

There are good hotel accomodations on both islands, good food, good drinking water, beautiful clear water for swimming, the fabulous Seven Mile Beach that is strewn with interesting rare shells, corals, and driftwood besides the numberless small beaches.

After being there 8 days in 1970 and 10 days in 1971, I had found Nerites, Purpuras (wide-mouthed), West Indies Top Shells, West Indian Tegula, Thais rustica (rustic rock shell), Thais deltoiden (Deltoid rock-shell), key hole limpets, and Tectarium muricatus (Beaded Perwinkles) on the rocks of both Grand Cayman and Cayman Brac. You can walk along the shore and find these on rocks. I found the Leucozonia on the grass at East End of Grand Cayman, and many other small unidentified shells. In North Sound, we found Cassis tuberosa (King helmets), Strombus gigas (Queen Conchs), Tellina radiata (Sunrise Tellins), Murex pomum (Apple Murex), Strombus ranius (Hawk Wing conchs), Strombus pugilis (West Indian Fighting Conchs), and Strombus costatus (Milk Conchs). A Charonia variegata (Trumpet Triton) was found in a cave on the reef in North Sound by one of our guides while spearing lobsters and fish for our lunch. At Rum Point, I found juvenile Strombus gigas, Lima pellucida (Antillean Lima), Tellina listeri (Speckled tellin), Constricted macoma, Prunum gutlum (Marginella), Mitra barbedensis (Barbados miter, Astraea longispina (Star shell). I found Flamingo tongues on the sea fans while I was snorkeling over the reefs. A teen-age girl found a lovely Strombus gallus (Rooster tail Conch) early one morning in the water on the Seven Mile Beach in front of our motel, the La Fontaine. I tried to trade one of my shells for the Rooster tail Conch -with out success.

If you swim and snorkel, a new world of many beautiful shells may be found in the Cayman Islands. Also there are brightly colored fished and interesting reefs with beautiful coral and undergrowth. It is a paradise for fisherman and underwater photographers.

If I should ever go back, I would choose to spend more time at Cayman Brac, but for those who have never been, I recommend both islands. I hope to go back to Cayman Brac someday and also visit Little Cayman.

SEA THOUGHTS

by James E. Wadsworth

The sea has a magnetic attraction for man comparable to that of the moon causing the tides. Lucky for us, Columbus could not resist that call.

As we stand on the beach, the sea makes us ask many questions:

What dangers lurk far beyond the shore?

What variety of creatures inhabit these rolling waters?

Where did these animals originate, and what is their life history?

As we look toward the sky, the wonder of it all impels us to ask other questions.

Why do the stars shine?

Are there really more stars in the sky than there are grains of sand on all the beaches of the earth?

Is our planet only a small grain of sand compared to other bodies in the universe?

How far away is the edge of space?

These thoughts cause us to express our thanks to God for the wonder and beauty of life. We are grateful for the ingenuity of man. We hope that some of the new techniques that have enabled man to walk on the moon will teach us to walk in peace on the earth.

A wentletrap or an olive at our feet brings us quickly from a delightful reverie, and once again we ponder the true identity and life history of these sea creatures.

NORTH CAROLINA SHELL CLUB'S FIRST SHELL SHOW

Dorothy J. Porter

Thirty-one cases of mollusks were displayed by thirteen contributors at the first North Carolina Shell Club show held Saturday October 2, 1971 in Coker Hall, U.N.C., Institute of Marine Sciences in Morehead City.

Most of the displays were shown in the recommended size cases with glass tops; however, one collection was shown in a World War II Japanese sea chest by Jim Wadsworth and another by Mrs. Lucy Piper was displayed in an antique glass-shelved cabinet.

Contributors by category entered were:

North Carolina, self-collected -

Walter Lowry, Mrs. Elizabeth McKinley, Mrs. Lucy Piper and Mrs. Harriett Riggs and Mrs. Mary Ladner.

