Scotch Bonnet

NUMBER 9

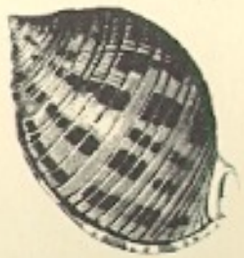
NORTH

CAROLINA

SHELL

CLUB

BULLETIN



MAY 1978
21st. YEAR

NORTH CAROLINA SHELL SHOW 1976 - Crabtree Valley Mall
Raleigh, NC (Photo - Paul R. Jennewein)

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EDITOR . . . HUGH J. PORTER

NORTH CAROLINA SHELL CLUB, INC.
(MAILING ADDRESS: PO BOX 609, MOREHEAD CITY, NC 28557

OFFICERS

1978

PRESIDENT	MRS. JOHN MOBLEY (Mary)
VICE PRESIDENT	MR. BILL MOFFITT
CORRESPONDING SECRETARY	MISS ANN YELVINGTON
RECORDING SECRETARY	MISS MARGUERITE THOMAS
TREASURER	MR. DOUGLAS NUNNALLY
EXECUTIVE COMMITTEE	
MEMBER AT LARGE	DR. JOHN FERGUSON

1977

PRESIDENT	MR. WM. VAN LANDINGHAM
VICE PRESIDENT	MRS. JOHN MOBLEY (Mary)
CORRESPONDING SECRETARY	MISS ANN YELVINGTON
RECORDING SECRETARY	MISS MARGUERITE THOMAS
TREASURER	MRS. J. STACY WALTON
ASSISTANT TREASURER	MRS. CRAIG VAN ATTA
EXECUTIVE COMMITTEE	
MEMBER AT LARGE	DR. JOHN FERGUSON

1976

PRESIDENT	MR. HUGH J. PORTER
VICE PRESIDENT	MRS. JOHN MOBLEY (Mary)
CORRESPONDING SECRETARY	MR. PAUL R. JENNEWEIN
RECORDING SECRETARY	MISS MARGUERITE THOMAS
TREASURER	MRS. J. STACY WALTON
EXECUTIVE COMMITTEE	
MEMBER AT LARGE	DR. JOHN FERGUSON

CONSTITUTION

(As revised to date)

NORTH CAROLINA SHELL CLUB, INC.

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 $3.00; For JUNIOR MEMBERS, $0.50. JUNIOR MEMBERSHIPS 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 of the EXECUTIVE COMMITTEE. HONORARY MEMBERS will not be eligible to hold an elected Shell Club Office, vote, or be required to pay dues.

* LIFE MEMBERSHIPS may be granted by a majority vote of the members present at a meeting following a recommendation by the EXECUTIVE COMMITTEE. LIFE MEMBERSHIP as defined would permit full rights as an active member to hold office and vote but not 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.

* Dr. John Ferguson, following granting of LIFE MEMBERSHIP in the North Carolina Shell Club by its membership, will be extended the privilege of serving as a permanent member of the EXECUTIVE COMMITTEE.

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.

Under no provision will any part of the corporations net earnings inure to the benefit of any of its officers, directors, members, or any other private individual.

In the event that the North Carolina Shell Club, Inc. should dissolve, all assets will be donated to the North Carolina Museum of Natural History.

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*Additions to the North Carolina Shell Club Constitution expected to be added during the May, 1978 meetings.

** The area enclosed by parentheses is expected to be reworded by the club membership during the May, 1978 meetings to read as follows: "two members from the club membership who shall be elected one each year to serve a two-year term. These MEMBERS AT LARGE shall not serve consecutive terms."

In assembling this BULLETIN, your editor remembered several policy changes instituted earlier by either the club membership and/or the EXECUTIVE COMMITTEE for which there may be no written record; there also may be more such undocumented but practiced policies. Such editor-known policies are:

1. Creation of the offices of CORRESPONDING SECRETARY, RECORDING SECRETARY, and ASSISTANT TREASURER.
2. The policy that a PRESIDENT'S term in office is restricted to two consecutive terms with the option of reelection to the same at a later date.

EDITOR'S COMMENTS

Up to somewhat recent years, club policy has been to publish a bulletin every other year and to hold a club-sponsored shell show in the intervening year. This evolved as club finances were not sufficient each year for both. During the last three years a shell show has been successfully held each year. Club dues have been raised recently but bulletin costs increased even more during recent years partly from restructuring of policies by our previous printer. We are grateful for all of the earlier free and/or at-below-cost help that Carl and Janet Truckner gave towards printing of previous bulletins. This bulletin was typed at the UNC-IMS by Mrs. Jane Garner and myself and printing again handled by the Truckners. Your editor apologizes that this edition was not published in 1977 as promised. Reasons for such are many but most related to typing problems and frustrations concerning certain articles. Reasons do include an illfated exploration into replacing the bulletin by an up-to-date newsletter similar to those published by the New York Shell Club and the Houston Conchology Society, Inc. Cost involved upon investigation and an inability to find one or more persons qualified and willing to act as editor and/or publisher scuttled the attempt. It is still your editor's belief that, as much as I like our past bulletins and believe that they contain excellent material, a quarterly or bi-yearly newsletter would be a lot more informative to the club membership and serve to increase interest by many of our club newcomers. Publishing costs however must be balanced and compared with bulletin usefulness to the membership vs. other worthwhile club expenses as for example - shell shows. I believe that the now yearly shell shows have done much for club interest but the membership must realize that the shows are expensive, particularly, as the show committees have had to frequently get qualified judges from out of state. This has involved major travel expenses and soemtimes an honorarium. l The problem of getting judges is more acute as more and more museum curators, having molluscan knowledge, and molluscan scientists are increasingly prevented from taking time off to judge shows by their staff duties or their superiors.

Many of you will note that the club is now incorporated, Such action has been talked about for a long time. Mary Mobley, our incoming PRESIDENT this year, took the

bull by horns and through a lot of personal effort and time make sure that such was done. She and Mrs. Charlotte Johnson deserve much thanks for such action. It is my belief that the legal status of the club, particularly that of the EXECUTIVE COMMITTEE, due to potential lawsuits arising from field trip related accidents, has been quite dangerous for some time by not being incorporated. In relationship to this, at present, the club has not yet applied for federal tax-exempt status - such application is being investigated. The status of the club in relationship to state tax-exempt status for franchise and income taxes was approved as of April 12, 1978. Some changes recently made to the club constitution were done to accomplish the above.

In all previous bulletins there has been included a TREASURER'S REPORT concerning the financial position of the club. Such a statement had been prepared by Mrs. Stacy Walton for inclusion in an early 1977 bulletin. As that statement is now quite out of date, it has not been included. Members in attendance at recent club meetings know that club finances are at present in good shape.

In preparation of this bulletin, I must give thanks for the help and advise by the other members of the bulletin committee: Carl Truckner and Ann Yelvington. Also thanks are due to Mrs. Jane Garner, Mrs. Doris Oakley, and to my wife, "Pinky" for proof reading.

One last item - the last several bulletins have been dedicated to outstanding North Carolina Shell Club Members who have meant so much to the club. It was not an oversight that such was not done this year, there are many that the bulletin should be dedicated to. But without making a big issue of it, I would like to think that this bulletin is dedicated to all who helped make the club a success during these past 20 years. Many of them attended the 20th year birthday party for the club which we held Oct. 1, 1977 in the North Carolina State University Falculty Club in Raleigh. The number of Charter Members, still belonging, is becoming increasingly small. BELATED HAPPY BIRTHDAY - North Carolina Shell Club.

AMU MEETINGS IN WILMINGTON JULY 16-21, 1978

EDITOR

The 44th annual meeting of the American Malacological Union, Inc., will be held on the campus of the University of North Carolina at Wilmington on Sunday through Friday July 16-21, 1978. The meetings are being hosted primarily by our club along with interested faculty from the University of North Carolina at Wilmington and Chapel Hill. All interested members of our club are urged to attend and participate in the activities of the meetings.

It has been questioned whether or not the club could afford to host such meetings. Club action, voted on and passed by the club membership, in effect stated that the club agreed to host the 1978 AMU Meetings in Wilmington, NC, BUT that in so doing, such action would be done without cost to the treasury of the North Carolina Shell Club.

Some North Carolina Shell Club members have further questioned: What is the "American Malacological Union, Inc."? the following is copied from the 4th ed. booklet "How to Study and Collect Shells, A Symposium" published by the AMU in 1974 (a valuable 107 page booklet for all - it can be purchased from Paul Jennewein of our club for $2.50, or less?):

"The American Malacological Union is a scientific, non-profit-making organization dedicated to the study and appreciation of mollusks and their shells. Membership is divided about equally between amateurs and those who make malacology their career - scientists, teachers, museum curators, research workers, etc. Regular membership is limited to residents of the Americas and the West Indies, but any interested person residing outside these boundaries is welcome to become a corresponding member upon application to the AMU Recording Secretary.

An annual meeting is held each summer, usually at one of the larger universities or museums. All AMU members are warmly welcomed to the meetings which combine scientific papers, a banquet, a field trip and such other attractions as the local committee may arrange.

The AMU Bulletin is an annual report in booklet form, sent without extra charge to all members. It gives summaries or abstracts of the papers presented at the Annual Meeting. It also provides an annually revised listing of all AMU members, together with their addresses and special malacological interests. During the year, newsletters supply members with information about current developments and reports from the many local shell clubs for whom the AMU provides a special membership. Advance notice of meetings is sent to all regular members."

Your editor would add that most shell clubs organized throughout this nation are also members of the AMU.

Most of the daytime meeting time will be taken up by technical or scientific papers. Do not let that discourage you though as some of the best have been presented by amateurs. The types of papers to be presented will be representative of the wide spread of malacological interests present at the meetings.

The North Carolina Shell Club will need help from the club members to help register persons attending, aiding in the wide variety of field trips which Sally and Doug Nunnally have so ably arranged, and in helping set up the banquet. All members should have received a notice concerning the activities of these meetings by publication time of this bulletin.

SHELL SHOWS - 1976-1977, NORTH CAROLINA SHELL CLUB

DOROTHY P. PORTER

Crabtree Valley Mall in Raleigh was the location of the North Carolina Shell Club's Standard Shell Show in October, 1976.

The two-day show was opened with a ribbon-cutting by the Hon. James Graham, Commissioner of Agriculture of the State of North Carolina. Mr. Elwood Perry, general manager of the Mall and Mrs. Becky Turner, promotion manager, also were present.

Mrs. Charlotte Johnson, Raleigh was arrangements chairman for the show.

Judges for the show were Dr. R. Tucker Abbott from the Delaware Natural History Museum in Greenville, DE; Dr. Charles Peterson from the University of North Carolina Institute of Marine Sciences, Morehead City, NC and Mrs. Bette Elliott.

