SHELLS AND SEA LIFE

A monthly publication since 1969.
ISSN 0747-6078
1701 Hyland St.
Bayside, CA 95524

$2.50 — August, 1985 — Vol. 17, No. 8

Conus ximenes Gray, 1839, Conus mahogany Reeve, 1843 and friends.

John K. Tucker
4053 Maxanne Dr., Kennesaw, GA 30144

Are *Conus ximines* and *C. mahogani* two different species or are they conspecific? Authors such as Hanna (Hanna, G.D. 1963. West American mollusks of the genus *Conus* — II. Occ. Pap. Cal. Acad. Sci. (35):103 p.) and Nybakken (Nybakken, J. 1970. Radular anatomy and systematics of the West American Conidae (Mollusca, Gastropoda). Amer. Mus. Novitates (2414):29 p.) considered them to be separate species. They both noted that these two species were very similar in shell morphology and in radular morphology. Many other authors including most notably Walls (Walls, J.G. 1979. Cone shells. TFH Publications, Inc., Neptune City, NJ 1011 p.) considered them to be conspecific. Walls (1979, p. 957) stated "...I cannot see how these two can be separated...." Most collectors no doubt accept Walls' determination and few would be likely to recognize two species. The present paper presents evidence that these two are in fact different species and that they can be objectively distinguished by a previously overlooked detail of the spire coloration.

If indeed these two are separate species, why then did competent authors such as Walls consider them to be conspecific? Walls and other authors identified specimens based on two criteria, namely body coloration and apertural coloration. *Conus ximenes* supposedly has few or no dark colored axial blotches or flammules and a violet colored aperture. *C. mahogani*, on the other hand, supposedly has heavy axial blotching and a white colored mouth. If only these two criteria are used, then Walls, who observed specimens with few or no blotches that had white mouths and specimens with heavy axial blotching that had deep violet mouths, was certainly justified in considering these to be variants of a single species.

Why, the reader may rightly ask, is Walls incorrect? The problem actually lies in the degree to which *Conus mahogani* varies in the extent to which the dark axial bars or blotches are developed. Specimens of *C. mahogani* (as identified by spire coloration) range from those with few or no axial bars (Fig. 1 & Walls, p. 732 upper right) to those with heavily developed dark brown or black axial bars (Fig. 2 & Walls, p. 732 upper left). It is these lightly colored specimens of *C. mahogani* that have been confused with *C. ximenes* and that have caused many authors to consider *C. mahogani* and *C. ximenes* to be conspecific.

If so, how, then does one distinguish these two species when it is apparent that the extent to which the axial bars are developed and the nature of the apertural coloration are not completely reliable?

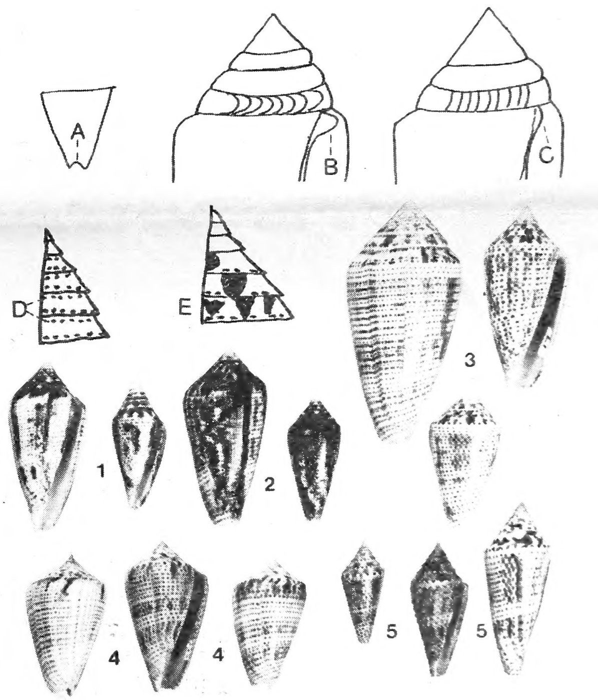


Figure Captions

Figures A-E. Diagramatic representations of A — an anterior notch; B — a deep C-shaped posterior notch; C — a shallow posterior notch; D — the location of the two rows of spots on the whorl tops of *Conus ximines*; and E — the location of the one row of spots on the whorl tops of *Conus mahogani*.

Figures 1-5. Shells of the spotted Panamic cones. 1— lightly colored examples of *Conus mahogani* Reeve, 1843; 2 — darkly colored examples of *C. mahogani*; 3 — specimens of *C. ximenes* Gray, 1839; 4 — specimens of *C. perplexus* Sowerby, 1857; and 5 — specimens of *C. tornatus* Sowerby, 1833.

It actually is very simple to do this if the details of the spire color pattern are used. The spire whorl tops of *Conus ximenes* have two rows of small round black dots on them. One of these borders the shoulder angle while the other row is located near the suture with the preceeding whorl (Fig. D). They are constant features of *C. ximenes*. The whorl tops of *C. mahogani* have only a single row of small dots bordering the suture with the preceeding whorl in *C. mahogani* (Fig. E). This difference is easily seen and was found to be absolutely reliable among the several hundred specimens of the two species that were examined.

You now know how to objectively separate *Conus ximenes* and *C. mahogani* but what about the other two Panamic cones (*C. perplexus* and *C. tornatus*) that have a spotted color pattern? They can and have been confused with each other and with *C. mahogani* and *C. ximenes*. The following brief key points out reliable and relatively easy ways to distinguish these four cones from each other as well as the page and location where they are illustrated in Walls.

KEY

1 Posterior notch is shallow or absent (Fig. C) ...2.

1' Posterior notch deep, C-shaped (Fig. B) ...3.

2 Two rows of small black dots on the whorl tops, one bordering the shoulder angle and the other along the suture with the preceeding whorl (Fig. D & 3) ... *Conus ximenes* Gray, 1839 (Walls, p. 732 bottom half).

2' Only one row of small black dots on the whorl tops which borders the shoulder angle (Fig. E and 1, 2) ... *Conus mahogani* Reeve, 1843 (Walls, p. 677 upper half, bottom left side; 732 upper half; 957).

3 Anterior notch (Fig. A) present; spire slightly concave in profile and not sclariform (Fig. 4) ... *Conus perplexus* Sowerby, 1857 (Walls, p. 564).

3' Anterior notch absent; spire not concave in profile and is sclariform or stepped (Fig. 5) ... *Conus tornatus* Sowerby, 1833 (Walls, p. 677 bottom middle & right side).

EDITOR'S NOTES

Here is the August issue — still late, but catching up quickly. We have been working night and day for the past several weeks to get everything done. Please forgive the delays in responding to your letters. If you give us a phone number with your order, we try to call if there is a serious delay.

As soon as the September issue is printed we will increase the number of articles in each issue and return with most of the other columns and features we have had in the past. We hope that you are finding more interesting material in each addition and will help by spreading the word to your friends.

We are waiting for some photographs and material from the summer shows and conventions. If you have photos of any of the meetings or displays to share, please send them. We will be happy to return them if you include a stamped, addressed return envelope. We will be especially pleased to get meeting information and photographs for some of the overseas events.

Our new format works best with glossy black and white photographic prints. The majority of the photographs in this issue were from color prints with varying results. In a few months we hope to get set up to handle color slide to black and white print conversions ourselves but for now we must go with commercial work (and prices).

We are working hard to get back on schedule and may just mail out the October issue during October. The May issue was published on September 8, 1985. The June issue was published on October 9, 1985. The July issue was published on October 11, 1985. We hope that this issue (August) will be published on October 14, 1985 with September hard on its heels.