Word Wide, self-collected -

Mrs. Ruth Dixon, Walter Lowry, Jim Wadsworth and Doug Wolfe

Word Wide, general -

Mrs. Charlotte (Raleigh) Johnson, Walter Lowry, Marguerite Thomas, Doug Wolfe and Jenny Worrall

Junior Member - Jimmy Truckner

Ribbon Winners Were: North Carolina, self-collected -

first, Mrs. Piper; second, Mrs. Riggs; third, Mr. Lowry

World Wide, self - collected-

First, Jim Wadsworth; second, Mrs. Dixon; third, Dr. Wolfe

World Wide, general -

first, Mrs. Johnson; second, Mr. Lowry; third, Miss Thomas
Junior Member - Jimmy Truckner

In addition, a "Best Shell of the Show" ribbon was given to Mrs. Riggs for a rare and unusual form of Sozon's Cone, which she had collected in North Carolina.

A golden cowry was shown in its own special case by Mrs. Johnson and three cases, not for judging, were displayed by Hugh J. Porter - one was Olividae, and two were North Carolina reef mollusks. Live Sozon's Cones, von Salis-Triton and an Emperor Helmet were shown in a salt water acquarium.

Judges were Will Hon, director of the Carteret County Marine Science Program, and Hugh J. Porter, assistant professor, UNC Institute of Marine Sciences. " Hurricane Ginger" delayed the services of a third judge, Dale Stingley, well known Florida collector from LaBelle, Florida.

After the judging, the show was opened to the public.

The Shell Show chairman was Mrs. Charlotte Johnson. Members of the committee were Wade Brown and Mr. & Mrs. Hugh Porter.

RECORD SIZES OF NORTH CAROLINA MOLLUSKS

LIST No. 2

Hugh J. Porter
U. N. C. Institute of Marine Sciences

This second listing, a continuation of List No. 1, published in the North Carolina Shell Club Bulletin No. 5, consists of two parts: 1. Additions and/or more recent records to List No. 1 which included only the Gastropods, Scaphopods and Chitons; 2. A comparable listing of those bivalves having a length of height of 15 or more mm. (0.59 inches).

These listings were created partly because of their valve to molluscan ecologista and/or taxonomists. More importantly, however, they were created to stimulate the amateur collector's interest in his North Carolina shells and to serve as a partial guideline for determing approximate shell values when merchandizing or bartering is involved. This later of course is important when one has extra shells in his collection or wishes to add unattainable specimens to it.

To be eligible for listing, specimens must have been found initially in North Carolina. Additional records will be kept of live taken specimens if these are not as large as a recorded empty shell. Measurements must be verified by a member of the North Carolina Shell Club's Executive Committee. It would be hoped that upon the dismantling of a collector's collection, recorded record-sized specimens would be offered to a well-known collection of North Carolina shells whether it be amateur or museum.

Measurements used are according to the Van Nostrand Catalogue, volume 2, page 276. Many of the IMS species measurements may seem small and possibly are; in regard to those species, the IMS Collection, which these listings were basically developed from, may have had just a few small specimens.

NOTES CONCERNING LISTINGS:

"†" = Species not listed in previous list.
"H" = Height of a shell (hinge edge to ventral edge).
"L" = Length of a shell (maximum anterior to posterior measurement).
"S.F."= Beaufort = Scallop Fishery, offshore Beaufort Inlet.
"*" = Live taken specimen.

Specimens reside in the following collections: Cochran - Mr. F. C. Cochran, Sea Level, N. C.; Crews - Dr. J. M. Crews, UNC, Wilmington, N. C.; Dudley - Mrs. D. Dudley, Beaufort, N. C.; DMR - Duke Marine Laboratory, Beaufort, N. C.; IMS - Mollusk Collection, UNC, Institute of Marine Sciences, Morehead City, N. C.; Johnson - Mrs. Charlotte Johnson, Raleigh, N. C.; Laughinghouse - Mr. Billy E. Laughinghouse, Beaufort, N. C.; Piper - Mrs. E. H. Piper, Gloucester, N. C.; Porter - Mr. H. J. Porter, Morehead City, N. C.; Riggs - Mrs. Harriett Riggs, Swansboro, N. C.; Truckner - Mr. C. Truckner, Durham, N. C.; Tyler - Mr. J. Tyler, Morehead City, N. C.; Walton - Mrs. J. S. Walton, Jacksonville, N. C.; Wolfe - Dr. D. A. Wolfe, Beaufort, N. C.