The categories of exhibits and winners in each division were as follows:

NORTH CAROLINA COLLECTIONS, MARINE DIVISION, SELF-COLLECTED: 1st - Olese Walton (included Atlantic Geoduck); 2nd - Carl Truckner; 3rd - Ann Yelvington (mollusks found alive in Bogue Sound).

NORTH CAROLINA COLLECTIONS, FOSSILS: 1st - Dorothy and Hugh Porter (Miocene and Pliocene periods); 2nd - Sally Nunnally (Cenozoic and Mesozoic from the Tar River).

REGIONAL COLLECTIONS, ANY SOURCE, MARINE DIVISION: 1st - Hugh Porter (macromollusks from 1200 ft. depth, Dry Tortugas); 2nd - Cornelia McInnes (Gulf of Mexico).

REGIONAL COLLECTIONS, MARINE DIVISION, SELF-COLLECTED: 1st - Ruth Dixon (Mexico, including Puerto Panasco and Cozumel); 2nd - Kay and Wayne Neff (Okinawa).

EDUCATIONAL: 1st - Hugh Porter (Molluscan variation within Class, Family and single Species); 2nd - Charlotte Johnson, Raleigh (Growth series of two introduced species, the Giant African Snail and a freshwater drainage-ditch snail); 3rd - Roland Shelley (Eleven endangered North Carolina mollusks); 3rd - Lucy Piper (Self-collected North Carolina mollusks).

FAMILY or GENUS COLLECTIONS, RECENT: 1st - Charlotte Johnson, Raleigh (five cases of Pectens, all having both valves); 2nd - Kathy Quinerly (63 species of Cypraeidae); 3rd - Hugh Porter (50 species of Olividae).

SPECIALIZED COLLECTIONS: 1st - Thelma Tripp (Color variation of Aequipecten gibbus Linne); 2nd - Olese Walton (Color variations of Lyropecten nodosus Linne dredged by North Carolina scallop boats).

JUNIOR, MARINE DIVISION, SELF-COLLECTED: 1st - Joe Carter (32 specimens collected in the shell piles at Williston, NC); 2nd - Chris Van Atta (Okinawa); 3rd - Trey Nixon (North Carolina and Puerto Pinasco, Mexico).

JUNIOR, ANY SOURCE: 1st - Miranda Attewell (collection made on a visit to New Zealand).

NOVICE, SELF COLLECTED: 1st - Mr. and Mrs. C. R. Von Atta (104 species from Okiniwa) - also received the DUPONT AWARD; 2nd - Billy Corbett; 3rd - Kay and Wayne Neff (Okiniwa).

NOVICE, ONE FAMILY: 1st - Katharine Hill (Wentletraps).

SHELL ART, PHOTO DIVISION: 1st - Ruth Dixon.

SHELLCRAFT: 1st - Olese Walton (Jewelry from the sea and delicate shell pictures) - also received "MOST BEAUTIFUL EXHIBIT" award' 2nd - Mrs. Van Atta (Christmas ornaments using oyster shells); 3rd - Charlotte Johnson, Raleigh (shell picture).

SHELL ART, GRAPHIC: 1st - Dorothy Porter (Needlepoint shell pillow designed by Maggie Lane); 2nd - Billy Corbett (Pencil sketches of 16 shells).

WORLDWIDE COLLECTION, MARINE DIVISION, ANY SOURCE: 1st - Cora Staples (Family - Cypraeidae) - "BEST OVERALL COLLECTION" award; 2nd - T. C. Van Landingham (Containing Conus milne-edwardsi Jousseaume, 1894 "Glory of India") - "BEST SHELL OF SHOW" award; 3rd - Kathy Quinerly (Bullidae, Mitridae, etc.)

LIVE MOLLUSK COLLECTION, MARINE: 1st T. C. Van Landingham (Live-collected Busycons); 2nd - T. C. Van Landingham (Aquarium with Busycon).

LIVE MOLLUSK DIVISION, LAND: 1st Eloise Walton (Euglandina rosea (Ferussae)).

ARTIFICIAL SHELLS: 1st - Charlotte Johnson (Shell Collecting in Antique Shops); 2nd - Dorothy and Hugh Porter (Antique glassware, shell-based designs); 3rd - Elizabeth Grady (plate "Shell and Tassel" design).

Among the non-competitive entries was "Odds and Ends From Here and There" shown by former North Carolina Shell Club President Carl Withrow and his wife Bess.

In November of 1977, the North Carolina Shell Club held a one-day shell show at the Marine Resources Center, Pine Knoll Shores near Morehead City. Judges for the event were Dr. Ned Smith, director of the center, and Walter Lowrey, a former president of the Shell Club, now residing in Georgia.

The"BEST SHELL OF THE SHOW" trophy was awarded to Cora Staples for a specimen of Cypraea guttata Gmelin. Renate and Ed. Skinner won the "BEST OVERALL COLLECTION" trophy for their self-collected rare cones.

The public was invited to the show and to tour the Marine Resources Center's facilities and aquariums.

Divisions and winners in the show were as follows:

NORTH CAROLINA COLLECTIONS, MARINE DIVISION: 1st - Billy Corbett; 2nd - Janet and Carl Truckner.

NORTH CAROLINA COLLECTIONS, FOSSILS: Ruth Dixon.

REGIONAL COLLECTION, ANY SOURCE, MARINE DIVISION: 1st - Ruth Dixon.

REGIONAL COLLECTION. 75% SELF-COLLECTED: 1st - Marguerite Thomas.

WORLDWIDE COLLECTION, ANY SOURCE, MARINE DIVISION: 1st - Kathy Quinerly; 2nd - Cora Staples; 3rd - Ruth Dixon.

WORLDWIDE COLLECTION, LAND DIVISION: 1st - Kathy Quinerly.

FAMILY or GENUS COLLECTION, RECENT DIVISION: 1st - Renate and Ed. Skinner; 2nd - Marguerite Thomas; 3rd - Kathy Quinnerly.

SPECIALIZED COLLECTION: 1st - Renate and Ed. Skinner; 2nd Griffith and Diane Trussell; 3rd - Billy Corbett.

MINATURE COLLECTION: 1st - Olese Walton; 2nd - Lynda Clay.

JUNIOR COLLECTION: 1st - Linda M. Taylor; 2nd - John Lindsey.

NOVICE COLLECTIONS: 1st - Jim, Linda and Kirstan Brunner; 2nd - Leonard and Carolyn Smith; 3rd - Herman and John Lindsey.

SHELL PHOTOGRAPHY: 1st - John H. Ferguson; 2nd - a tie - Ruth Dixon; 2nd - Tommy Clay.

SHELLCRAFT: 1st - Leonard and Carolyn Smith; 2nd - Billy Corbett; 3rd - Sarah Cahoon.

ARTIFICIAL SHELLS, ANTIQUES, ETC.: 1st - Charlotte G. Johnson.

COMMENTS ON THE SYSTEMATIC CHARACTERS USED IN IDENTIFICATION OF SPECIES IN THE GENUS TURBONILLA (GASTROPODA, PYRAMIDELLIDAE).[1]

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Shells of the opisthobranch family Pyramidellidae are among the most difficult of all molluscs to identify. Dall and Bartsch (1909) divided this family into three major genera - Pyramidella, Odostomia, and Turbonilla. The genus Turbonilla, with which this article is concerned, was described by Dall and Bartsch (1909) as those pyramidellids with a single columellar fold and a slender many-whorled growth form. Within this genus, they placed a large number of subgenera including Chemnitzia, Turbonilla, Strioturbonilla, Pyrgiscus, Mormula, and Peristichia.

Today, even the common turbonillas are so poorly understood that correct identifications are rare indeed. Even pyramidellid experts have often failed to agree. Perhaps the best example is the controversy that surrounded the identification of Turbonilla interrupta in 1909. Bartsch (1909a) described and figured what he considered to be T. interrupta. Bush (1909) disagreed, figured what she considered to be T. interrupta and called Bartsch's (1909a) shell T. pseudointerrupta. Later, Bartsch (1909b) pointed out that the shell described by Bartsch (1909a) and the shell described by Bush (1909) were not only the same species but in fact, the same specimen. In this case, the two pyramidellid authorities of the time could not even agree that the same specimen was the same species. Many other examples could be listed.

Why are turbonillas so poorly understood? There are a large number of described species none of which are very well known. Shell characters have been used to differentiate these species. Unfortunately, the ones that have been used notoriously variable, particularly the number of axial ribs and the pattern of spiral bands. Poor understanding of this variability has been the prime source of confusion for it often makes the distinction between species very difficult, not only because the variability within a species is large, but also because, all too often, different species have the same characters varying in a nearly identical manner. In addition, few quantifiable characters have been used. Words such as "more, less, stronger, weaker", etc., are frequently used. Such words require examples of both species for comparison and thus make identification of single specimens of species nearly impossible. The failure to use quantifiable characters and to document the variability of the characters used has resulted in the complete systematic chaos that is found today.

The purpose of this paper is to discuss the shell characters possessed by the turbonillas and to suggest how they might best be used in identification. Characters that are useful because of their presence or absence (either-or characters) and quantifiable

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1 The paper was presented at the October 1, 1976 meetings in Yaupon Beach, N.C.

2 Mr. Powell is at present a candidate for the Ph.D degree in this department.

characters which are easily measured are stressed. Angle measurements which require a goniometer or similar device and the usage of equations requiring large numbers of measurements (e.g. Kohn and Riggs, 1975), while valuable for the specialist, will not normally, in the author's opinion, be employed by most people interested in identifying a Turbonilla and are not stressed in this paper.

Laws (1937) and Odé and Speers (1972) listed a number of potentially useful systematic characters possessed by the turbonilla shell, including the axial and spiral sculpture, the protoconch, the type of aperture, and the type of growth form. Within each of these five categories are a number of potentially useful characters as well as a number of almost useless ones.

The single character most often relied upon in the past for identification in most subgenera is the pattern of the spiral sculpture. Unfortunately, this is the single most variable and most confusing character possessed by many Turbonilla. Lopes (1958) has described the variation in spiral banding in a species of Turbonilla (not T. dispar as they claim). Porter (1977) has described similar variability in Odostomia seminuda and O. impressa. This variation has often led to multiple naming of single species. For example, O. beauforti Jacot 1921 is a specimen of O. impressa possessing six instead of the usual four spiral lines. This problem is compounded by the occurrence of species with identical (but still variable) or nearly identical spiral patterns. For example, both T. aragoni Dall and Bartsch 1909 and T. acicula Holmes 1860 have seven spiral cords. Spiral sculpture patterns must, therefore, be used with caution and rarely, if ever, as the only identifying character of a species.