Best regards,

Steve Long

Editorial Staff

Managing Editor .... Steven J. Long
Assistant Editor .... Sally Bennett
Contributing Editor .... Hans Bertsch
Photographic Editor .... David K. Mulliner
Contributing Editor .... Tom Rice

Editorial Review Board

R. Tucker Abbott, David W. Behrens, Hans Bertsch, Kerry B. Clark, Walter O. Cernohorsky, Malcolm Edmunds, Eugene V. Coan, Terrence Gosliner, Michael T. Ghiselin, James R. Lance, George L. Kennedy, T.E. Thompson, William G. Lyons

SHELLS and SEA LIFE was formerly known as the OPISTHOBRANCH NEWSLETTER. The magazine is open to articles and notes on any aspect of malacology, fossils or related marine life. Technical articles submitted for publication are subject to editorial board review. Articles should be submitted typed and double-spaced. Authors receive 10 reprints of their article. Additional reprints are available for purchase. For additional information send for free booklet "Suggestions for Preparing Manuscripts for SHELLS and SEA LIFE."

We undertake no responsibility for unsolicited material sent for possible inclusion in the publication. No material submited will be returned unless accompanied by return postage and packing.

Display advertising is $26 per column inch, minimum, with discounts for larger ads & multiple insertions. Send for rate card.

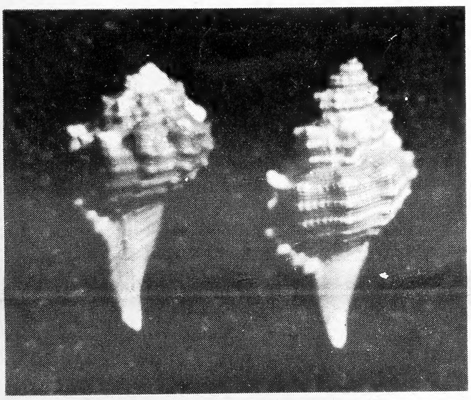
SHELLS and SEA LIFE ISSN 0747-6078 is published monthly for $24 per year by Steven J. Long & Sally Bennett, 1701 Hyland, Bayside, CA 95524. Second-Class Postage Paid at Bayside, CA. POSTMASTER: Send address changes to: SHELLS and SEA LIFE, 1701 Hyland, Bayside, CA 95524. Charge on MasterCard or VISA — telephone (707) 822-1024. Outside U.S. postal ZIP code areas — $30 surface or $40 air mail. Send change of address 6 weeks in advance. The publisher reserves the right to change subscription rates during the term of a subscription upon 30 days' notice. This notice may be by mail to the subscriber, by notice contained in the publication itself, or otherwise. Subscription rate changes may be implemented by changing the duration of the subscription.

ON THE REEF WITH BOB PURTYMUN: Cymatium

Cymatium sarcostomum (Reeve, 1844) is a rather rare mollusc. I collected a specimen on the north shore of Pago Pago Bay off the little village of Lepua, American Samoa in 1975. It was on a hard coral bottom, sparsely covered with sand under a coral slab about two meters deep. My next contact with this elusive shell was when Ellen Owens found one off Waikiki in Hawaii (see HSN Jan. 1976 p. 6 Recent Finds). Again the habitat was hard coral bottom with sparse sand pockets and scattered coral heads, although much deeper than my Samoan find.

My latest find was in the lee of Coil Reef, one of the many small reefs that make up the Great Barrier Reef. This shell was in the same habitat as my previous find. The next day I found still another specimen about 200 meters farther north on the same reef, same habitat.

Snap judgement on identification of shells is not always the best idea. When I cleaned these two shells at a later date I was pleasantly surprised to find that when viewed together they were quite different. With a little research I determined that my last find was *Cymatium tabulatum* (Menke, 1843). *C. tabulatum* appears to be confined to the Australia-New Guinea area while *C. sarcostomum* is truely Indo-Pacific, as I have specimens in my collection from the Red Sea.



Bob Purtymun, P.O. Box 643, West Point, CA 95255

READER FORUM

IRS Not Charitable to Some Conchologists If you're in the sunset of your life and have saved and invested wisely, perhaps you're ready to travel the world to observe, if not collect, a few shells or spend some of your well-earned money buying books to read about your favorite pastime -- conchology.

One way to reduce some nasty taxes, and a great way to help the science of malacology, is to donate part or the whole of your beautiful shell collection to a non-profit college or public museum -- especially since keeping it in ship-shape condition can get to be a chore. Perhaps the resthome has no room and your children might not have the slightest interest in shells with data.

But wait! They've changed a few rules. The 1984 tax act upped the ante for claiming a charitable deduction for a donation of property with a claimed value of more than $5000. So you think your collection is worth ten times that? Tough! For 1985 and later years, a "qualified appraisal" is necessary for any single donation of property, such as stamps, coins, shells, books, paintings, land and buildings.

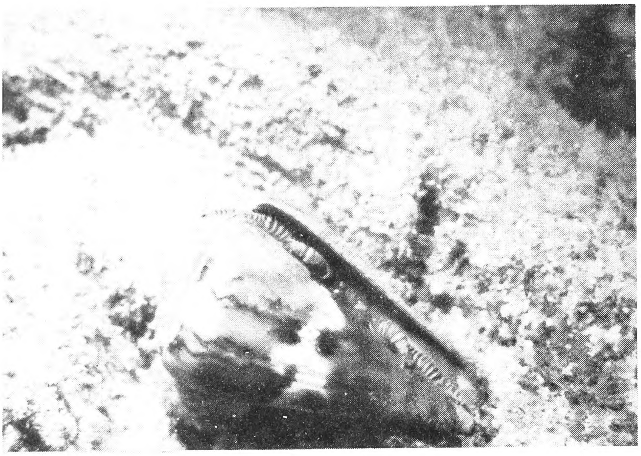
The appraisal must be made during the 60 days prior to the actual date of the donation, and must be made by one or more persons qualified to appraise the property, with a fee not dependent on the eventual deduction. A person connected with the museum getting the shell collection cannot do the appraisal. However, many organizations, eager for your contribution, may wish to foot the bill for the appraisal; if they don't, you can deduct the cost.

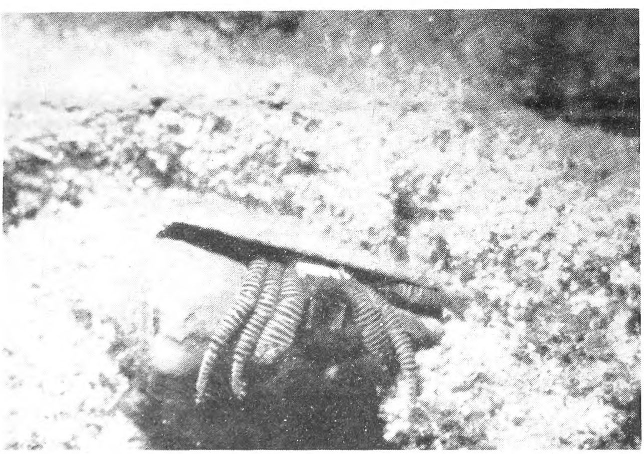
Remember, some museums will accept data-less shells if they are to be used in exhibits or educational classes, but most want specimens with good geographical information and the date they were collected.

Unless a qualified appraisal occurs, Uncle Sam will not allow you a tax deduction. Not all dealers would qualify as appraisers. I found it necessary to obtain two legitimate licenses for myself to be an appraiser of shell collections. In my twenty years of appraising, I have analyzed collections rangin value from $100 to $100,000. Ask if the dealer has an appraisal license. There is more to it than knowing the value of a few rare cowries and cones, and their price tags are not evidence of current values. -- Dr. R. Tucker Abbott, P.O. Box 2255, Melbourne, FL 32902-2255

NOTES FROM HANS BERTSCH:
Mobile homes and itinerant tenants: sea shells, hermit crabs and coelenterates.