LIST No. 1 REVISION

Gastropods, Scaphopods and Chitons

†AMAEA RETIFERA Dall (Reticulated Wentletrap)	1.02 inch (26mm)	Riggs	S.F., Beaufort
	0.83 inch (21mm)	Walton	
		now IMS No. -	S.F., Beaufort
ARCHITECTONICA NOBILIS Roding (Common Sundial)	1.54 inch (39mm)w	Laughinghouse*	S.F., Beaufort
†BURSA BUFO (Bruguiere) (Chestnut Frog Shell)	2.44 inch (62mm)	Cochran	S.F., Beaufort
	2.24 inch (57mm)	Walton	
		now IMS No. -	S.F., Beaufort
BUSYCON CANALICULATUM (Linne) (Channeled Whelk)	8.42 inch (214mm)	Laughinghouse	Bogue Sound?
BUSYCON CONTRARIUM (Conrad) (Lightning Whelk)	12.52 inch (318mm)	Laughinghouse	
		now IMS -	S.F., Beaufort
†CIRSOTREMA DALLI Rehder (Dall's Wentletrap)	1.30 inch (33mm)	Laughinghouse	S.F., Beaufort
CORALLIOPHILA CARIBAEA Abbott (Caribbean Coral Shell)	1.02 inch (26mm)	Laughinghouse	S.F., Beaufort
CYMA†IUM KREBSII (Morch) (Krebs' Triton)	2.76 inch (70mm)	Cochran	S.F., Beaufort
	2.44 inch (62mm)	IMS No. - *	S.F., Beaufort
CYMATIUM PARTHENOPEUM (von Salis) (von Salis' Triton)	6.18 inch (157mm)	Piper *	S.F., Beaufort
CONUS SOZONI Bartsch (Sozon's Cone)	4.06 inch (103mm)	Laughinghouse *	
		now IMS	S.F., Beaufort
CYPHOMA MCGINTYI Pilsbry (McGinty's Cyphoma)	1.22 inch (31mm)	IMS No. 518	Fort Macon Beach
CYPRAEA CERVUS Linne (Atlantic Deer Cowrie)	5.04 inch (128mm)	Piper*	S.E. Cape Lookout
CYPRAECASSIS TESTICULUS (Linne) (Reticulated Cowrie-helmet)	2.80 inch (71mm)	Laughinghouse	S.F., Beaufort
	2.28 inch (58mm)	Tyler	Off N. C. Coast
DISTORSIO CLATHRATA (Lamarck) (Atlantic Distorsio)	2.87 inch (73mm)	Truckner *	S.F., Beaufort
FASCIOLARIA TULIPA (Linne) (True Tulip)	8.66 inch (221mm)	Johnson*	Wrightsville Beach
†FICUS COMMUNIS Roding (Common Fig Shell)	4.42 inch (112mm)	Laughinghouse	S.F., Beaufort
MUREX POMUM Gmelin (Apple Murex)	3.02 inch (77mm)	DML No. 523*	Off Cape Lookout
NASSARIUS TRIVITTATUS (Say) (New England Nassa)	0.79 inch (20mm)	DML No. 358*	Off Oregon Inlet
OLIVA SAYANA Ravenel (Lettered Olive)	3.58 inch (91mm)	Cochran	S.F., Beaufort
PHALIUM GRANULATUM GRANULATUM (Born) (Scotch Bonnet)	3.46 inch (88mm)	Porter	Off Wrightsville area
PLEUROPLOCA GIGANTEA (Kiener) (Florida Horse Conch)	16.25 inch(412mm)	Piper*	Off Beaufort Inlet
SCAPHELLA DUBIA (Broderip) (Var. Georgiana (Clench))	4.42 inch (112mm)	DML No.2511*	ESE Cape Lookout
SCAPHELLA JUNONIA (Shaw) (Junonia)	5.28 inch (134mm)	Dudley	Fort Macon Beach
	4.25 inch (108mm)	Crews	Wilmington area
SINUM PERSPECTIVUM (Say) (Common Baby's Ear)	1.73 inch (44mm)w	DML No. 2309*	Pivers Island