The second most frequently used character, the number and shape of the axial ribs, is also quite variable. Wharton (1976) has discussed the variability in rib number found in Turbonilla nivea and Lopes (1958) in Turbonilla sp. Moreover, as noted by Laws (1937), the last few whorls of the adult often show a distinct increase in axial rib number as well as significant changes in spiral band pattern. Laws (1937) called the former senescent axial acceleration. Thus even a statistical treatment is often difficult. The inclusion of individuals showing this phenomenon in a population assessment would seriously change means and standard deviations for the population. Moreover, shells possessing this trait often appear remarkably different from others of the same species. Differences in strength, spacing and shape of the ribs are found but are difficult to quantify and are therefore of limited value. One either-or character does seem to be of value. The slant of the ribs with respect to the shell axis tends to be either prosocline (fig. 1a) or opisthocline (fig. 1b). This character becomes more apparent as the shell becomes older. Completely vertical ribs (orthocline) are rare in turbonillas.

The protoconch provides a wide variety of good systematic characters that vary relatively little. It is unfortunate that few workers besides Laws (1937) and Odé and Speers (1972) have stressed these and that few holotypes have intact protoconchs. Possible characters include the width (fig. 2), the degree of insertion into the first teleoconch whorl (fig. 3), the number of whorls, the angle of the protoconch axis to that of the teleoconch, and the spire height. All but the angle of axis are easily measured. For example, Wells and Wells (1961) have demonstrated clear differences in the angle of the axis and the degree of insertion of the protoconchs of Odostomia seminuda and O. dux. Photographs of the protoconch of Turbonilla crenata and T. elegantissima published by Rodriguez Babio and Thiroit-Quievreux (1975) show the differences in width and spire

height that can be found between species.

Another character of considerable importance is the basic growth form of the shell - the rate of whorl expansion and spire translation, the convexity of a whorl, and the way in which two whorls meet at a common suture. Unfortunately, the last two are particularly difficult to define and quantify although the presence or absence of a channeled suture or a shouldered whorl is important. Kohn and Riggs (1975) have demonstrated the usefulness of the first two characteristics in Conus systematics. Both measurements, the rate of whorl expansion and spire translation, depend on a constant increase from whorl to whorl throughout the life of the snail. Such a constant increase is all too rare in turbonillas. They often are convex in outline, the early whorls increasing in size more rapidly than later ones. More rarely, the opposite occurs resulting in a slightly concave shell outline. The usage of specimens of varying whorl number may include some with one rate of spire translation and others whose later whorls have a different rate. However, measurements of growth form can be useful if based on the ratio of the width of a whorl (W, fig. 2) to either its height (H, fig. 2) or the distance from its abapical suture to the apex of the shell (L, fig. 1b). Teleoconch whorl number seven appears to be most useful for these measurements for two reasons. First, a shell of seven whorls is large enough to make measurement easy. Second, turbonilla shells are easily broken and, particularly when working with fossil or dead, recent material, specimens with an intact protoconch, of more than seven whorls, are rare. The absolute width and height of whorl seven and the ratio of the two are easily quantifiable, easily measurable, and highly useful characters. A large number of turbonillas can be distinguished using these characters and those of the protoconch. For example, specimens of Turbonilla sp. Holmes 1860 (fig. 1b) and T. punicea Dall 1883 (fig. 1a) can be distinguished readily by use of such measurements.

Many species descriptions contain careful descriptions of the aperture as well as the presence and strength of a columellar plication. Neither of these, except in the rare cases noted below, is a useful tool for species identification. The outer lip of the aperture is very fragile. The cause of the frequently occurring major injuries to turbonilla shells (e.g. fig. 1) noted by Odé and Speers (1971) is the loss of as much as one half of the outer portion of the last whorl from the outer lip edge back. A fossil specimen with a complete aperture is extremely rare. Even live specimens with broken apertures are common. This breakage not only destroys the shape of the aperture but also exposes the columella farther back than can be seen in an animal with a complete outer lip. In many turbonillas, this either exposes a tooth not normally seen or exposes the tooth at a position where it appears stronger than it does at the aperture. A few either-or apertural characters, such as the presence or absence of (1) lineations inside the outer lip and (2) a thickened rissoid-like outer lip, are potentially useful.

Special care must be used in identifying and describing worn shells. Several characters are readily changed. The aperture may be broken as previously discussed. Fine spiral line and striations disappear much more quickly than spiral cords or axial ribs. Worn specimens of Strioturbonilla may be confused with Turbonilla and Chemnitzia for this reason. The protoconch may be damaged. Such damage may be missed without careful examination resulting in measurements of W and H_p (fig. 3) being much too small.

Systematic characters used in turbonilla identification should be either quantifiable and easily measurable or amenable to an either-or choice for identification by a

nonspecialist because such identifications are often made without access to specimens of closely related species for comparison. Nonquantifiable characters, necessitating the use of adjectives such as stronger, less, fewer, etc., require a comparison between species or an intimate knowledge of the group and should not be used. However, a reasonable scheme of identification can be based on characters that meet the above criteria. The use of the characters possessed by the protoconch and the growth form of the shell as previously discussed allow identification of many species consistently and accurately. A number of either-or characters such as the presence or absence of spiral sculpture, lineations inside the outer lip, and the slant of the ribs relative to the teleoconch axis - prosocline or opisthocline - can be used. The extensive use of axial rib number and spiral sculpture pattern has created much of the systematic chaos which is found today in Turbonilla. It is doubtful that these features can be used to extract the turbonillas from it. They should be used only when other characters fail to differentiate species adequately. However, the use of the characters as recommended in this paper, characters which have not been extensively used in the past, should provide the basis for a consistent and accurate identification scheme for the genus Turbonilla.

Acknowledgments

I wish to thank Drs. Charles Jenner and Walter Wheeler and Mr. Hugh Porter for the advice and support given during the course of this project; Drs. Charles Jenner and Dirk Frankenberg for reading and critically evaluating this paper; Mr. Gilbert Libby who photographed the shells; and Mr. Greg Miller who prepared the photographs for publication.

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My Neighbor - The Malacologist

W. Bruce Huffaker

I asked him if he would come by
A little shell to identify.
He launched into some strange linguistics
Quoting Abbott in Latinistics,
Then Aristotle to Peter Dance
He went 'till I was in a trance.
Tho I think him wise and clever
He left me as confused as ever.

The Porpoise

W.B.H.

I travel the great Atlantic
And challenge the waves gigantic
But my present abode
When not on the road
Is the ball room of the Titanic

The Snail

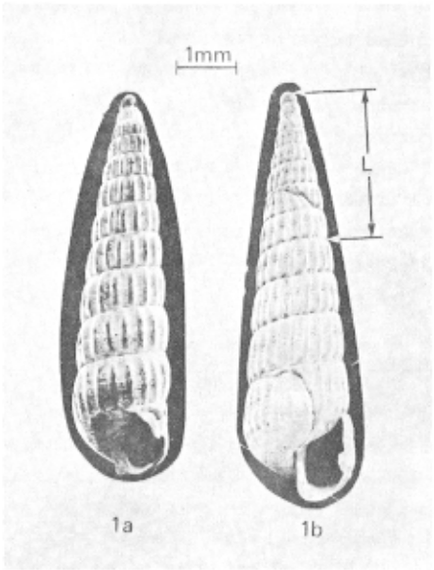
W.B.H.

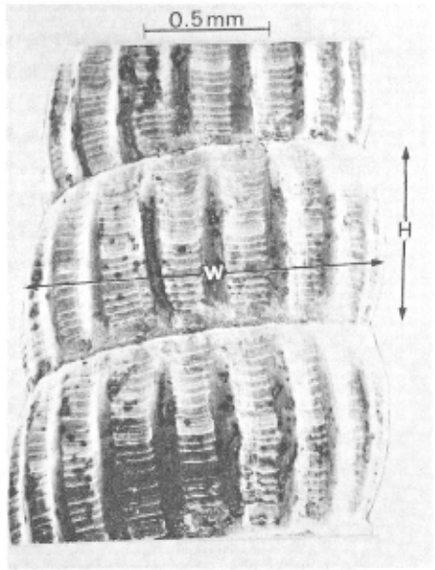
You never could forget his name
For he's the one of "slow poke" fame
Tho never has he won a race
His name is famous for his "pace"
Do not blame him for what he's not
He does his best with what he's got.

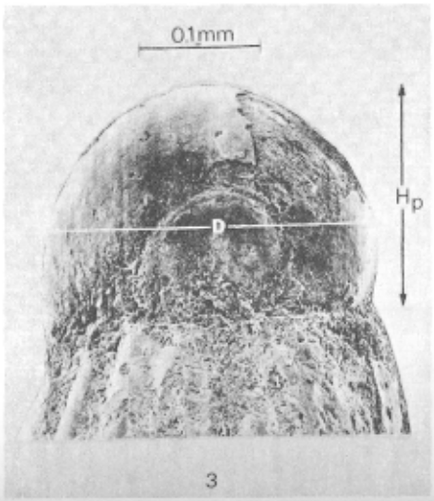
Figure 1: a) Turbonilla punicea Dall 1883 collected from the White Oak River, North Carolina. b) Turbonilla sp. collected from Banks Channel, Wrightsville Beach, N. C.

Figure 2: Turbonilla punicea whorl seven.

Figure 3: Turbonilla sp. protoconch. D is the width of the protoconch; H_p, its height above the first teleoconch whorl.







SUPERFAMILY: TONNACEA PEILE, 1926

PART I: FAMILIES CASSIDAE (HELMETS & BONNETS); TONNIDAE (TUN SHELLS); FICIDAE (FIG SHELLS).

JOHN H. FERGUSON

In this Mesogastropod superfamily, Part I covers three out of five currently accepted families (from which is now excluded the 'Colubrariidae', of Dall, 1909, which is best made a subfamily of the Neogastropod family MURICIDAE (in MURICACEA da Costa 1776)). TONNACEA replaces the older invalid name 'DOLIACEA'; its oldest Family is CASSIDAE Swainson, 1822 the Helmet and Bonnet Shells and their relatives. The coverage in Tucker Abbott's 1968 monograph in Vol. 2 of Indo-Pacific Mollusca is excellent and extends the 1943-1944 articles in Vol. 1 of Johnsonia.

GENUS: Cassis ("Klein, 1753") Scopoli, 1777, is based on the strict type-species Cassis (Cassis) cornuta (Linné, 1758), the Giant Horned Helmet of the Indo-Pacific. Although large and handsome, this particular species does not lend itself to good 'cameo' carvings (see later), but it is a popular shell ornament in many parts of the world. The South Sea natives often slice it in half to use as a canoe bailer or as a container for fluids. A conspicuous feature of most Helmet and Bonnet Shells is the broad parietal shield, or callus, of extra shell, which is laid-down by calcareous (=lime) secretions of the mantle membrane as it extends from the columellar (inner) lip of the aperture over the adjacent parietal area of the body whorl, and also over the thickened outer lip, including the tooth-like projections which jut into the shell-opening (aperture). The anterior (or siphonal) canal is strongly upturned and its main function is to protect the retractable proboscis and other mouth parts. The mollusk's eyes are located at the base of short tentacles (feelers), and the large crawling foot is broad and flat. On top of the foot is a relatively small, slender, elongated, horny operculum. The animal likes to feed on sea-urchins. Mature adult Horned Helmets range in height from 7 to 14 inches or more. Besides a number of fossils, there are four more 'recent' species of C. (Cassis). C. (Cassis) tessellata (Gmelin, 1791), the Tessellated Helmet, comes from Central West Africa, but the other three are from the Caribbean and adjacent regions of the northwest Atlantic, including the Southeast Coast of the U.S.A.