Hans Bertsch, 4444 W. Pt. Loma Bl. #83, San Diego, CA 92107





Figures 1 & 2. Hermit crab *Trizopagurus strigatus* inside cone shell. (Nanakuli, Oahu)

Several decades ago, while still quite young, I was given a Christmas present of that fine book, Pagoo (written by C. Holling). It was a marvelous tale about the peregrinations of a charming pagurid; this little hermit crab had numerous intertidal adventures and an equally charming personality. Since then I have met many real hermit crabs and have watched them scurry and scamper between shells, over sandy patches, and under rocks. They probably don't have pagoo's personality — but they are fascinating living demonstrations of evolutionary adaptation.

The asymmetric abdomen is reduced in size, curled, and lacks the hard exoskeleton; the abdominal segments are greatly reduced; the left or right first peropod (thoracic appendage) is greatly enlarged (one primary pincer is larger than the one on the other side of the body): these are all morphological adaptations that have evolved to "allow" the animal to live backed up into a sea shell. Coevolution can frequently be seen between various species of hermit crabs, anemones, hydrocorals, sponges, etc.

This month I will describe some of the biology and adaptations of three hermit crabs, the sea shells in which they live, and some astounding behavioral interations with coelenterates. Hermit crabs are natural conchologists. Their shells are not for display nor hidden away in cabinets, but are essential for their protection. Hermit crabs are crustaceans, a large assemblage of marine arthropods. Crustaceans are the most numerous multi-celled animals in the ocean. Their classification is lengthy and complex, reflecting the incredible adaptive radiation they have undergone:

Abbreviated Crustacean Classification

- Class Cephalocarida (small, primitive, little differentiation of segments; recently discovered; 9 species)
- Class Branchiopoda (often with carapace forming a dorsal shield or bivalve shell; includes numerous freshwater forms such as fairy shrimp, brine shrime, and caldocerans; about 800 species)
- Class Ostracoda (body completely enclosed within a bivalved carapace; about 2000 species)
- Class Mystacocarida (small, interstitial forms; 9 species)
- Class Copepoda (one-eyed, no carapace; free-living or parasitic; about 7500 species)
- Class Branchiura (ectoparasites on fishes; about 130 species)
- Class Cirripedia (barnacles; free-living and endo- or ectoparasitic in/on coelenterates, crustaceans and echinoderms; about 1100 species)
- Class Malacostraca (the remaining crustaceans; over 20,000 species)
  - Order Decapoda (carapace enclosing branchial chambers; 5 pairs of walking legs)
    - Infraorder Palinura (lobsters)
    - Infraorder Anomura (hermit crabs; mole crabs; porcelain crabs)
    - Infraorder Brachyura (true crabs)

The hermit crabs are buried deep within one group of the largest class of crustacea. There are many other divisions of malacostracans, but I have listed the most commonly known forms.

Having placed the hermit crabs within their proper taxonomic position, we can now discuss several species of them.

Among the numerous hermit crabs of the Hawaiian Islands, two are especially interesting to shell collectors.

Trizopagurus strigatus has a greatly flattened body that allows it to live comfortably inside cone shells (Figs. 1 & 2).

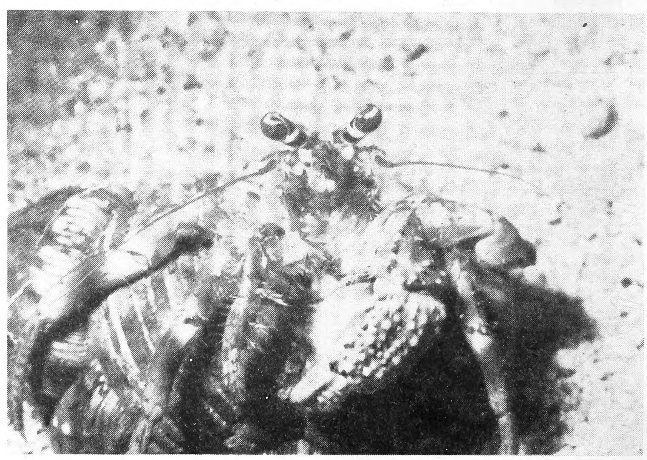


Figure 3 *Dardanus cf. gemmatus* looking out from its *Turbo* shell home. (Maile, Oahu).

Hermit crabs of the genus *Dardanus* inhabit various species of shells (Fig. 3), but have a unique association with anemones of the genus *Calliactis*. In the Hawaiian Islands, *Calliactis polypus* is always found on shells inhabited by *Dardanus* DELVANEY & ELDREDGE, 1977: 141-142). They have a very special behavioral relationship: *Dardanus* actively detaches and transfers the commensal anemone!

SEASHELL TREASURES BOOKS

1701 Hyland St.
Bayside, California 95524 U.S.A.
Sally Bennett & Steve Long
Telephone (707) 822-1024 (24 hours)

New and Antiquarian Books
(October, 1985)

Part 3

We carry the world's largest selection of molluscan books, in stock, and available for immediate delivery anywhere. The current list includes mollusks, fossils, marine invertebrates, geology and general natural history works. Our present book list includes all types of publications: new, used, reprinted, photocopied, out of print books & separates, journals and other serial publications. We will be glad to order ANY book for you.

TERMS & CONDITIONS

VISA and **MasterCard** are accepted! Prepayment is required on all orders. U.S. orders are shipped via United Parcel Service (requires street address — no post office boxes). Shipping and handling are $2.50 for the first book plus $.75 for each additional book ordered. Overseas orders are shipped by book rate post and must include $5.00 per order for registration and handling. All other shipping costs are ADDITIONAL (e.g., Air Parcel, C.O.D., insurance). Payments not is U.S. dollars will be credited at the rate given us by our bank. Any money overage will be credited to your account or refunded as you wish. Payments may be made by BANK TRANSFER payable to SHELLS and SEA LIFE, Account No. 833-061170 at Security Pacific National Bank, 875 Crescent Way, Arcata, CA 95521. California residents must add appropriate sales tax.

This list supersedes all previous price lists. All books and accessories are sold as complete and in good condition unless otherwise noted. Prices are subject to change without notice. We are not responsible for price changes of books. All books are subject to prior sale. You will always be offered a prompt refund of your money if a book is no longer available. We can **not** be responsible for books shipped without registration or insurance. Any item not received as listed may be returned within 10 days after you receive your order. All prices are quoted as net and are in U.S. dollars.

All items with a number starting with "0" will normally be in stock and available for shipment quickly. We hold as many copies as we can of these trade books. All other numbers may be one-of-a-kind or low quantity stocking items. Please allow 6 to 8 weeks for delivery on these items

All journals and serial publications are "as issued" unless otherwise noted. Many individual issues are not listed here. Please send specific interests if you are looking for complete sets or parts of serial publications. We will notify you of their availability. Subscriptions are available to many of these journals and serials. Please allow a minimum of 60 days for subscriptions to to arrive. We can trim or bind books and papers for you. Please specify what you would like. Prices vary but are reasonable — estimates on request. We also maintain open orders for specific serials, books & author papers (at a 10% discount) and will ship automatically as they arrive.