LIST NO. 2 BIVALVES

AEQUIPECTEN MUSCOSUS (Wood) (Rough Scallop)	1.85 inch (47mm)L	IMS No. 1845*	ESE New River
AMERICARDIA MEDIA (Linne) (Atlantic Strawberry Cockle)	1.38 inch (35mm)H	IMS No. 1847	ESE New River
ANADARA BRASILIANA (Lamarck) (Incongruous Ark)	2.48 inch (63mm)L	IMS No. 762	Fort Macon Beach
ANADARA LIENOSA FLORIDANA (Conrad) (Cut-ribbed Ark)	4.36 inch (111mm)L	IMS No. 85	Atlantic Beach
	3.65 inch (92mm)L	IMS No 1103.3*	S.E. Cape Lookout
ANADARA OVALIS (Brugiere) (Blood Ark)	2.24 inch (57mm)L	IMS No. 546a*	Holden's Beach
ANODONTIA ALBA LINK (Buttercup Lucine)	2.76 inch (70mm)L	IMS No. 71	Atlantic Beach
ANODONTIA PHILIPPIANA Reeve (Chalky Buttercup)	3.74 inch (96mm) L	IMS No. 712	Cape Lookout
?ANOMIA ACULEATA (Gmelin) (Prickly Jingle)	1.97 inch (50mm)H	DML No. 856*	Off Cape Lookout
ANOMIA SIMPLEX (d'Orb) (Atlantic Jingle)	1.33 inch (32mm)H	IMS No. 708*	Cape Lookout
ANTIGONA RUGATINA (Heilprin) (Queen Venus)	1.77 inch (45mm)L	IMS No.2598*	S.E. Cape Lookout
ARCA IMBRICATA Brugiere (Mossy Ark)	2.60 inch (66mm)L	IMS No. 1880*	S.E. New River
ARCA ZEBRA Swainson (Turkey Wing)	3.55 inch (90mm)L	IMS No. 1879.9*	S.E. New River
ARCINELLA CORNUTA (Conrad) (Florida Spiny Jewel Box)	1.95 inch (49mm)H	IMS No. 2282*	Off Cape Fear
ARGOPECTEN GIBBUS (Linne) (Calico Scallop)	2.96 inch (75mm)L	IMS No. 782d*	Off Bogue Inlet
ARGOPECTEN IRRADIANS (Say) (Atlantic Bay Scallop)	3.46 inch (88mm)L	IMS No. 1791.9*	Bogue Sound
ASTARTE BOREALIS Schumacker (Boreal Astarte)	1.18 inch (30mm)L	DML No. 576*	Off Oregon Inlet
ASTARTE CASTANEA Say (Smooth Astarte)	1.10 inch (28mm)L	DML No.1646 *	Off Oregon Inlet
ASTARTE UNDATA Gould (Waved Astarte)	1.30 inch (33mm)L	DML No. 1225*	Off Oregon Inlet