C. (Cassis) tuberosa (Linné, 1758), the so-called King Helmet, ranges up to North Carolina and also to Bermuda. It is a massive shell, reaching 4 to 9 inches, with a finely reticulated surface sculpture (which helps to distinguish it from the Flame Helmet). Its parietal shield is rather triangular (whereas this is more oval in the Queen and Flame Helmets). There is a large brown-colored patch at the center of the parietal shield and the same brown coloration also occurs between the teeth on the outer lip (which is not the case in the Flame Helmet).

C. (Cassis) madagascariensis Lamarck, 1822, the Queen (or Emperor) Helmet, is not from Madagascar but is Caribbean and also extends to our S.E. coast and out to Bermuda. Fine specimens come from the Bahamas. In the Queen Helmet, the parietal shield is oval and is salmon-colored. A blackish-brown coloration occurs between the teeth on the outer lip, and also extends under the parietal callus all along the inner lip, but it is not concentrated in a central patch, as it is in the King Helmet. The surface sculpture is more ridged than reticulated and there are three rows of conspicuous nodules. The most massive

specimens reach 14 inches in height, or even larger, especially in the following subspecies.

C. (Cassis) madagascariensis spinella Clench, 1944 may be called Clench's Helmet. This form preponderates, almost exclusively, in Florida, but its range extends to N. Carolina, where it is especially to be found on Cape Lookout. The -spinella form is more swollen (or rotund) and with more numerous and smaller nodules. The name 'Cassis rotundata', of Perry, 1811, may have priority, but it has not been used for 150 years, and Abbott is petitioning the ICZN to suppress this term and to conserve the name -madagascariensis, of Lamarck, 1822.

C. (Cassis) flammea (Linné, 1758), the Flame Helmet, does not occur in N. Carolina, but it is found in Bermuda and all over the Caribbean to the lower Florida Keys. It is a smaller shell, seldom exceeding 5 inches, and it does not have a reticulated surface sculpture, but merely the typical flame-like red-brown markings. The parietal shield is notably thinner and the teeth on the outer lip do not have intervening brown markings (as is the case of the King and the Queen Helmets). Young shells of the three species are more easily confused than the adults, however.

Of the two other subgenera of Cassis, one is a California (Eocene) fossil, C. (Coalingodea) tuberculata †Gabb, 1864.

The subgenus C. (Hypocassis) was created by Tom Iredale, 1927, for several Australian shells, including the subtype species, C. (Hypocassis) fimbriata Quoy & Gaimard, 1833, the Fimbriate (or Bicarinate) Helmet, typically from Western Australia. The 'two-keeled' variety (named-bicarinata by Jonas, 1839) is really synonymous as are several other forms which have been needlessly separated by the name splitting Australians. Iredale split off C. (Nannocassis) for the species -nana Tenison-Woods, 1879, which is the Nodulose Helmet of eastern Australia. Abbott rejects 'Nannocassis' as a mere synonym of C. (Hypocassis); the preferred name, therefore, is C. (Hypocassis) nana. This is one of the smallest of the Helmet shells, usually reaching only 1 to 2 1/2 inches. The absence of axial wrinkles on top of the whorls readily distinguishes -nana from -fimbriata, or, also, from a young -cornuta.

The now separate GENUS: Cyraecassis Stutchbury, 1837, is based on the strict type-species Cypraecassis (Cypraecassis) rufa (Linné, 1758), the Red Helmet, or Bullmouth, of the Indo-Pacific. It ranges from East Africa to Australia and to Polynesia. It is the principal Helmet used in the cameo-carving shell art, which was particularly developed in Italy, mostly using shells imported from East Africa. Typical adult shells range from 2 1/2 to 7 1/2 inches and the best cameos are exquisite.

C. (Cypraecassis) testiculus testiculus (Linné, 1758), is the typical West Indian Baby Bonnet, or Reticulated Cowrie Helmet. Its surface shows longitudinal ridges and irregularly crossing spiral grooves, which create the reticulate (or net-work) appearance. The outer lip of the aperture becomes thickened and toothed, while the inner lip and adjacent body whorl become covered with a thin parietal callus that has an orange tinge. A distinctly knobby ridging, at and below the shoulder, is a rather uncommon variation, which is incorrectly called the form -crumena in Warmke and Abbott's Caribbean Seashells. Actually, '-crumena' (Bruguiere, 1792) is a synonym for C. (Cypraecassis) testiculus senegalica (Gmelin, 1791), which is a good subspecies named from its location in Senegal, West Africa.

C. (Cypraecassis) tenuis (Wood, 1828), the Slender Helmet of the Panamic region of the Central Eastern Pacific, reaches 3 to 5 inches, and its range is from lower California to the Galapagos Islands, off Ecuador.

Subgenus Cypraecassis (Levenia) Gray, 1847, is based on the single, subtype species C. (Levenia) coarctata (Sowerby, 1825), the Contracted Cowrie Helmet. It is also Panamic, ranging from the Gulf of California to Peru. Its names refer to the curious contraction in the upper third of the body, which results in a distinct infolding of the edge of the outer lip.

The GENUS: Phalium Link, 1807, is another which is now separated from the Cassis group. It is based on the strict type-species Phalium (Phalium) glaucum (Linné, 1758), Gray Bonnet or Glaucous Helmet, of the Indo-Pacific ranging from East Africa to the Northwest Pacific, from Melanesia to Japan. Looking into the aperture, the basal region of the outer lip shows four or five outwardly-jutting little spines. Phaliums differ from Cassis shells in not having much of a parietal shield and by not making an extended upturned anterior (siphonal canal), although this does curve sharply back.

P. (P.) bandatum (Perry, 1811), -areola (Linné, 1758), -decussatum (Linné 1758), and -fimbria (Gmelin, 1791) are four Indo-Pacific species, with several subspecies, and some other fossil cousins.

P. (Phalium) strigatum (Gmelin, 1791), the Indo-Pacific Striped Bonnet is another well-known member of this group, which Abbott says does not need to be put into a separate subgenus ('Bezoardicella' according to Habe, 1961).

Omitting the fossil subgenera P. (Mauicassis†) and P. (Galeodosconsia†), we come to another subgenus P. (Echinophoria) Sacco, 1890, which is based on an Italian fossil, P. (Echinophoria) intermedium †(Brocchi, 1816), but which also includes some rare and interesting deep-water recent species, which are described by Tucker Abbott in the new (1974) edition of his American Sea Shells, as well as in Indo-Pacific Mollusca. They include the Coronado Helmet, Phalium (Echinophoria) coronadoi (Crosse, 1867), the first live-taken specimen of which was trawled on Wimble Shoals off the Coast of North Carolina, and was studied and photographed by Hugh Porter.

Subgenus Phalium (Tylocassis) Woodring, 1928, was based on the species called "Buccinum inflatum" by Shaw 1811, which is now known to be just a synonym of P. (Tylocassis) granulatum (Born, 1778). This is the correct name for our Scotch Bonnet, which the N.C. Shell Club got our State Legislature to designate as the State Shell, the first of its kind, in 1965. Fine specimens are dredged on the scallop beds, offshore.

P. (T.) granulatum shows a thin, but obvious, parietal shield on the lower portion of which, near the inner lip, are numerous pimples (or pustules), while on the thickened outer lip there are evident tooth-like ridges. The brown, horny operculum is elongated and somewhat fan shaped. The surface sculpture of the shell shows flat circular ridges with squarish brown color patches. Some specimens, especially from deeper waters, may have a conspicuous varix, or axial rib, caused by the persistence of the thickened outer lip from an earlier stage in the shell growth. Some authors retain Shaw's name -(granulatum) inflatum for this form, but, since it is just an incidental and variable growth phase, it does not really merit any special naming. On the other hand, P. (Tylocassis) granulatum centriquadratum (Valenciennes) is fully justified for a Panamic (West Central America)subspecies, particularly based on the scientific guess that it

resulted from some independent further evolution over the millions of years since the geological formation of the land isthmus of Panama separated its ancestors from the original Caribbean stock. Another good subspecies P. (Tylocassis) granulatum undulatum (Gmelin, 1791) comes from the Mediterranean, and may have been from an even earlier ancestry. There is a 'smooth' form of the Scotch Bonnet in the Bahamas and West-Indies, which is often called P. (Tylocassis) [grandulatum] cicatricosum ("Meuschen, 1787", Gmelin 1791). Because of intervening intergrades, Abbott now concludes that this is just a variable form of P. (T.) granulatum, which relegates the term -cicatricosum to a junior synonymy. There are a couple of good fossil subspecies, however, according to Abbott's monograph, as well as a separate Mississippian fossil full-species (P. (T.) callaturum ℗ (Conrad, 1848)).

Because of the tourist demand for our State Shell, a number of the coastal souvenir shops are selling to the unwary a somewhat similar Bonnet Shell, which actually comes from Japan and is a somewhat distant cousin, the correct name of which is Phalium (Semicassis) bisulcatum (Schubert & Wagner 1829), the common Double-grooved Indo-Pacific Bonnet. It is the subtype species of Phalium (Semicassis) Mörch, 1852, and it has many synonyms, including '-japonicum' (Reeve, 1848), '-persimilis' "Kuroda MS", Kira, 1955, and '-pila' (Reeve, 1857). There is, however, one good subspecies P. (Semicassis) bisulcatum sophia (Brazier, 1872), Sophia's Helmet, from Australia, according to Abbott, although the Australian workers include this in another questionable subgenus P. ('Xenogalea') --see later.

Other P. (Semicassis) species include the following: P. (Semicassis) glabratum (Dunker, 1852), the Smooth Bonnet of the S. W. Pacific, which has three subspecies, including the 'Bubble' form, P. (S.) glabratum bulla ("Kuroda, 1952", Kira 1955), from Japan, etc. P. (Semicassis) semigranosum (Lamarck, 1822), the Half-grain Helmet (or Bonnet) from Tasmania and South Australia. Abbott does not agree with Tom Iredale, 1927 (and others) in creating a separate subgenus 'Antephalium' for this shell. 'Faurotis' and 'Kahau' ℗ are other subgeneric synonyms, and there are several more recent species and many fossils ℗ in the P. (Semicassis) group.