7874 Hertlein, L.G. & Geol.&-Paleo. Mar.Pliocene S.D., Pt.2b $19.95

7872 Hertlein, L.G. & Geol.&-Paleo. Mar.Pliocene San Diego $2.75

7860 Hertlein, L.G. Mar. Pleisto. Invert. Puerto Penasco $1.95

7509 Hertz, C. Illustrations of the types named by S. Stillman Berry in his "Leaflets in Malacology". 42 pages 98 b&w photos. $9.95

4037 Hewitt, Susan J. 1984. Your Collection -- A How-To Column: #1, What Makes a Good Collection. S&SL, 16(8):124-125. — $2.50

4038 Hewitt, Susan J. 1984. Your Collection -- A How-To Column: No. 2, Labels, Part 1. S&SL, 16(10):145. — $2.50

4039 Hewitt, Susan J. 1984. Your Collection -- A How-To Column: No. 3, Labels, Part 2. S&SL, 16(10):161. — $2.50

4040 Hewitt, Susan J. 1984. Your Collection -- A How-To Column: No. 4. About Collecting. S&SL,-16(11):209. — $2.50

4041 Hewitt, Susan J. 1984. Your Collection -- A How-To Column: No. 5. Keeping a Field Notebook. S&SL, 16(12):243. — $2.50

8020 Hickman, C.P. 1955. Integrated Principles of Zoology, 956 pp. FA HB $7.50

8031 Hickman, C.P. 1966. Integrated Principles of Zoology, 3rd Ed., 965pp., FA HB $8.50

3073 Hinkley, A.A. 1915. New fresh-water shells from the Ozark Mountains. Proc. USNM, 49:587-589, pl. 78. $2.50

7185 Hinton, A. Guide to Australian Seashells. This book has 77 full pages of color illustrations. Over 1600 individual shells are pictured which represent over 1060 distinct species and are arranged for easy identification. Format 8" x 10" printed on finest coated paper. This is a must for collectors! Hardbound — $14.95

7192 Hinton, A. Guide to shells of Papua, New Guinea. Another outstanding book in the series of identification books by this famous author. 68 full page color plates representing 1450 separate shells of over 950 distinct species. Full coverage of the land shells of New Guinea as well as the marine shells. A very excellent value! Hardbound — $14.95

0327 Hinton, A. Shells of New Guinea and Central Indo-Pacific. This is the most popular book we have ever sold in the price range. Complete in every detail with finest color plates throughout. Every described shell is illustrated in color. 99p. with 44 full color plates. Outstanding buy. Hardbound — $18.50

0295 Hinton, S. Seashore Life in Southern California (United States). Color and halftone illustrations. 181p., Complete introduction to animal life found on California beaches south of Point Conception. A well-prepared paperback by the University of California. Softbound — 0295S $3.95

3007 Hirase & Taki 1951. Handbook illustrated shells natural colors from Japanese Islands ... adjacent territories. 238p., 134 pls (130 color) HB $45.00

7000 Howard, F.B. 1963. New Name for a Pyrene from Mexico. Occ. Pap. Santa Barbara Mus. N.H., 1p. $1.00

8050 Howchin, W. 1925-1930. The Building of Australia and the Succession of Life. Parts 1-3. Pp. 1-750. Covers both fossil and recent material. Very scarce set. Softbound in 3 volumes. $60.00

8060 Howell, B.F. 1951. The Vogdes Collection of Trilobites. Trans. San Diego Soc. Nat. Hist., 11(11):257-328, pls. 1-13. [AV $6.50]

0100 Howorth, P. Abalone Book. Complete data on North American Haliotis, identification, history, evolution, locality and more. 80 pages, color cover and illustrated in color and halftones. Charts and graphs, very good. Hardbound 0100H — $10.95; Softbound 0100S — $4.95

0147 Humann, P. Ocean Realm Guide to Reef Creatures: Invertebrates. Ocean Realm Publishing Corp., 80 pages. Softcover — $10.95

0287 Humphreys, M. Seashells of the West Indies. Coverage of the Jamaican and Caribbean areas. 650 species illustrated in full color plus 20 explanatory drawings. 351 pages with chapters on collecting, cleaning and storing. Values for shells with notes on the most valuable West Indian species. Lists 350 minute and inconspicuous species. Hardbound — $19.95

7216 Hyman, L. The Invertebrates Volume VI, Mollusca 1. 792 pages illustrations, graphs, charts and maps. One of the foundation works on mollusks. The most complete reference volume on these animals. Indispensable to their study. Hardbound — $74.95

2164 Indo-Pacific Mollusca 1, No. 7 Powell May, 1967. Family Turridae Part 1. $6.75

2163 Indo-Pacific Mollusca Vol. 1 No. 6 Rosewater, J. April, 1965. Family Tridacnidae $9.00

2181 Indo-Pacific Mollusca Vol. 1, No. 13 Emerson & May, 1973. Genus Drupa in the Indo-Pacific. 40 pages, 35 plates. $6.

2265 Indo-Pacific Mollusca Vol. 3, No. 15 Powell November, 1973. Patellid Limpets of the World (Patellidae). 132 pages, 123 plates. $14.75

2162 Indo-Pacific Mollusca Vol. 3, No. 16 Rehder, H. November, 1973. Family Harpidae of the World. 68 pages, 65 plates. $9.00

2243 Indo-Pacific Mollusca Vol. 3, No. 17 Cernohorsky, W.O. Mitridae of the World, Part 1, Subfamily Mitrinae, 256 pages. $31.25

2488 Indo-Pacific Mollusca Vol.1, No. 8 Wilson & Mc December, 1967. -Genus Cypraea (subgenus Zoila Jousseaume) $6.25

2490 Indo-Pacific Mollusca Vol.2, No. 10 Powell September, 1969. Family Turridae in the Indo-Pacific, Part 2. 214 pages, 137 plates. $17.75

2491 Indo-Pacific Mollusca Vol.2, No. 11 Rosewater, J. November, 1970. Family Littorininae, Part 1. 90 pages, 62 plates. $13.90

2492 Indo-Pacific Mollusca Vol.2, No. 12 Rosewater, J. January, 1972. Family Littorininae, Pt. 2. Subfam. Tectariinae & Echinininae. 28 p., 22 pls. $5.75

2489 Indo-Pacific Mollusca Vol.2, No. 9 Abbott, R.T. August, 1968. Helmet Shells of the World (Cassidae). 202 pages. 187 plates, some in color. $22.50

2494 Indo-Pacific Mollusca Vol.3, No. 14 Robertson, R.R. May, 1973. Genus Gabrielona (Phasianellidae) Indo-Pacific & West Indies. 34 p. 29 pls. $6.25

2070 Indo-Pacific Mollusca. Complete original set in 3 large binders with many color and halftone plates. The early (and in many cases, most popular) sections have long been out of print. — $295.00

2071 Indo-Pacific Mollusca. Complete in 3 binders, one part in photocopy — $275.00

7151 Ingram, W.M. 1939. Cypraeidae from Makatea Island, Tuamotu Archipelago. Occ. Pap. Bernice P. Bishop Mus., 14(18):323-325. $2.50

3022 Ingram, W.M. 1947. Additions to knowledge of Cypraeidae based on the collections of AMNH. AMNH Novitates (1366):1-4. — $2.50

7148 Ingram, W.M. 1947. Hawaiian Cypraeidae. Occ. Pap. Bishop Mus., 19(1):1-23, figs. 1-9. $4.00

4042 Innocenti, Boris. 1984. The Intelligent Octopus. S&SL, 16(10):181, 3 photos. — $2.50

3012 Iredale, T. 1939. Great Barrier Reef Expedition 1928-29. Brit. Mus. (N.H.) Sci. Rep., 5(6):209-425, 7 pls. $29.00

0153 Iverson, E.S. & R.H. Skinner How to Cope with Dangerous Sea Life. A Guide to Animals that Sting, Bite, or are Poisonous to Eat from the Waters of the Western Atlantic, Caribbean, and

Gulf of Mexico. 64 pages, many color illustrations. Full color photos identify each of the dangerous creatures one is likely to encounter in these areas. Includes first aid techniques. This booklet will make salt water activities safer and more enjoyable. Softbound — $3.25