ATRINA RIGIDA (Lightfoot) (Rigid Pen Shell)	9.18 inch (233mm)L	IMS No. 407*	Beaufort
ATRINA SEMINUDA (Lamarck) (Half-naked Pen Shell)	7.36 inch (187mm)L	IMS No. 529c	Holden's Beach
	5.91 inch (150mm)L	IMS No 1797*	Off Shackleford
ATRINA SERRATA Sowerby (Saw-toothed Pen Shell)	9.85 inch (251mm)L	IMS No. 973*	Bogue Banks
BARBATIA CANDIDA (Helbling (White-bearded Ark)	0.98 inch (25mm) L	IMS No. 2225*	S. E. Cape Lookout
BARBATIA DOMINGENSIS (Lamarch) (White Miniature Ark)	1.18 inch (30mm)L	IMS No. 2265*	S. E. Cape Lookout
BARNEA TRUNCATA (Say) (Fallen Angel Wing)	2.21 inch (56mm)L	IMS No. 1936	Newport River
BRACHIDONTES EXUSTUS (Linne) (Scorched Mussel)	0.79 inch (20mm)L	IMS No. 6*	Pamlico Sound
BRACHIDONTES RECURVUS (Rafinesque) (Hooked Mussel)	1.85 inch (47mm)L	IMS No. 560c*	New River
CALLISTA EUCYMATA Dall (Glory-of-the-Seas Venus)	1.18 inch (30mm)L	IMS No. *	S. E. Cape Lookout
CHAMA CONGREGATA Conrad (Little Corrugated Jewel Box)	1.34 inch (34mm)H	IMS No. 939*	Cape Lookout
CHAMA MACROPHYLLA Gmelin (Leafy Jewel Box)	1.46 inch (37mm)H	IMS No. 764	Fort Macon
CHIONE CANCELLATA (Linne) (Cross-barred Venus)	1.66 inch (42mm) L	IMS No. *	Middle Sound-Wrightsville Beach
CHIONE INTAPURPUREA Conrad (Lady-in-waiting Venus)	1.50 inch (38mm)L	IMS No. 2707*	S. E. Cape Fear
CHIONE LATILIRATA Conrad (Imperial Venus)	1.34 inch (34mm)L	IMS No. 2295.1*	E.SS. E. Cape Lookout
CRASSOSTREA VIRGINICA (Gmelin) Easter Oyster	8.34 inch (212mm)H	IMS No. 883.2*	Cedar Island
CUMINGIA TELLINOIDES (Conrad) Tellin-like Cumingia	0.90 inch (23mm)L	IMS No. 763	Fort Macon
	0.63 inch (16mm)L	IMS No. 1937*	Newport River
CYRTOPLEURA COSTATA (Linne) Angel Wing	5.55 inch (141mm)L	IMS No. 532	Holden's Beach
	4.92 inch (125mm)L	IMS No. 241*	Peletier Creek