Phalium (Xenophalium) Iredale, 1927, is the last subgenus under Phalium, with the subtype species P. (Xenophalium) pyrum (Lamarck, 1822), the Pear-shaped Bonnet (or Pear Helmet), from South Africa, South Australia, Tasmania and New Zealand. Iredale, 1927, tried to separate another subgenus 'Xenogalea', based on the form P. (X.) pyrum hedleyi (Iredale, 1927), from New South Wales, Australia, but Abbott sees no justification for this and so he regards 'Xenogalea' as a synonym of P. (Xenophalium). There are several good subspecies of P. (Xenophalium) pyrum. Quite close to this group is another, centering around P. (Xenophalium) labiatum labiatum (Perry, 1811), typically from Australia and New Zealand. It, too, has definite subspecies, including P. (X.) labiatum iheringi (Carcelles, 1953), from Eastern South America, and P. (X.) labiatum iredalei (Bayer, 1935), from South Africa. The most interesting thing according to Abbott's monograph, is that each of the three P. (X.) labiatum species can hybridize with P. (X.) pyrum to yield forms which differ, in several ways, from the parents. Just to cite one example, Phalium (Xenophalium) zelanicum (Lamarck, 1822) is a common South African Bonnet, which I have particularly found on the shore at Muizenberg, on the False Bay (Indian Ocean) side of the Cape Peninsula. South African malacologists used to call this shell "Cassis achatina" (Lamarck, 1816), but Lamarck's specimens were from New Holland, in the Indo-Pacific, and were undoubtedly the same as the typical P. (X.) labiatum labiatum (of Perry, 1811). It

would appear that -zeylanicum (Lamarck, 1822) is the most appropriate name for the hybrid between the subspecies P. (X.) labiatum iredalei (Bayer, 1935) of the S. African coastal waters and P. (X.) pyrum pyrum (Lamarck, 1822) from deeper waters offshore. Abbott points out that all members of the P. (Xenophalium or 'Xenogalea') subgenus evolved in the cool ocean regions extending toward the South Pole, around the globe from New Zealand and South Australia to South Africa and the southern tip of South America. It could very well be that the original primeval stocks may stem from some common ancestor before the great drifts of the 'tectonic plates' separated into the present-day southern continents. I think these broad malacological observations and speculations are very thoughtful and interesting.

Apart from fossils, ℗ there are several other members of the P. (Xenophalium) group, including P. (Xenophalium) inornatum (Pilsbry, 1895), the Unadorned Bonnet, dredged off China and Japan.

The next separable Cassid GENUS: Casmaria H. & A. Adams, 1853, is based on the type-species Casmaria erinaceus erinaceus (Linné, 1758), the typical 'Common Bonnet' of the Indo-Pacific, which also has a number of forms or subspecies. Linnaeus used the type-species name for the form which has definite nodules on the shoulders. He studied many specimens in Queen Ulrica's collection and the illustrations of such classical early works as Rumphius, Gualtieri, and others. Hence, the next page of his classical Systema Naturae gives another 'species' name -vibex to the smooth-shouldered form, and this term is widely used in the literature, along with minor terms for several variations. Abbott concludes from exhaustive studies that most of these terms, including '-vibex' are not worthy of separation from the original first-named -erinaceus. He does admit, however, the subspecies C. erinaceus halosmodix (Melvill, 1883) for a form from Hawaii and Polynesia, and C. erinaceus vibexmexicana (Stearns, 1894) for a Panamic form, ranging from southern Baja California to Panama and the Galapagos Islands. A separable species is Casmaria ponderosa (Gmelin, 1791), the Ponderous Bonnet of the Indo-Pacific. It, too, has a number of subspecies, including C. ponderosa atlantica Clench, 1944, from the Bahamas and lower Florida Keys to the Caribbean. The most typical -ponderosa has a heavy deposit of callus on the inner lip and adjacent parietal wall, as well as a thickened outer lip of the aperture. Another feature is a second series of tiny teeth on the inner edge of the outer lip, in addition to the more conspicuous outer teeth. A third distinguishing feature is that the topmost brown bar on the outside of the outer lip is well below the suture, instead of close to it as in the case of the -erinaceus '-vibex' (etc.) species. Abbott also discusses the name "Casmaria cernica" (Sowerby, 1888), still used by some Japanese workers. It would seem that Sowerby's shell came 'from Mauritius' and is not now identifiable, so that Abbott just includes it as a questionable synonym of C. ponderosa.

The genus Sconsia Gray, 1847, is based on the strict type-species Sconsia (Sconsia) striata (Lamarck, 1816), the Royal Bonnet, which is uncommonly dredged off S.E. Florida, Texas, and down to N. Brazil. It is a nice and valuable Bonnet to add to your shell collection.

The genus name Galeodea of Link, 1807 is not invalidated by the similar term 'Galeodes' earlier used for an Arachnid (spider) genus by Olivier, 1791. It was not necessary, therefore, for Lamarck to substitute the name 'Cassidaria', in 1822. (Incidentally 'Galeodes' as used by Röding, 1798, for the shell genus, properly called Melongena

Schumacher, 1817, is invalidated by the spider name). The ICZN now has a clear ruling that even a one letter difference is sufficient to validate a separation between similar names. Galeodea echinophora (Linné, 1758), the Spine-bearing Bonnet of the Mediterranean, is the type species of the present 'Galeodea'. There is also a Japanese species G. echinophorella Hirase.

The GENUS: Morum Röding, 1798, includes a number of small Cassids that are typically covered with little surface nodules, suggesting a 'mulberry' appearance, which is the meaning of the Latin name. The strict type-species is Morum (Morum) oniscus Linné, 1767), the Atlantic Morum, or Woodhouse (named for another fancied resemblance). It ranges from Bermuda and the Caribbean to S.E. Florida and to Brazil. Morum (Morum) tuberculosum (Reeve, 1842, ex Sowerby MS), the Lumpy Morum, is Panamic, ranging from the Gulf of California to Peru. It is more elongated and darker in color. Another group of Morum shells are distinguished by their large size and distinctly cancellate (=criss-cross) surface sculpture. Wenz cites M. (Oniscidia) cancellatum ("Sowerby"), crediting Swainson, 1840 with the subgeneric separation of 'Oniscidia'. The Japanese workers use the term M. (Onimucira), for the species -grande A. Adams, 1855, cancellatum "Sowerby" and macandrewi "Sowerby". Most recently Emerson and Old, 1963 create the subgeneric M. (Cancellomorum), based on the species -grande A. Adams, 1855 (from Japan) and including -dennisoni (Reeve, 1842), Dennison's Morum, rarely found off N. Carolina and down to Texas and Brazil as well as a couple of other rare species, one Caribbean and the other Panamic named by Emerson in 1967, 1968. Besides old J. Sowerby, there were three G. B. Sowerby's, all important malacologists, and I am not sure of the exact authorship of the "Sowerby" Morum species names. If I am correct, they are referable to Thesaurus Conchliorum, a series of monographs dated 1847-1887, first edited by G. B. Sowerby, Jr. (2nd of the name), but completed (in 5 volumes) by G. B. Sowerby IIIrd. The early drafts or manuscripts available in 1842 to Reeve, the year he published the 2nd. vol. of his Chonchologia Systematica, included the Morum species names which he attributed to "Sowerby", but which (being only 'in MS') should properly be credited to Reeve himself (as the real publisher). My analysis does not account for the M. cancellatum "Sowerby", which was made the subtype species of M. ('Oniscidia') of Swainson, 1840. I can only surmise that the Japanese workers (Habe 1959?) found invalidity in Swainson's 'Oniscidia' and hence coined the subgeneric term.

M. (Onismusiro), is based, I believe, on M. (O.) grande A. Adams 1855. Since Emerson and Old, 1963, use this same species for their M. ('Cancellorum'), I am sure their term must be considered an invalid junior synonym.

According to Wenz, there are four more fossil genera in the Family CASSIDAE, but we will not cover these. Wenz also includes two other genera of recent mollusks, of questionable classification and very rare.

(?) Pachybathron marginelloideum Gaskoin, 1853, is reported from the West Indies.

(?) Dalium solidum Dall, 1889, is also from the West Indies. When Clench and Abbott published their Johnsonia article in 1943, only one dead specimen of this shell had been dredged, off Grenada, by the Blake expedition. F. M. Bayer in 1971, however, found live specimens and these are now illustrated in the new Abbott (p. 169), but the genus has been reassigned to the subfamily: Oocorythinae of the next family: TONNIDAE (see later).

Family TONNIDAE Peile, 1926 (replacing the invalid term 'Doliidae'), and its subfamily Tonninae, are based on GENUS: Tonna Brunnich, 1772, which name predates 'Cadus' Röding, 1798, 'Dolium' Lamarck, 1801, etc. The type-species is Tonna galea (Linne, 1758), the Giant Tun (or Cask) Shell, which is widely distributed in the Mediterranean, N.W. Atlantic (including N. Carolina to Texas and the West Indies), and in the Indo-Pacific. It reaches 5-7 inches and, while it is thin-shelled, it is fairly strong, although the lip is easily broken. Our best specimens come from the scallop dredgings offshore, especially in Florida waters. The ground color is a whitish- to a light coffee-brown, sometimes slightly mottled, and in young specimens, frequently with a purple brown tip or apex. The operculum is lost in the adult stages.

Tonna maculosa (Dillwyn, 1817), is the Atlantic Partridge Tun, ranging from Bermuda and S.E. Florida through the Caribbean to Brazil. It is typically smaller, up to 2-5 inches, and with a fairly pointed spire, whereas most of the other tuns are flattened on top. A rare albino form is just a variant, but has been called T. (maculosa) 'alba' (Conrad, 1854).

Tonna perdix (Linné, 1758) is the better-known Indo-Pacific Partridge Tun which although it is close to -maculosa in most respects, is a separate species. There are a number of other Tonna species in the Indo-Pacific, of which the following are an illustrative selection:

Tonna allium (Dillwyn, 1817), the Ribbed (or Costate) Tun (from the synonym -costatum (Deshayes, 1832)) is from the western Pacific, including the Philippines. Its appearance is fairly close to that of T. galea.

Tonna canaliculata (Linné, 1758), the Channelled Tun, for which Linné also coined the unnecessary synonym T. 'olearium' is common in Japan, etc. Its circular ridges are flattened and broadened so that the thin channels between them become the more obvious surface feature.

Tonna sulcosa (Born, 1778). The Grooved (or Banded) Tun, ranges from Japan to Australia. It has brown bands on a whitish background and often goes under the synonym T. 'fasciata' (Bruguière, 1792).

Tonna luteostoma Küster, 1857, the Golden-mouthed Tun, from Japan, is one of the largest and prettiest members of the genus.

Tonna variegata (Lamarck, 1822), the Variegated Tun, is very similar to the foregoing, but is smaller. It occurs in Australia and elsewhere in the Indo-Pacific.

Tonna tessellata (Lamarck, 1816), the Tessellated Tun, has narrower ribs with wider spaces in between. It comes from the China Sea and the S.W. Pacific.

T. perselecta Iredale, 1931 is a small species dredged in Sydney Harbour, Australia, for which Iredale 1931 proposed a separate (sub) generic term T. (Parvitonna).

A number of other recent Tonna species exist.