3023 Jackson, H.G. 1941. Check-list of the terrestrial and fresh-water Isopoda of Oceania. Smith. Misc. Coll., 99(8):1-35. $7.00

7075 Jackson, R.T. 1917. Fossil echini of the Panama Canal Zone and Costa Rica. Proc. USNM, 53:489-501, pls. 62-68. $5.40

3032 Jacobson, M.K. & G. Usticke 1966. What is Arca caelata Reeve? Nautilus, 80(1):10-13, 1 photo. — $2.00

7804 Jacobson, M.K. & W. Emerson Shells from Cape Cod to Cape May. Illustrated with many excellent identification drawings. SB $5.25

3040 Jacobson, M.K. & W.E. Old, Jr. 1966. On the identity of Spisula similis (Say). Ann. Rep. 1966 AMU p. 30-31. — $2.00

3012 Jacobson, M.K. & W.E. Old, Jr. 1974. On a sinistral specimen of Liguus virgineus with additional remarks on the genus Liguus. Nautilus, 83(1):28-29, figs 1-2. — $2.00

7097 Jacobson, M.K. & W.K. Emerson 1961. Shells of the New York City Area. 142pp, 150 drawings by A. D'Attilio. Hardbound $9.95

3027 Jacobson, M.K. 1953. The Phyletic Development of the Pulmonata — after Johannes Thiele. Translated by Jacobson. 12p. — $3.50

3021 Jacobson, M.K. 1958. Results of the Puritan-American Museum of Natural History expedition to western Mexico. 3. The terrestrial mollusks. AMNH Novitates (1899):1-14, figs. 1-2, tbl. 1. — $2.50

3041 Jacobson, M.K. 1964. On Rhytidothyra jacobsoni Alcalde. Nautilus, 77(3):97-101, 2 photos. — $2.50

3014 Jacobson, M.K. 1966. A new Streptostyla from Nicaragua. Nautilus 79(3):101-103, fig. 1. — $2.50

3033 Jacobson, M.K. 1968. On a collection of terrestrial mollusks from Nicaragua. Nautilus, 81(4):114-120. — $2.50

3034 Jacobson, M.K. 1969. On Lymnaea pseudopinguis (F.C. Baker). Nautilus 82(3):110-112. — $2.50

3033 Jacobson, M.K. 1968. On a collection of terrestrial mollusks from Nicaragua. Nautilus, 81(4):114-120. — $2.50

3034 Jacobson, M.K. 1969. On Lymnaea pseudopinguis (F.C. Baker). Nautilus 82(3):110-112. — $2.50

7096 Jacobson, M.K. 1971. Index to Revista de la Sociedad Malacologica 'Carlos de la Torre'. Sterkiana (44):1-44 — $5.95

3036 Jacobson, M.K. 1972. Malacology in Cuba. Sterkiana (45):37-42. — $2.50

3035 Jacobson, M.K. 1972. Observations on the siphonal behavior of young surf clams, Spisula solidissima. Nautilus, 86(1):25. — $2.00

3031 Jacobson, M.K. 1973. Some Notes on Sexual Dimorphism in the Shark Eye, Polinices duplicatus (Say) at Rockaway Beach, New York. Bull. AMU for 1972, p.27. — $2.50

3037 Jacobson, M.K. 1974. Charles Wright (1811-1875) in Cuba as revealed by his letters. Sterkiana (53):1-7, 1 photo, 1 map. $2.50

3039 Jacobson, M.K. 1975. The freshwater prosobranch, Tarebia granifera, in Oriente, Cuba. Nautilus 89(4):106. — $2.50

3038 Jacobson, M.K. 1975. Type material of some Cuban helicinids. Nautilus 89(2):54-55. — $2.50

3028 Jacobson, M.K. 1976. Some Remarkson Felipe Poey's "Memorias Sobre la Historia Natural de la Isla de Cuba." WSM Annual Report (9):55-58, 1 photo. — $2.50

3029 Jacobson, M.K. 1977. Felipe Poey of Cuba and his "Memorias." Sterkiana (65-66):1-4. — $2.50

7487 Japan Science Museum World Seashells - Kawamura Collection. Large format color photo book illustrating many of the spectacular shells in the collection. Includes absolute top quality photos of many rare and unusual shells and forms. Soft cover — $15.95

4043 Jensen, Kathe R. 1984. A Nomenclatural Problem in the Ascoglossa -- or: Why One Should Never Name a Green Sea-Slug "Viridis". S&SL, 16(11):188-190, 1 photo. — $2.50

0292 Johnson M. & Snook Seashore Animals of the Pacific Coast. Gives full and complete coverage of the animals, seaweeds, and fauna of the Pacific Coast area of North America. Illustrated with color and halftone plates. A valuable and detailed study. 650 pages. Softcover — $6.95

0480 Johnson, S. Living Seashells. A beautifully illustrated book on seashells, and the living animals that inhabit them. It shows and briefly discusses a selection of different shells in their living state. It encourages an appreciation for mollusks as more than simple ornaments, but as beautiful living creatures. 117 pages, 235 individual color plates. Softbound — $8.95

2080 Johnsonia Vol. 1(1) - 5(50) (Vol. 1(18) index in photocopy). $250.00 a few individual volumes & numbers are available. Write for prices on specific parts.

2834 Johnsonia Volume 1 (Reprint) $49.95

2835 Johnsonia Volume 2 (Reprint) $49.95

2090 Journal de Conchyliologie Series, individual volumes & numbers are available in original, microfiche, or photocopy. Write for specific items.

2100 Journal of the Malacological Society of Australia All volumes are available in original, microfiche or photocopy. Write for prices.

7454 Kaas & Van Belle 1981. Genus Lepidochitona Gray, 1821 Northeast Atlantic Ocean, Mediterranean Sea & Black Sea. 43p., 128 figs., 3 maps $8.50

7410 Kaas, P. & R.A. Van Belle 1980. Catalog of Living Chitons. 144p., 8 vo. Cloth. $21.75

7108 Kaestner, A. 1967. Invertebrate Zoology Volume I. Protozoa through Annelida (including Mollusca). 597p., many line drawings, some halftones. $46.25

0126 Kaplan, E.H. A Field Guide to Coral Reefs of the Caribbean and Florida including Bermuda and the Bahamas. 289 pages, 16 color plates, 21 black and white plates. Hardcover — $18.75

3066 Karpinsky, A.P. 1945. Travaux scientifiques. I. Acad. Sci. URSS, 521p., illus. + fold-outs and separate plates. Hardbound. In Russian. $55.00

8120 Kay, E.A. 1961. On Cypraea tigris schilderiana Cate. Veliger RPT. $2.50

0197 Kay, E.A. Hawaiian Marine Shells. Reef and shore fauna of Hawaii, Section 4: Mollusca. This is an exceptionally fine work on the molluscs of Hawaii. An extensive study, illustrated in color and halftones. 650 pages. Best seller for Hawaiian shells. Hardbound Order No. 197 $37.25

7140 Kaye, C.A. 1959. Shoreline Features... Puerto Rico. USGS Prof. Paper 317B SB $5.75.

3062 Keen, A.M. 1936. A new pelecypod genus of the family Cardiidae. Trans. SD Soc. Nat. Hist., 8(17):119-120. — $2.00

8150 Keen, A.M. 1958. Seashells of Tropical West America, 1st Ed. Fair condition, loose binding, pages out of sequence. $24.00

7102 Keen, A.M. 1963. Marine Molluscan Genera of Western N.A. 1st edition. — $12.75.

7103 Keen, A.M. 1964. A Quantitative Analysis of Mol. Coll. Isla Espiritu Santo, Baja Calif. Mexico. Proc.Cal. Acad.Sci. 30(9):175-206, figs. 1-4 $3.50