DINOCARDIUM ROBUSTUM (Lightfoot) (Giant Atlantic Cockle)	4.68 inch (119mm) H	Piper*	Cape Lookout
DIPLODONTA PUNCTATA (Say) (Atlantic Diplodon)	0.79 inch (20mm)L	IMS No. 3133	SSE Cape Hatteras
DIVARICELLA QUADRISULCATA D'Orb (Cross-hatched Lucine)	0.79 inch (20mm)L	IMS No.501*	Bird Shoal
DONAX VARIABILIS Say (Florida Coquina)	0.79 inch (20mm)L	IMS No.2605†*	Bogue Banks
DOSINIA DISCUS (Reeve) (Disk Dosinia)	2.84 inch (72mm)L	IMS No.647a*	Shackleford Banks
DOSINIA ELEGANS Conrad (Elegant Dosinia)	3.90 inch (99mm)L	IMS No.396	Off Bogue Banks
	3.58 inch (91mm)L	IMS No.1104.1*	S.E. Cape Lookout
ENSIS DIRECTUS Conrad	5.00 inch (127mm)L	IMS No. 1342*	Newport River
EUCRASSATELLA SPECIOSA (A. Adams) (Gibb's Clam)	2.32 inch (59mm)L	IMS No.3956	Off Emerald Isle
	2.28 inch (58mm)L	DML No. 571*	S. Cape Hatteras
GLYCYMERIS AMERICANA (DeFrance) (Giant American Bittersweet)	4.02 inch (103)L	Piper*	Offshore Scallops'
GLYCYMERIS SPECTRALIS Nicol (Spectral Bittersweet)	0.98 inch (25mm)L	IMS No.2713.3*	Cape Fear
HIATELLA ARCTICA (Linne) (Artic Saxicave)	1.14 inch (29mm)L	IMS No. -	S.E. Cape Lookout
	0.63 inch (16mm)L	IMS No.2045*	S.E. New River
LABIOSA ANATINA (Spengler) (Smooth Duck Clam)	2.80 inch (71mm)L	IMS No.473	Bird Shoal
LABIOSA PLICATELLA (Lamarck) (Channeled Duck Clam)	2.72 inch (69mm)L	IMS No.732	Fort Macon
LAEVICARDIUM LAEVIGATUM Linne (Common Egg Cockle)	2.72 inch (69mm)H	IMS No. 768	Fort Macon
	2.56 inch (65mm)H	IMS No.2734*	Off Oregon Inlet
LAEVICARDIUM MORTONI (Conrad) (Morton's Egg Cockle)	0.73 inch (18.5mm)H	IMS No.444	Bogue Sound
LAEVICARDIUM PICTUM (Ravenel) (Ravenel's Egg Cockle)	1.02 inch (26mm)H	IMS No.1895*	S.E. New River
LIMA SCABRA (Born) (Rough Lima)	2.60 inch (66mm)H	IMS No.2704	S.E. Cape Fear
LITHOPHAGA ANTILLARUM (d'Orb.) (Giant Date Mussel)	3.23 inch (82mm)L	IMS No.1064*	Off Cape Lookout
LITHOPHAGA ARISTATA Dillwyn (Scissor Date Mussel)	1.34 inch (34mm)L	DML No. 1160*	Off Cape Lookout
LITHOPHAGA BISULCATA (d'Orb) (Mahogany Date Mussel)	1.10 inch (28mm)L	IMS No.2589*	Bogue Sound
LUCINIA PENNSYLVANIA (Linne) (Pennsylvania Lucine)	2.48 inch (63mm)L	IMS No.1065	Off Core Banks
	2.05 inch (52mm)L	DML No. 2508*	E. of Cape Lookout
LYONSIA BEANA d'Orb. (Pearly Lyonsia)	0.71 inch (18mm)L	IMS No. -*	S.E. Cape Lookout
LYROPECTEN NODOSUS (Linne) (Lion's Paw)	4.72 inch (120mm)L	IMS No.1842*	ESE New River
MACOMA BALTHICA (Linne) (Balthic Macoma)	1.06 inch (27mm)L	IMS No.1130.1*	Adams Creek, N.C.
MACOMA BREVIFRONS Say (Short Macoma)	0.95 inch (24mm)L	IMS No. -	S.E. Cape Lookout
MACOMA PHENAX Dall	0.79 inch (20mm)L	IMS No. - *	Neuse River
MACOMA TENTA Say (Tenta Macoma)	0.67 inch (17mm)L	IMS No.1236*	Bogue Sound
MACROCALLISTA MACULATA Linne (Calico Clam)	3.39 inch (86mm)L	IMS No.2738*	S. of Cape Lookout
MACROCALLISTA NIMBOSA (Lightfoot) (Sunray Venus)	6.38 inch (162mm)L	IMS No. 390*	Cape Lookout
MACTRA FRAGILIS Gmelin (Fragile Atlantic Mactra)	1.97 inch (50mm)L	IMS No.1500*	Bogue Sound
MARTESIA CUNEIFORMIS Say (Wedge-shaped Martesia)	0.59 inch (15mm)L	IMS No.439*	Core Sound
MERCENARIA CAMPECHIENSIS (Gmelin) (Southern Quahog)	5.58 inch (142mm)L	Truckner*	Cape Lookout Bight
MERCENARIA MERCENARIA (Linne) (Northern Quahog)	4.42 inch (112mm)L	IMS No.98*	Hoop Pole Creek
MERCENARIA CAMPECHIENSIS - MERCENARIA HYBRID ??	5.94 inch (151mm)L	IMS No. - *	Bogue Sound
MODIOLUS AMERICANUS (Leach) (Tulip Mussel)	1.81 inch (46mm)L	IMS No.46*	Core Sound