GENUS: Eudolium Dall, 1889, is based on the type-species Eudolium crosseanum (Monterosato, 1869), Crosse's False Tun, from the Mediterranean. It occurs rarely also in the N.W. Atlantic from New Jersey to Barbados in the West Indies, and it is one of some eight Eudolium species, all living in deep water.

Eudolium pyriforme (Sowerby, 1914), the Pear-shaped False Tun, is dredged off the coast of Japan.

GENUS: Malea, Valenciennes, 1832, is based on the strict type-species M. (Malea) ringens (Swainson, 1822), the Great Grinning Tun, which is aptly named for the appearance due to two large teeth projecting into the aperture from the inner margin. It is Panamic, ranging from the Gulf of California to Ecuador.

Malea (Quimalea) pomum (Linne, 1758), the Apple False Tun, or Indo-Pacific Grinning Tun, is much smaller and less striking. Tom Iredale, the Australian malacologist, put it in the questionable subgenus.

GENUS: Protodolium Wilckens, 1922, is based on a fossil from New Zealand.

Subfamily: Oocorythinae P. Fischer, 1885, is based on the GENUS: Oocorys P. Fischer, 1883, with the strict type-species O. (Oocorys) sulcata P. Fischer, 1883, the Grooved (or Sulcate) False Tun, ranging from off N. Carolina to the Lesser Antilles. It is also found off West Africa. Among some 18 other species is O. (Benthodolium) abyssorum (Verrill and S. Smith, 1884), occurring offshore from New Jersey to N. W. Florida.

GENUS: Galeocorys Kuroda and Habe, 1957, is based on the type-species Galeocorys leucodon (Dall, 1907), the Alabaster False Tun, dredged off the coast of Japan. Kira's 1955 term G. 'leucoderma' "Dall" is a misnomer, which may rank as a junior synonym. Galeocorys granulosa (Schepman, 1909) the Granular False Tun, from the Java Sea, is the other species in this genus.

GENUS: Dalium Dall, 1889, is now put here in the Oocorythinae, according to the new Abbott instead of its former questionable assignment to the CASSIDAE. The type-species, Dalium solidum Dall, 1889, Dall's Solid Dalium (or 'False Tun') is very rare, as we noted previously.

FAMILY: FICIDAE Conrad, 1867, is based on GENUS: Ficus Röding, 1798 (long known under the synonym 'Pyrula' Lamarck, 1799), with the strict type-species Ficus (Ficus) ficus (Linne, 1758). This is the original Fig Shell of the Indo-Pacific.

F. (Ficus) communis Röding 1798, the Common Fig Shell, is from the N. W. Atlantic, ranging from N. Carolina to the Gulf of Mexico. The so-called 'Paper Fig' F. (F.) 'papyratia' Say, 1822 is probably a synonym rather than a true variety, but there are several other forms, which may deserve special naming (e.g. F. (F.) carolae Clench, 1945), and others that constitute separable species, both in the Caribbean and in the Panamic regions. F. (Ficus) ventricosa (Sowerby, 1832), the Fat Fig, for instance, comes from West Central America.

F. (Ficus) subintermedia (d'Orbigny) is one of the Fig Shells from Japan and the Indo-Pacific.

According to Wenz, there are at least two fossil subgenera of Ficus, and several other fossil genera (and subgenera). It is easy to identify a 'fig'-shell, as to the genus, and, while the species differences are not great they are sufficiently distinct and unmistakable.

(Above was presented at the May 14, 1977 N. C. Shell Club meetings in Ocracoke, N. C.)

REMEMBRANCES OF THE MARCH, 1978 NAGS HEAD MEETINGS

EDITOR

The above meetings are now history. As I drove home from them I had time to savor their experiences. What follows below is what I can remember of them.

Who will forget the weather? Cold torrential rains accompanied us on our trip to the meetings; snow was with some part of the way. In spite of a new car, Doug. N. had a flat tire in the worst of it. Did he later, as is rumored, try to exchange Sally N. for a good spare tire at various service stations with no success?

In spite of the dangerous driving, 50-60 attended the meetings, some driving over six hours to reach the motel. We wondered throughout the meetings about the absence of the Moffitts and the Fergusons. A week later I accidentally ran into them while attending a ballet in Raleigh and learned their story - they tried to get to the meetings but because of the ice and snow, they were unable to get out of their driveways in Chapel Hill.

Sunday morning I wondered about the road signs in Nags Head warning "High Water Ahead". Would not "Watch Out Ahead for Thick Ice" have been more appropropriate?

Still unanswered are: Did Alta ever get anything to eat Friday night and what was it that she was finally served but didn't eat?

Saturday morning shelling was poor and was also miserable due to the cold and high winds. Of the few shells I saw, I recognized several later while judging for the BEST (FIELD COLLECTED) FIND OF THE DAY award. Shells which I saw on the beach and can remember included a few Atlantic Jackknife Clams (Ensis directus Conrad), Ponderous Arks (Noetia ponderosa Say), Atlantic Surf Clams (Spisula solidissima Dillwyn), Knobbed Whelks (Busycon carica Gmelin), and living Atlantic Slipper Shells (Crepidula fornicata Linne). All but the last mentioned were old well-worn shell. Also were the usual assortment of soft-drink and beer cans or bottles and plastic clorox bottles. Unfound was the bed of living Steamer Clams (Mya arenaria Linne) which I heard was at Oregon Inlet.

During the morning collecting I met one member who had just lost her collected material to a hungry dog. Question: Was the dog a most ardent shell collector or was it a rabid environmentalist interested in protecting the local precious (?) beach fauna? While it was a frightening experience at the time, I suggest that the two-legged collector got the better deal than the four-legged one.

Throughout the meetings, inside the motel a different kind of collecting took place. I again went over my budget. Who said rarity and cost go together? When have we had so many Golden Cowries available? Were any really sold? What about the number of Bednall's Volutes present? Was tickled to get a live-collected specimen of Phalium coronadoi wyvillei (Watson). Have since closely compared it with the UNC-IMS's live-collected specimen (from North Carolina waters) of P. coronadoi coronadoi (Crosse). To me there is a difference; however, Tucker Abbott in his 1968 Cassid monograph does state that the former is quite variable. (Cornelia, please don't get upset about the lack of a common name in the above. To my knowledge neither has a common name) There is a picture of the latter on the cover of the booklet "Sea Shells Common to North Carolina" written by myself and Jim Tyler.

North Carolina basketball was on TV Saturday afternoon. Rumors have it that a few of our group were not watching - they are being checked for insanity or other non North Carolinian characteristics.

The talk by Van on Saturday night, concerning his collecting and buying trip to Taiwan, was great and most informative. From his contacts there, I now understand why he is to be referred to as the "Shell Godfather" in Ocracoke.

Judging Saturday evening's contest for the best find of the day was interesting. With my before mentioned morning poor shelling experience in mind, I thought I was in trouble (unless a certain dog showed up). However no problem and no flack from the loosers as a late arrival saved me - a freshly-dead Scotch Bonnet (Phalium granulatum Born) still containing part of the original animal. It's collector found it on the Ocracoke beach and was almost too late in getting back to the meetings.

In retrospect, I enjoyed the meeting and hope that I have indicated so in the above ramblings.

MOVEMENTS OF SHELL COLLECTIONS WITHIN NORTH CAROLINA

EDITOR

The history of malacology is full of cases where collections, which later became important, have become lost through unrecorded movements. No attempt has previously been made to document the movements and/or disposition of the many shell collections within this state. There is a need to do this as some contain valuable specimen material. The following transfers is an attempt to document some of the collection movements going on in North Carolina. It is accurate only to the best of the editor's knowledge. Inaccuracies and additions shoud be brought to the attention of the editor of the bulletin. Chronological order is not followed as dates of transfers generally were not known.

1. Mrs. Elizabeth Tate Mathews Collection: to Dr. K. Brantley Watson, Durham, NC.
2. Mr. Wade Brown Collection: to Mrs. George "Cora" Staples, Butner, NC; Mrs. Kenneth L. Johnson, Raleigh, NC; and to Mr. T. C. Van Landingham, Ocracoke, NC.
3. Dr. K. Brantley Watson Collection: to Duke University Art Museum, Durham, NC.
4. Mr. H. Roberts Collection (Cedar Mountain, NC): to Mollusk Collection, UNC Institute of Marine Sciences, Morehead City, NC (gift a documented Florida collected collection).
5. Mr. William A. Beaumont Collection (Chapel Hill, NC): to Mollusk Collection, UNC Institute of Marine Sciences, Morehead City, NC (gift a general world-wide collection).
6. Mrs. Harriet Riggs Collection: to Mr. T. C. Van Landingham, Ocracoke, NC and to Campbell College, Buies Creek, NC.
7. Mr. A. J. "Bob" DaMotta Collection: to East Carolina University, Greenville, NC; collection described in a newspaper release as one of the world's foremost collections.

TWO YEARS IN THE LIFE OF A BUSYCON CARICA (KNOBBED WHELK)

ALTA VAN LANDINGHAM

So many times in my shell collecting I had found the long Whelk egg cases with the babies still unhatched, and had dreamed of watching them hatch and grow. But I always put the unhatched egg case back in the water until December, 1974.

We had had a recent storm and along with the shells on the beach there were quite a few of the Whelk egg cases. I decided, on the spot that this time I was going to try to hatch one of the cases.

Since the egg case was completely intact, I saw no reason why it couldn't survive in a bucket of salt water until I could get an aquarium set up. I purchased a 30 gallon tank, complete with under gravel filter, pump, hood, light and heater. The lady in the aquarium shop was ready to sell me an instant ocean mix, and 20 pounds of aquarium gravel. I said no, I wanted to use natural ocean water, and gravel from my beach. She was horrified, and tried to explain why I couldn't do this. I had already decided to do this my own way, so I just smiled and turned a deaf ear. She gave up on me.

My aquarium looked beautiful when Van and I finished setting it up. In went the egg case, along with some small Hermit Crabs, and a few other live shells I had found on the beach. The egg case was the main attraction as far as I was concerned, and I watched it almost 24 hours a day. Finally on December 26, 1974 the babies began emerging. (We learned later that the hatching was premature, due to the heated water in the aquarium.) Each capsule on the egg case had a tiny round hole that was covered by a thin membrane. The babies punctured this membrane and came crawling out. It was fascinating. The hatching kept on over a period of 2 weeks, and finally on January 10, 1975 the remaining capsules started moulding.

There were still live babies in them, so I helped nature along. I cut open the remaining capsules and freed the babies. I discovered that each capsule housed at least 50 babies, and some as many as 100. A few of the shells were empty, being in the capsule for the purpose of feeding.

Now that my babies were born, I was in a panic as to what to feed them. My first attempt was tiny bits of cut up shrimp. They seemed to like this. I also opened up an Oyster and this too was well received. I noticed there was a bit of cannibalism going on, and while I didn't especially like it, I figured this is nature!