7104 Keen, A.M. 1966. Moerch's W. Central Amer. Molluscan Types ... Semele. Occ. Pap. Calif. Acad. Sci., (59):33 pp., good, $3.50

7105 Keen, A.M. 1968. West Amer. Mollusk Types at the British Museum (Natural History) IV. Carpenter's Mazatlan Collection. 51 pp., $5.95

0233 Keen, A.M. 1974. Marine Molluscan Genera of Western North America. Revised edition. The Veliger review states "This book is a must for every serious shell collector." Hardbound, cloth cover, 208 pages with excellent indexing, fully illustrated in fine halftone photos and drawings. An identification book by Stanford University Press. — $20.75

0290 Keen, A.M. Seashells of Tropical West America, 2nd Ed. This book is THE authority on tropical American shells from the west coast of Mexico, Panama, and Southern California. Every collector of shells from this area cannot afford to be without this book. Large book with finest hard library binding. 1019 pages, fully illustrated with color, halftones and line drawings. Includes an excellent bibliography, index, and maps. — $47.50

0309 Kellum, A. Shellcraft Critters. 32 pages of well-illustrated instructions on making 15 critters. Pamphlet, 5-1/2" x 8-1/2" — $1.95

7285 Kensley, B. Sea-Shells of Southern Africa - Gastropods. 236 pages, illustrated in color and in halftone drawings. Covers 910 species of gastropods. Cloth binding. — $28.75

7851 Kerney, M.P. & R.A.D. Cameron 1979. A Field Guide to the Land Snails of Britain and North-west Europe. Hardbound. $26.95

7854 Kerney, M.P., R.A.D. Cameron & J.H. Jungbluth 1983. Die Landschnecken Nord- und Mitteleuropas. 384 pages, 776 illus., col. B&W; German. HB $23.25

4046 Kerstitch, Alex. 1984. A Threatened Giant. S&SL, 16(5):54-55, 4 photos. — $2.50

4044 Kerstitch, Alex. 1984. Killer Cone. Opisthobranch, 16(2):12-13, 2 photos. — $2.50

4047 Kerstitch, Alex. 1984. Octopus, The Maligned Mollusk. S&SL, 16(6):72-73, 2 photos. — $2.50

4048 Kerstitch, Alex. 1984. Partnerships in the Sea. S&SL, 16(8):130, 132, 5 photos. — $2.50

4045 Kerstitch, Alex. 1984. The Predatory Murex. Opisthobranch, 16(3):29, 2 photos. — $2.50

7474 Kilburn, R. & E. Rippey Seashells of Southern Africa. 249p., 49 plates plus photos and illustrations. Covers over 600 species in detail, most illustrated in full color. Over 200 supplementary text- figures emphasizing fine details and diagnostic structures. Particular emphasis on biology of the living creature and field observations previously unpublished. Large library hard binding. — $51.75

7496 Kilburn, R.N. 1981. Revision of the Genus Ancilla Lamarck, 1799. Ann. Natal Mus., 24(2):349-463, 1 color pl., 262 figs. SB $7.95

7108 Kincaid, Trevor 1957. Local races and clines in the marine gastropod Thais lamellosa Gmelin a population study. 75p., 55 pls. This is a very rare copy of a hand-bound book. A few of the plates are loose but apparently complete. AV $45.00

3006 Kira 1954. Shells of Japan. 206p. 67 plates. Hundreds of shells illustrated in color. HB + hard slip cover. Text Japanese, Latin names. $25.00

3033 Kirk, E. 1926. Cymbidium, a new genus of Silurian pentameroid brachiopods from Alaska. Proc. USNM, 69(23):1-5, pl. 1. $1.50

3022 Kirk, E. 1927. Pycnodesma a new molluscan genus from the Silurian of Alaska. Proc. USNM, 71(20):1-9, pls. 1-2. $2.35

3076 Kirk, E. 1927. Tanaodon, a new molluscan genus from the Middle Devonian of China. Proc. USNM, 70(12):1-4, pl. 1. $1.20

3025 Kirk, E. 1928. Bathymopterus, a new fossil gasteropod genus from the Silurian of Alaska. Proc. USNM, 74(8):1-4, pl. 1. $1.30

7176 Kirklady, J.F. Fossils in Colour. 183 full color specimens illustrated, with additional maps, charts and graphs. 4th revised edition. An excellent informative and detailed book. Hardbound — $8.95

0286 Kirtisinghe, P. Seashells of Sri Lanka. Covers the rich variety of shells found in the Sri Lanka (Ceylon) area of the Indian Ocean. 120 pages, 58 pages of color illustrations, 18 pages of halftones. Hardbound — $12.50

7099 Kopper, P. 1982. The National Museum of Natural History. Harry Abrams, Inc., New York, 496 pages, color throughout. Coffee table book Hardbound — $65.00

3048 Korringa 1951. Nature & function of "Chalky" deposits in shell Ostrea edulis Linnaeus. Proc. Cal. Acad. Sci., 27(5):133-158, 2 text figs. $5.00

7209 Kosuge, S. Illustrations of Type Specimens of Molluscs described by William Healey Dall. 64p., 29 halftone pls. SB $15.00

0117 Kozloff, E.N. Seashore Life of the Northern Pacific Coast. An Illustrated Guide to Northern California, Oregon, Washington and British Columbia. Univ. Washington Press, 370 pages, 299 color photos., Softcover — $19.95

8160 Krancer, A.E. 1980. Revision of Mesozoic Nannofossil Genera Bidiscus, Biscutum, & Discorhabdus. Paleo. Cont. (U. Kansas), 97:12pp., ill. [EX $1.75]

7284 Kuroda, T. Habe & Oyama Seashells of Sagami Bay. A spectacular book. Covers all Japanese shells in general and in particular all the shells contained in the collection of the Emperor of Japan. Text full in both English and Japanese. 106 full page color plates and 15 pages of excellent halftones. Complete data on all Japanese shells, locality, sizes and all information necessary. Hardbound with book jacket and slip cover. — $90.25

2802 La Conchiglia many single issues (pre-1980/issues) $5.00 per issue.

2801 La Conchiglia Published in Italy. International edition in English. many single issues (1980-1985 issues) $3.50 per issue.

7111 La Rocque, A. 1966-1970. Pleistocene Mollusca of Ohio. Pts. 1-4. Ohio Geological Survey, Bull. 62. 800pp. + index pp. i-xxiv. SB $28.00

7429 Laboute, P. & Y. Magnier Underwater Guide to New Caledonia. This underwater guide describes the most representative types of flora and fauna found among the mangrove swamps, coral reefs, beaches and rocks of this region, and the photographs reveal a hidden world of beauty and color. Hardbound, 155 pages, 212 color photographs. — $14.25

7266 Lan, T.C. Rare Shells of Taiwan. 80 species of shells (rare) from Taiwan waters. At least one-fourth of these have not been illustrated before. Malformed shells and other oddities. 63 pages of full color plates of excellent quality, all with English descriptions. First quality. Hardbound — $20.95

7254 Lance, J.R. New Panamic Nudibranchs-Gulf of California. Pamphlet. $3.50

7112 Laszlo, M. 1983. Magyarozszagi Pleistocen es Recens. Malakologai Bibliographia. 116pp. $19.00.

3052 Lea Art.II. - New Unionidae of the United States. Acad. Nat. Sci. Philadelphia, Journal, NS, 5, pt 1, Art. 2 p53-109, pls.1-18 folio. EX $18.00

3053 Lea New Unionidae of the United States & Arctic America. Acad. Nat. Sci. Phila., Jour. NS, 5, part 2, Art. 5, p.187-216, pls. 24-33 folio. EX $15.00