MODIOLUS DEMISSUS (Dillwyn) (Atlantic Ribbed Mussel)	5.24 inch (133mm)L	IMS No. -	Radio Island
MODIOLUS MODIOLUS (Linne) (Northern Horse Mussel)	4.48 inch (114mm)L	IMS No.1111*	ENE Oregon Inlet
MULINA LATERALIS (Say) (Dwarf Surf Clam)	0.86 inch (22mm)L	IMS No. - *	Neuse River
MYA ARENARIA Linne (Soft-shell Clam)	3.65 inch (92mm)L	IMS No.1627	Cape Lookout
	3.18 inch (81mm)L	DML No. 2506*	Shackleford Banks
MYTILUS EDULIS Linne (Common Blue Mussel)	2.56 inch (65mm)L	DML No. 786	N. of Cape Hatteras
	2.23 inch (56.5mm)L	IMS No.693*	Kitty Hawk
NOETIA PONDEROSA (Say) (Ponderous Ark)	2.48 inch (63mm)L	IMS No.1121.5*	Off Shackleford
OSTREA EQUESTRIS Say (Crested Oyster)	2.05 inch (52mm)H	IMS No. 244C *	Bogue Sound
OSTREA PERMOLLIS Sowerby (Sponge Oyster)	1.66 inch (42mm)H	IMS No. -*	ESE New River
PANDORA TRILINEATA Say (Say's Pandora)	1.10 inch (28mm)L	IMS No.2549*	W. Wimble Shoals
PANOPE BITRUNCATA Conrad (Atlantic Geoduck)	7.15 inch (181mm)L	IMS No. 405d	Off Core Banks
PAPYRIDEA SOLENIFORMIS (Bruguiere) (Spiny Paper Cockle)	1.50 inch (38mm)L	IMS No. 637	New Topsail
	0.94 inch (24mm)L	IMS No.2325.2*	SSE Cape Hatteras
PECTEN RAVENELI Dall (Ravenel's Scallop)	2.76 inch (70mm)L	IMS No.1885*	S.E. New River
PERIPLOMA LEANUM (Conrad) (Lea's Spoon Clam)	1.73 inch (44mm)L	IMS No. 1383	Southport
PETRICOLA PHOLADIFORMIS Lamarck (False Angel Wing)	2.21 inch (56mm)L	IMS No. 747p	Fort Macon
	1.77 inch (45mm)L	DML No.1845*	Harkers Island
PHOLAS CAMPECHIENSIS (Gmelin) (Campeche Angel Wing)	2.76 inch (70mm)L	IMS No.451b	Yaupon Beach
PITAR MORRHUSANA (Linsley) (Morrhua Venus)	1.46 inch (37mm)L	DML No.514	Off Oregon Inlet
	1.42 inch (36mm)L	DML No. 514*	Off Oregon Inlet
PHACOIDES FILOSUS (Stimpson) (Northeast Lucinia)	1.22 inch (31mm)L	DML No. 519*	Off Oregon Inlet
PLACOPECTEN MAGELLANICUS (Gmelin) (Atlantic Deep-Sea Scallop)	6.38 inch (162mm)L	Piper*	Above Cape Hatteras
PLICATULA GIBBOSA (Linne) (Kitten's Paw)	1.33 inch (32mm)L	IMS No. -	Off Cape Fear
PODODESMUS RUDIS (Broderip) (False Atlantic Jingle)	1.02 inch (26mm)H	IMS No.363*	S.E. Cape Lookout
POLYMESODA CAROLINIANA (Bosc) (Carolina Marsb Clam)	2.09 inch (53mm)L	IMS No.2601*	Calico Creek
PSEUDOCHAMA RADIANS (Lamarck) (Atlantic Left-handed Jewel Box)	2.21 inch (56mm)H	IMS No.1830*	S.E. New River
PTERIA COLYMBUS (Roding) (Atlantic Wing Oyster)	3.81 inch (97mm)L	IMS No.1881*	S.E. New River
RANGIA CUNEATA (Gray) (Common Rangia)	3.18 inch (81mm)L	Wolfe*	Neuse River
RUPELLARIA TYPICA (Jonas) (Atlantic Rupellaria)	1.10 inch (28mm)L	DML No.1221*	Off Cape Lookout
SEMELE BELLASTRIATA (Conrad) (Cancellate Semele)	0.83 inch (21mm)L	IMS No.2512	Off Cape Fear
	0.67 inch (17mm)L	IMS No.2210*	S.E. Cape Lookout
SEMELE PROFICUA (Pulteney) (White Atlantic Semele)	1.38 inch (35mm)L	IMS No.630b	New Topsail Inlet
SEMELE PURPURASCENS (Gmelin) (Purplish Semele)	1.10 inch (28mm)L	IMS No. 2513	Off Cape Fear
	1.02 inch (26mm)L	IMS No - *	S.E. Cape Lookout
SOLECURTUS CUMINGIANUS Dunker (Corrugated Razor Clam)	2.84 inch (72mm)L	IMS No. 1640	Offshore N. C.
SOLEMYA VELUM (Say) (Boreal Awning Clam)	0.79 inch (20mm)L	IMS No. 1350*	Bogue Sound
SOLEN VIRIDIS (Say) (Green Jackknife Clam)	1.38 inch (35mm)L	IMS No. - *	Atlantic Beach
SPENGLERIA ROSTRATA (Spengler) (Spengler Clam)	1.18 inch (30mm)L	IMS No. - *	Off Cape Fear