Meanwhile, I found a beautiful Pen Shell about 3 inches long. As my baby Whelks were still only pinhead size, I was sure he would be safe with them. He survived about 12 hours. The baby Whelks used team work to open his shell and devour him. There are hundreds of the Whelks completely covering the shell.

After seeing this amazing feat, I decided voracious little babies would be able to handle live Coquinas, which they did, and to this day, Coquinas are still their basic diet, although now they are large enough to open Clams, Oysters, Cockles, etc.

Although all of the Whelks had the same environment, growth rate was variable. All had more than doubled their size in the first two months. Growth rate was much faster the first year. After four months, I separated them into batches to do some experimenting. I kept some in a heated tank, some in a cold tank. I fed some a steady diet of Coquinas,

and others had a variety. Some had water changes oftener than others. Some lived only with their own species, and others lived with a variety of marine life. After two and a half years the only difference I have found is that the Whelks that have been in heated tanks seem to be an inch or so larger than all the others.

After the first four months the cannibalism stopped and they were content to feed on whatever I provided for them. Until that time, they spent a lot of time crawling up the sides of the aquarium, but after that began burying in the gravel and emerging only at feeding time.

When feeding on a Coquina, Clam, etc., the Whelk will hold the bivalve in a perfect position to jam the bivalve against his lip and thus pry it open. This causes much lip damage. After the meal is consumed, the Whelk usually buries in the gravel for a few days, and when he emerges again, the damage is repaired. Most times the repair job is perfect, but once in awhile a sloppy job is done, and this results in some interesting shapes and lines.

As this first crop of Knobbed Whelks grows, we continue to learn new things, and by the time they reach maturity, we hope to have a fairly accurate history of their life cycle.

Oh! My Aching Back

W.B.H.

Tennis elbow and football knees,
Writers cramp and pollen wheeze,
Painters colic and diver's bends-
What e're we do a pain portends.

I am very sorry for those involved
And hope they get their problems solved
But better these, or a raspy throat,
Better the place where the devils gloat,
Better the land of coughs and croups
Than one bad spell of "Shellers Stoops".

Mollusks of the Badlands National Monument

Dorothy E. Beetle

The Badlands National Monument in South Dakota may seem a desolate place to shell, but during the summers of 1975-1976 I found 27 species in 14 Genera of living land and fresh water mollusks. It was my good fortune to be there as a Volunteer-in-Parks, presenting astronomy slide shows and constellation identification, nature walks and other assorted duties of a park ranger. Off duty I prowled the Badlands to discover mollusks and found them in the prairie sod, isolated stands of juniper and in seeps and man-made stock ponds.

The Badlands, elevation 700 - 990 meters, are slowly being carved from the loosely consolidated sediments underlying the prairie. "The Wall", a scenic 50 meter long spine of pinnacles,saw-toothed ridges and supporting buttresses, creates the impression of great height. Surprisingly, it rises only 45 - 90 meters above the lower grass table. Most of its surface is bare crumbling mudstone and siltstone with capping layers of more resistant coarse sandstone. Features change with the storms that erode the soft sediments.

During Oligocene time, 35 - 25 million years ago, this land was a marshy plain crossed by sluggish streams; Helix leydi, a large land snail, lived here. In some places fossil shells, like pebbles, are thickly scattered over the waste. The fossils are more resistant than the material they were buried in. They weather out elevated above the surface on thin pedestals of hard dirt, until, this too, is eroded and they topple. One section of a mussel, 4 cm long, was found in a single locality. In the Cretaceous time, 80 - 65 million years ago, a shallow sea covered the region. In its thick muds (Pierre shales) are some beautiful Cephalopod fossils.

At present less than 40 cm of rain fall annually. Snow depths average 60 cm most years. Summer rains are generally brief gully washes which erode the cliffs and flood the sandy washes. Hours after a rain, only a few puddles remain. The dry season extends from mid-July through October.

There are no natural lakes. The few springs occur along the contact of the Quaternary-Tertiary deposits where impervious clay layers below the loess prevent further downward movement of the water. Records of early settlers indicate springs flowed more abundantly than at present. With increasing land use by farmers, tourists and cattle around the monument borders, springs dry by mid-July. Creeks are intermittent. Runoff from the Badlands drains into the Bad, Cheyenne and White Rivers. Even the White River, this far upstream, may cease to flow in drought years for as long as six weeks. Runoff carries such a heavy load of silt that streams look milky and stock ponds silt up in less than 15 years. Water, even after settling for weeks, remains cloudy with finely suspended clay particles. This would explain the absence of bivalves locally.

The temperature has a recorded range of 88°C. Summer day temperatures flucuate between 32.2 - 43.3°C (90 - 110°F). Winter temperatures fall to -23 to -40°C.

The 30 cm tall ant hills of the Harvester ants are a good place to start searching for land snails. The ant hills are covered with an insulating layer of tiny pebbles, rodent teeth and bones, bits of arrowheads, snail shells and insect carapaces.

Succinea vaginacontorta is the most conspicuous and abundant snail of the prairie. Live animals occur around the base of grasses, in cracks and under mud clods along the washes. Prairie remnants, called sod tables, and even pedestals of grass a few meters square standing above the eroded landscape, support its populations. A count indicated

approximately 50 snails per square meter.

As ridges are undermined, they slump to create hummocky pockets where underground water surfaces in seeps or springs. The largest slump at present, Cliff Shelf, supports the greatest variety of plants and animals in the Monument. There is an open grove of junipers and shrubs there. A small pond, less than a meter deep, is surrounded by a few cottonwoods, ash and willows. Two pupillids and two vallonias are common below ground on decaying juniper roots and in the sandy needle duff and under sandstone blocks fallen from the cliff. Succinea avara and the slug, Deroceras laeve, inhabit the leaf debris around the pond.

From the age of juniper stumps on Cliff Shelf, it is estimated the cliff face fell about 400 years ago, creating the slump. The shallow pond on it will be lost to erosion in a few years; erosion being accelerated by a double loop of highway, parking lot and a heavily used nature trail. Indeed, the entire Cliff Shelf is a transitory phase in the erosional cycle.

Lymnaea elodes almost exclusively occupies Cliff Shelf pond. A small population of of L. bulimoides cockerelli is also present. When the water level was down to a film, the pond bottom was a solidly writhing mass of Lymnaea. After the pond dried the last week of July, a count of the shells embedded in the algal mat and mud yielded 700 - 885 per square meter of surface.

The only bivalves found in the Monument were dead and each in a different pond. They include single adult specimens of Pisidium casertanum, Sphaerium lacustre rykholti and two S. partumeium. The springs and ponds on the prairie are isolated from each other and any flowing water. Each contains a different assemblage of mollusks. They were most likely populated by accidental introductions which have persisted (waterfowl?).

The low annual rainfall, intermittent creeks, sandy well drained soil or impervious clay layers and the high erosional rate combine with the resulting lack of plant life to limit severely the molluscan species inhabiting the Badlands. No endemic species occur. Land snails present are ones found in surrounding plains states. Freshwater species show a random distribution which probably reflects accidental introduction.

Species found in the Badlands National Monument

Zonitoides arboreus Say
Deroceras laeve Müller
Succinea avara Say
Succinea vaginacontorta Lee
Gastrocopta armifera Say
Gastrocopta pellucida hordeacella (Pilsbry)
Pupoides albilabris C. B. Adams
Pupilla blandi Morse
Vallonia parvula Sterki
Vallonia gracilicosta Reinhardt
Vallonia albula Sterki
Vallonia cyclophorella Sterki
Sphaerium lacustre rykholti (Normand)
Sphaerium partumeium Say
Pisidium casertanum Poli
Lymnaea bulimoides cockerelli (Pilsbry & Ferriss)
Lymnaea caperata Say
Lymnaea elodes Say
Lymnaea reflexa Say
Physa gyrina Say
Gyraulus circumstriatus Tryon
Gyraulus parvus Say
Promenetus exacuous Say
Promenetus umbilicatellus Cockerell
Helisoma anceps Menke
Helisoma trivolvis Say
Helisoma trivolvis subcrenatum (Carpenter)

SHELLING BEACHES OF NORTH CAROLINA - A ROUGH COMPARISON

HUGH J. PORTER

In 1976 an attempt was made to develop a checklist of North Carolina shells. (Printed checklists aid bird-watchers in the annual bird counts or keep track of what has been seen.) The 1976 checklist, primarily based upon shells listed in the booklet "Sea Shells Common to North Carolina" by Jim Tyler and me, was six typewritten pages long; however, by printing, it might have been possible to reduce it to about one sheet. Copies of the typewritten list were given to a few friends with the request that they try using it on a beach and then evaluate the worth of the checklist. Further refinement to the checklist has not been attempted as little response was received concerning it; however, several of the checklists were returned filled out.

What follows is a discussion and a comparison of information reported on the above returned lists and some that I used for several beaches. Ideally if all collections had been made at the same time and with the same effort, their comparison would have more meaning. Further, it is no secret that all beaches have good and bad collecting days and that only through frequent collecting can the true worth of a collecting beach be assessed. The experience and/or immediate interest of the reporting collector is also important. For example, I believe that my lists may include small bivalve species overlooked by most collectors.

The following checklists of beach collections are here reported and briefly discussed:

Ocracoke, NC - inner and outer beaches. Collector: Alta Van Landingham.
Collection date or period: one year (1976-1977). Comments: very intensive collecting throughout period. Report may be one of the best listings yet published on what shells can be found on Ocracoke Island.

Cape Lookout, NC - inner and outer beaches. Collector: Patricia Howland.
Collection date or period: 1977-1978. Comments: listing the result of what the collector remembers of the Cape Lookout fauna following a number of field trips to it during the past year. Several additional species known to have been collected from the Cape by Mrs. Lucy Piper and others are not included.

Fort Macon, NC - beach near Atlantic Beach, NC. Collectors: author and Tom Whitford.
Collection date: Jan. 20, 1977. Comments: oceanside area between Park Ranger's office and park public bathing beach; very cold day, low tide.

Hammock Beach - near Swansboro, NC. Collectors: Harriet and Jimmy Riggs.
Collection date: March 4, 1976. Comments: calm day, low tide; an interesting collection by excellent collectors.

Holden's Beach, NC. Collectors: author and class from UNC at Wilmington.
Collection date: Nov. 30, 1976. Comments: very cold day, low tide.

Sunset Beach, NC. Collector: author. Collection date: Oct. 2, 1976.
Comments: very low tide, southern-most beach in North Carolina that I could get to.

In the interest of space and also so as not to confuse the amateur by use of the latest of the ever-changing scientific nomenclature, only common names are used. Appropriate scientific names can be found in the above-mention booklet (nomenclature out of

date) or in Abbott's 2nd edition of "American Seashells". Listed below are only those shells found and thus recorded in or added to the checklist. Species in the checklist but unrecorded are not included below.

Abbreviations used in relationship to occurrence: Occ. = occasional occurrence; L = living specimen or specimens present; R = shell or shells present showing signs of recent life. All occurrences reported and not followed by either "L" or "R" must be considered as shell of unknown age. An "*" before the name of a shell indicates that it possibly is a dominant shell almost always found on the North Carolina beaches. See "Discussion" for how this was determined.