3010 Lea, I. 1852. A synopsis of the family of naiades. 3rd. ed., 88 p. $25.

3004 Lea, Isaac 1836. A Synopsis of the Family of Naiades. 61p., color frontispiece, WS HB $18.00

7113 Lecointre, G., K.J. Tinkler & H.G. Richards 1967. The marine Quaternary of the Canary Islands. Acad. Nat. Sci. Philadelphia, 119(8):325-344. $2.95

7324 Lellak, J. Shells of Great Britain and Europe. Fully colored. Illustrated. 88 full color pages. Common and scientific names. 235 pages. Hardbound — $7.95

7115 Leonard & Frye 1975. Pliocene & Pleistocene deposits & molluscan faunas, east-central New Mexico. NM Bur. Mines & Mineral Res., Mem. 30, 44p. $4.95

7114 Leonard & Frye 1978. Paleontology of Ogallala Formation, northeastern New Mexico. New Mexico Bureau of Mines & Mineral Res., Circ. 161, 21 pp. $3.95

7116 Leonard, Frye & Glass 1975. Late Cenozoic mollusks & sediments, southeastern New Mexico. NM Bureau Mines & Mineral Res., Circ. 145, 19pp. $3.50.

7117 Leydig, F. 1870. Anatomie und Physiologie der Lungenschnecken. pp.43-67. [includes handwritten French translation] $7.50

7118 Leydig, F. 1876? Ueber Paludina vivipara. Zeitschr. f. wissensch. Zool., pp.125-194. $21.00

0214 Light, S.F., R.I. Smith et al Intertidal Invertebrates of the Central California Coast. (Light's Manual). 2nd edition. illus. Hardbound. 716p. $33.75

4049 Liltved, Bill. 1984. Notes on Pedicularia elegantissima Deshayes, 1863. S&SL, 16(11):-194. — $2.50

7453 Lindberg, D. Acmaeidae. In this manual, all California limpets in the Family Acmaeidae are described, illustrated and discussed. Hardbound $17.25

0171 Lindner, G. Field Guide to Seashells of the World. More than 1000 different shells of the world are illustrated in full and excellent color. Complete descriptions with all scientific data and common names are give as well. This is one of our best sellers and we highly recommend it to any collector. 271 pages. Softbound — $10.95

0167 Lippson, A.J. & R.L. Lippson Life in the Chesapeake Bay. Johns Hopkins Univ. Press, 229 pages, illustrated. Guide to fishes, invertebrates and plants from Cape Cod to Cape Hatteras. Softbound — $13.95

3059 Lowe 1935. New marine mollusca West Mexico, list shells collected Punta Penasco, Sonora, Mexico. Trans. SDSNH, 8(6):15-34, pls. 1-4 $5.80

8180 Lozek, V. 1952. The Quaternary molluscs of the settlement Zamecek at Nitriansky Hradck. Anthropozoikum (Prague), 1:37-52. $2.25

7121 Lozek, V. 1954. Neue Mollusken aus dem tschchoslowakischen Pleistozan: Anthroposoikum (Prague), 3:327-342. $2.25

7122 Lozek, V. 1954. The loess section at Banka near Piestany (western Sovakia). Anthropozoikum (Prague), 3:301-323. $3.45

7123 Lozek, V. 1978. Moglichkeiten und perspectiven der Malakoanalyse in Ablagerungsfolgen des Binnenlandes. Caroline Univ., Prague, pp. 253-268. $2.10

7119 Lozek, V. 1982. Faunengeschichte Grundlinien zur spat- und nachiszeitlichen Entwicklung der Molluskenbestande in Mitteleuropa. 92(4):106p. $16.50

7329 Lozet & Petron Shells of the Caribbean. Exceptional paperback with color illustrations. Good identification of all species. Common and scientific names. Synonyms, well indexed. English edition. Excellent! Softbound — $11.50

7510 Lubinsky 1980. Marine Bivalve Molluscs Canadian Central & Eastern Arctic: 42 maps, 11 p. halftone plates, 111 pages total. $11.70

7883 Luciflora, Donata 1977. Marvellous World of Shells. Translated by J. Peter Tallon. Abbey Library, London, 108 pages, color throughout, Hardbound — $23.95

7150 Luther, R. & N. Chung Cowry & Cone Shells of Hong Kong. Fully illustrated in color, complete coverage of the shells with scientific and common names. Softbound, 128 pages. — $8.50

7124 MacFarland, F. 1931. Drepanida, New Name for Drepania. 1p. $2.50

7125 MacFarland, F.M. 1929. Drepania A Genus of Nudibranchiate Mollusks New to California. Proc. Cal. Acad. Sci., 18(15):485-496, pl. 35 $2.50

7126 MacGinitie, G.E. & Nettie MacGinitie 1968 Natural History of Marine Animals. 2nd ed. 1-523, figs. 1-286. halftones & line drawings. Hardbound, new condition. — $24.95

7236 Macpherson, J.H. & C.J. Gabriel 1962. Marine Molluscs of Victoria. 475p., 468 figs. Hardbound $19.25

0316 Magnotti, G. Shelling & Beachcombing in the Caribbean and Florida. Very good coverage of shells and beach life in the area. Tells how, where, even when to look. Heavily illustrated in full color. Some illustrations in halftones. Good quality paperback. — $4.95

0127 Magruder & Hunt 1979. Seaweeds of Hawaii. 116pp., color illus. $9.95

2625 Malacological Review Vol. 10 (1977) $15.00

2630 Malacological Review Vol. 12 (1979) $15.00

7127 Mann, A. 1925. Marine Diatoms of the Philippine Islands. USNM Bull. 100, 6(1):182pp., 39 pls. $28.50

3015 Marcus, Ernst, 1958. On western Atlantic opisthobranchiate gastropods. AMNH Novitates (1906):1-82, figs. 1-111. — $12.30

2859 Marcus, Ernst. 1961. Part One. Opisthobranch Mollusks from California. The Veliger, 3(Supp. pt. 1):1-85, pls. 1-10. $7.50

3024 Marcus, Eveline & Ernst Marcus 1956. On two sacoglossan slugs from Brazil. AMNH Novitates (1796):1-21, figs. 1-23. — $4.20

7215 Marincovitch Intertidal Molluscs of Iquique Chile. good halftone illustrations. 50 pages with charts and graphs. $4.95

3078 Marsh, C.D. 1926. On a collection of copepoda from Florida with a description of Diaptomus floridanus, ns. Proc. USNM, 70(10):1-4, figs. 1-6 — $2.50

7143 Marsh, J.M. & O.H. Rippingdale Cone Shells of the World. All illustrations are water color plates. Excellent coverage of the cones of Australia, Indian Ocean, and tropical areas. 24 full page color plates, 500 species described and illustrated. 158 pages. A valuable addition to your library. Hardbound — $39.50

3028 Marshall, W.B. 1927. The Australian land shell Thersites bipartita and its allies. Proc. USNM, 72(15):1-16, pls. 1-3. $4.70

3030 Marshall, W.B. 1932. Two new land shells of the genus Bulimulus from Bolivia. Proc. USNM, 81(14):1-3, pl. 1. $1.30

3025 Mayr, E. & C.B. Rosen 1956. Geographic Variation and Hybridization in Populations of Bahama Snails (Cerion). AMNH Novitates (1806):1-48, figs. 1-9, tbls. 1-7. — $9.60

0189 McDonald, G. & J. Nybakken Guide to the Nudibranchs of California. Over 100 color plates, collecting techniques, photographing techniques, anatomy, biology, and keys to species are included. Covers species found from Alaska through California. Softbound — $13.95