SPISULA RAVENELI (Conrad) (Southern Atlantic Surf Clam)	4.64 inch (118mm)L	IMS No.	Nags Head
	4.13 inch (105mm)L	IMS No. 1343*	Cape Lookout
SPONDYLUS AMERICANUS Herman (Atlantic Thorny Oyster)	3.23 inch (82mm)H	IMS No. -	Off Cape Fear
	3.07 inch (78mm)H	IMS No.2596*	S.E. Cape Lookout
TAGELUS DIVISUS Spengler (Purplish Tagelus)	1.30 inch (33mm)L	IMS No.504*	Bird Shoal
TAGELUS PLEBEIUS (Lightfoot) (Stout Tagelus)	3.58 inch (91mm)L	IMS No.503*	Bird Shoal
TELLIDORA CRISTATA Recluz (White-crested Tellin)	0.95 inch(24mm)L	IMS No.929	Atlantic Beach
TELLINA AEQUISTRIATA Say (Lintea Tellin)	0.90 inch (23mm)L	IMS No.513*	Bird Shoal
TELLINA ALTERNATA Say (Alternate Tellin)	2.48 inch (63mm)L	IMS No.541a	Holden's Beach
TELLINA LISTERI Roding (Speckled Tellin)	1.73 inch (44mm)L	IMS No.2316	SSE Cape Hatteras
TELLINA MAGNA Spengler (Great Tellin)	4.42 inch(112mm)L	IMS No.1867	S.E. New River
TELLINA NITENS C. B. Adams (Georgia Tellin)	1.42 inch (36mm)L	IMS No. - *	S.E. Cape Lookout
TELLINA PROBRINA Boss	0.79 inch (20mm)L	IMS No. -	S.E. New River
TRACHYCARDIUM EGMONTIANUM (Shuttleworth) (Prickly Cockle)	2.96 inch (75mm)H	DML No.2232	Cape Lookout
	2.80 inch (71mm)H	Piper*	Cape Lookout Bight
TRACHYCARDIUM MURICATUM (Linne) (Yellow Cockle)	1.66 inch (42mm)H	IMS No.	Middle Sound - Wrightsville Beach area
TUCETONA PECTENATA (Gmelin) (Comb Bittersweet)	0.86 inch (22mm)L	IMS No.644	Shackleford
VENERICARDIA BOREALIS (Conrad) (Northern Cardita)	1.33 inch (32mm)L	IMS No.1219*	Off Oregon Inlet
YOLDIA LIMATULA (Say) (File Yoldia)	1.66 inch (42mm)L	DML No.593*	Off Oregon Inlet
YOLDIA SAPOTILLA Gould (Short Yoldia)	0.86 inch (22mm)L	IMS No.1224*	Off Oregon Inlet

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