BEACHES TREATED BY CHECKLIST

SPECIES PRESENT	OCRACOKE	CAPE LOOKOUT	FORT MACON	HAMMOCK BEACH	HOLDEN'S BEACH	SUNSET BEACH
*Blood Ark	Many-L	Many	Occ.	Many	Many	Many-R
Cut-ribbed Ark	Occ.-R	Many	Few			
*Incongruous Ark	Occ.-R	Occ.	Many	Many	Many	Occ.
Mossy Ark		Occ.	Occ.	Many		Few
*Ponderous Ark		Occ.	Occ.-R	Many	Many	
Turkey Wing or Zebra Ark	Occ.-R	Occ.				
Comb Bittersweet						
Giant American Bittersweet	Occ.	Few		Few		
*Atlantic Ribbed Mussel	Many-L		Many-L	Few		Many-L
Cinnamon Chestnut Mussel				Many		
False Tulip Mussel		Few				
Hooked Mussel	Many-L					
Scissor Date Mussel	Few -L					
Scorched Mussel		Occ.			Few -L	
Atlantic Wing Oyster	Occ.-L	Few		Few -L		
Half-naked Pen Shell			Many-L			
Rigid Pen Shell	Occ.	Many-L			Few	
Saw-toothed Pen Shell	Many-L	Few	Few -R	Few	Few	
*Atlantic Bay Scallop	Many-L	Many	Occ.	Few		
Atlantic Deep-sea Scallop	Occ.					
*Calico Scallop	Many-L	Many		Occ.-L	Few	
Lion's Paw	Occ.-L	Few		Few		
Ravenel's Scallop	Occ.	Few				
*Kitten's Paw	Many	Many	Occ.-R			
*Atlantic Jingle	Many-L	Many	Occ.	Many	Few	
Crested Oyster				Occ.		
*Eastern Oyster		Many	Many-L	Many	Many	
*Buttercup Lucina	Many-R	Few	Occ.	Many		
Chalky Buttercup	Many		Few			
*Cross-hatched Lucina	Many-L	Occ.	Many	Many	Occ.	
Many-lined Lucina			Few			
Thick Lucina					Occ.	
Florida Spiny Jewel Box	Occ.-R	Few	Few			
Little Corrugated Jewel Box		Occ.			Few	
Gibb's Clam	Occ.	Few				
Atlantic Strawberry Cockle				Few		
Common Egg Cockle	Many-L	Few		Few	Few	
*Giant Atlantic Cockle	Many-L	Many	Many-L	Many	Many	
*Prickly Cockle	Many	Few	Few	Occ.	Occ.	
Spiny Paper Cockle				Occ.		
Yellow Cockle		Few		Occ.	Many	
Atlantic Surf Clam	Many-L	Occ.	Occ.			
*Channeled Duck Clam	Many-R	Many	Many	Many	Many	Many
*Dwarf Surf Clam		Many		Occ.	Few	Many
Fragile Atlantic Mactra						Few ?
Ravenel's Surf Clam					Many-R	
Smooth Duck Clam	Occ.	Many	Occ.	Few	Few	

	OCRACOKE	CAPE LOOKOUT	FORT MACON	HAMMOCK BEACH	HOLDEN'S BEACH	SUNSET BEACH
*Atlantic Jackknife Clam	Many-L	Many	Occ.-R	Occ.	Many-R	Many
Corrugated Razor Clam		Few ?				
Green Jackknife Clam	Few -R					
Alternate Tellin	Many-R	Few		Few	Few	
Iris Tellin						Many-L
Northern Dwarf Tellin						Occ.-R
Say's Tellin					Occ.	
White Strigilla					Few	
*Coquina Shell	Many-L	Many-L	Few -R	Many-R	Occ.	Many-R
Stout Tagelus	Many-L	Occ.	Few	Occ.	Few	
*Common Atlantic Abra		Many	Many		Few	Occ.
Purplish Semele		Few ?				
Tellin-like Cumingia		Occ.				
White Atlantic Semele		Occ.				
Carolina Marsh Clam	Many-L					
Calico Clam	Occ.-R	Few				
*Cross-barred Venus	Many-L	Many-L	Occ.	Occ.	Occ.	
*Disk Dosinia	Many-L	Occ.	Many-R	Few	Many-R	
Elegant Dosinia		Many				
Gray Pygmy Venus					Few	
Imperial Venus	Many-R	Many				
Lady-in-waiting Venus		Many				
*Morrhua Venus		Many	Many	Many		
*Northern Quahog	Many-L	Many		Occ.		
Southern Quahog		Few		Occ.	Occ.	
Sunray Venus	Many-L	Many-L				
Atlantic Rupellaria				Few		
False Angel Wing	Many-R	Few		Few	Few	
Ovate Paramya					Few	
Soft-shell Clam	Occ.		Occ.	Few		
Barratt's Corbula					Few	
Atlantic Geoduck	Occ.-R					
*Angel Wing	Many-R	Few	Occ.	Occ.	Few	
Campeche Angel Wing	Occ.			Few		
Fallen Angel Wing				Few	Few	
Wedge Shaped Martesia				Few	Occ.-R	
Glassy Lyonsia	Occ.-R					
Cayenne Keyhole Limpet	Occ.	Few		Occ.	Few	Few
Chestnut Turban	Occ.			Few		
Marsh Periwinkle	Many-L			Few		Many-L
Knorr's Worm-shell	Occ.-R	Occ.		Occ.		
Common Sundial	Occ.-R					
Florida Cerith	Occ.	Few				
Variable Bittium		Few				
Common Janthina	Occ.-R					
Angulate Wentletrap	Occ.	Few	Few			
Humprey's Wentletrap		Few	Few			
Many-ribbed Wentletrap		Few				
*Atlantic Slipper Shell	Many-L	Many	Occ.	Occ.	Occ.	
Convex Slipper Shell	Occ.-R			Few		
Eastern White Slipper Shell		Occ.	Few	Occ.	Few	
Spiny Slipper Shell				Occ.		
Atlantic Carrier Shell	Occ.-R	Occ.				
Florida Fighting Conch	Many-L					
Atlantic Deer Cowrie	Occ.					
McGinty's Cyphoma	Few -R					
Single-toothed Simnia		Few -L				
*Atlantic Moon Snail	Many-L	Many	Few	Occ.	Occ.	
*Baby's Ear	Many-R	Many	Occ.	Many	Many	
Colorful Atlantic Natica	Occ.					
Maculated Baby's Ear	Occ.-R	Many				
Northern Moon Snail	Occ.-R					
Emperor or Queen Helmet	Many-R	Occ.		Few		
Reticulated Cowrie-helmet	Few -R					
Scotch Bonnet	Many-L	Occ.	Occ.	Few		
Atlantic Distorsio	Occ.	Occ.				
Kreb's Triton	Occ.					

	OCRACOKE	CAPE LOOKOUT	FORT MACON	HAMMOCK BEACH	HOLDEN'S BEACH	SUNSET BEACH
Poulsen's Triton	Occ.-R					
Von Salis Triton	Few -R					
Giant Tun	Occ.-R	Few				
Fig Shell	Occ.-R			Few		
Apple Murex	Occ.-R	Few		Few	Few	
Atlantic Oyster Drill	Many-L	Occ.				
Florida Rock Shell	Many-L					
Giant Atlantic Murex	Occ.-R	Few				
Thick-lipped Drill	Many-L	Many				
Greedy Dove Shell	Many-L	Occ.				
Tinted Cantharus	Occ.			Few		
Channeled Whelk	Many-L	Few	Few	Occ.		
Channeled Whelk egg strings			Few -R			
Kiener's Whelk	Occ.				Occ.	
Knobbed Whelk	Many-L	Occ.-L	Few	Few	Occ.	
*Lightning Whelk	Many-L	Many-L		Few	Occ.	
Pear Whelk	Occ.-R			Few	Occ.	
Common Eastern Nassa	Many-L					
Eastern Mud Nassa	Many-L	Many-L				
New England Nassa				Occ.		
Banded Tulip	Many-L	Few -L		Few	Few	
Florida Horse Conch	Occ.-L	Few				
True Tulip	Occ.-R	Few -L				
*Lettered Olive	Many-L	Occ.-L	Few	Occ.	Occ.	
Variable Olivella		Occ.-L				
Junonia	Occ.-R					
Common Nutmeg	Occ.-R	Few		Few		
Atlantic Marginella	Occ.					
Sozon's Cone	Occ.	Few				
Atlantic Auger	Many-L	Many			Occ.	
Half-smooth Odostome	Many-L					
Adams' Baby-bubble	Many-L					
Eastern Melampus						Many-L
Ivory Tusk		Occ.	Few			
Paneled Tusk	Many					
Ram's Horn	Many-R	Few				
TOTAL SPECIES COLLECTED	102	91	44	65	51	16
NUMBER of SPECIES SHOWING SIGNS of RECENT LIFE	78	12	10	3	4	7

DISCUSSION:

From the above it can be seen that Ocracoke can be a profitable collecting area if sampled intensively. I have long believed that the ocean area between Cape Hatteras and Cape Lookout (Raleigh Bay) may be a larval trap for many of the mollusks being carried north as larvae by the Gulf Stream. It would be interesting to see how this Ocracoke list would compare with lists from Cape Lookout, Hammock Beach, Onslow Beach, and Holden's Beach if these latter could be sampled as intensively as was Ocracoke. I mention these latter because I believe them to be our best collecting beaches.

When comparing lists from the single day collections, it is interesting that all but Sunset Beach have somewhat similar numbers of total species collected. Hammock Beach was a little higher and included some species not mentioned in the other lists. This may be partly related to who the collectors were and the fact that the beach (on an island) is not collected as intensively as the other beaches are. Sunset Beach may have better collecting days and the fact that it was the only beach where several recent-living Tellins were recorded may be indicative of this, but I still remain unimpressed with its

potentialities.

From the lists it is tempting to try to determine what shells are the dominant ones on the North Carolina beaches (below Cape Hatteras), or in other words, shells a collector would expect to find on our beaches any time they went collecting. I have placed an asterisk before those that I suggest might fall into this category. Arbitrarily I assigned the value 1 to any "Occ." or "Many" occurrence in the one day samples and the same value only to the "Many" occurrences in the Ocracoke and Cape Lookout lists; a total value of 3 or more for a species qualified it for an "*". Twenty-eight species received this distinction (some will call this number playing and I agree that it might be). I concur with most species so listed, but I do believe that there are some serious omissions.

The above comparison has been an interesting exercise. This has been done, I believe, for other areas, so it is not new. I do hope that it will provide stimulus for our members to really examine more closely what can be found on our beaches and to compare such seasonally.

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Rev. G. Scott Turner, Lillington, NC; Mrs. J.E. Rice (deceased;
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