3079 McEwan, E.D. 1919. A study of the brachiopod genus Platystrophia. Proc. USNM, 56:383-448, pls. 42-52. $9.50

0240 McKay, F.P. Let's go shelling. 88 pages, 5-1/2" x 8-1/2". Shell collecting has long been both hobby and profitable business for the author. Her primer tells you when, where and how to find shells, and how to clean, display and use them. Softcover — $1.95

0782 McLachlan, D.H. & J. Ayres Fieldbook of Pacific Northwest Sea Creatures. 208p., color illus. Over 200 common marine animals. Animals grouped by common characteristics with notes on similarities. Softbound 782S — $9.95, Hardbound 782H — $15.95

7206 Mclean & Owen Hybridization of Eastern Pacific Abalones. 47 pages illus. color and halftones. Large paperback. $4.50

7864 McLean, J.H. 1961. Marine Mollusks from Los Angeles Bay, Gulf of California. Trans. S.D. Soc. Nat. Hist., 12(28):449-476, figs. 1-3. — $3.25

7253 McLean, J.H. Marine Shells of Southern California. 104p., illus. A primary reference for Southern California shells. Excellent black & white illustrations. Softbound — 1253 $8.95

7848 McLean, James H. 1984. Systematics of Fissurella in the Peruvian and Magellanic provinces (Gastropoda: Prosobranchia). Contributions in Science, Los Angeles County Museum, (354), 70 p., 267 b&w figs. The 58 named fissurellid taxa have been reduced to 13 species and 3 subspecies. Excellent illustrations are given of the shells and the animal's radulae. Soft cover — $7.50

4050 McLean, James H. 1984. The World of Marine Micromollusks. S&SL, 16(9):152-156, 2 pls., 1 photo. — $2.50

7121 McMillan, N.F. British Shells. Concise text. Wealth of color and halftone illustrations. 600 marine shells, 200 freshwater and land snails are described. 344 illustrations. 196 pages. Excellent buy at this price. Hardbound — $9.95

7131 Mead, A.R. 1979. Pulmonates. [Fretter, V. & J. Peake, eds.] Volume 2B Economic Malacology. 150pp. HB, illus. $19.50

0353 Melvin, O.G. 1000 World Seashells. (Rare to common with values). Describes 1000 rare to common species. Over 50 numbered plates in color and halftones. Values are given. Companion book to "Sea Shells of the World with Values". Completely different shell coverage. Hardbound — $18.50

7682 Melvin, O.G. Gems of the World Oceans. 96 pages of information on all phases of identification, collecting, cleaning and displaying. 14 full page color plates. Dr. Melvin is a well known authority and author of shell books. Hardbound 1682H — $9.95; Softbound 1682S — $6.75

0275 Melvin, O.G. Seashell Parade. Rare shells are shown in excellent halftone photographs (75 full pages of illustrations). Fact filled book that is fine reading. 369 pages. Covers trading with dealers. Hardbound. — $11.50

0289 Melvin, O.G. Seashells of the World with Values. Over 1100 shell species are listed with 27 full color pages and 27 excellent halftone pages. Full descriptions with locations and sizes given. Prices of shells are given (only a general guide as prices change!). 167 pages. Hardbound — $19.50

4051 Millen, Sandra & Sven Donaldson. 1984. Living in Mud. Opisthobranch, 16(4):46-47, 1 fig. — $2.50

2190 Minutes of the Conchological Club of Southern California Complete set of 200 numbers (some reprint). $295.00

2875 Minutes of the Conchological Club of Southern California individual numbers. $0.25 per page (specify which numbers you want)

2200 Minutes of the Conchological Club of Southern California No. 135-200. $97.50

8210 Miscellaneous Pamphlets 25 pamphlets on fresh & salt water fish & marine invertebrates including 9 issues of "Salt Water Aquarium" $25.00

8220 Mitt. Bayer. Staatssamml. Palaont. hist. Geol. 1973. 13:205pp, 12 pls. [German; English sum.; Miocene gastropods & Ammonites + paleo. $27.50]

2240 Mollusca April, 1945. 1(4):41-56, 3 pls. + mimeo shell auction list. Oliva reticularis pattersoni n. ssp. + other articles. — $6.00

2975 Molluscan Digest 1971-1974. Bibliographical citations of all types of mollusk papers. Vol. 1(1)-4(2) all published to date. $30.00

2250 Molluscan Digest Individual numbers (specify which volume and issue number you want). $2.50 ea.

2977 Molluscan Digest Individual volumes (specify which volume number you want). $12.50 ea.

2246 Monographs of Marine Mollusca No. 1. Houbrick, R. Cerithiidae. illustrated color and halftones. $23.80

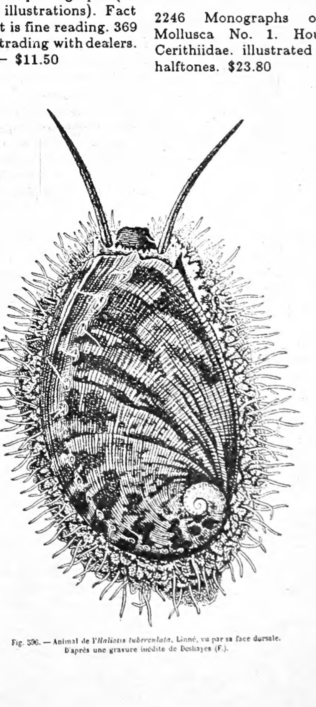


Fig. 596. — Animal de l'*Haliotis tuberculata*, Linné, vu par sa face dorsale. D'après une gravure inédite de Deshayes (F.).

2424 Monographs of Marine Mollusca No. 2. Cernohorsky, W.O. 1981. 52p., 42 text-figs. $10.50

7881 Moore Fossil Mollusks of San Diego Co. $3.50

7880 Moore, E.J. Conrad's Cenozic Foss.Moll.Types at the Acad. NP $4.50

R002 Moore, R.C. [ed.] 1953-1971. Treatise on Invertebrate Paleontology. Parts E, F, G, H (1&2), I, K, L, N (1-3), O, P, Q, R (1&2), S (1&2) U (1&2), V, W. University of Kansas Press, Geological Society of America, 22 volumes. Dark blue cloth bindings, excellent condition. Shipping weight 58 lbs. $1250.00

R003 Moore, R.C., C.G. Lalicker & A.G. Fischer 1952. Invertebrate Fossils. McGraw-Hill Book Co., Inc., 766 p., hundreds of line illustrations. Cloth binding, some wear, but very serviceable — $44.00

0271 Morris et al. Intertidal Invertebrates of California. 34 contributors. Lavishly illustrated work with 900 photographs in full color. It is an extensive and detailed study of the creatures living in California's coastal water. Complete coverage of every major group. Coverage extends from Puget Sound, Washington through Baja California, Mexico. Includes Univalves, Bivalves and Nudibranchs with many, many other groups. Oversize hardbound — $48.75

0168 Morris, P. Field Guide to Shells of the Atlantic Coast, Gulf Coast and West Indies. A Peterson Field Guide. Third revised edition. 1033 species illustrated in full color. Many halftone photos. Hardbound. First quality. One of the best guides available and a best seller. Hardbound 168H — $15.95; Softbound 168S — $8.95

7132 Morris, P.A. 1952. A Field Guide to Shells of the Pacific Coast and Hawaii. 1st ed. 220pp., 40 pls. $7.75

0172 Morris, P.A. Field Guide to Shells of the Pacific Coast and Hawaii. The Pacific Coast companion to the Atlantic volume. Peterson Field Guide. 8 full pages halftone illustrations. Covers 945 species. Section on the Gulf of California (Mexico). Hardbound $12.95

7255 Mulliner, D.K. New Platydoris from the Galapagos Islands. $2.50

4055 Mulliner, David K. 1984. Tritons: the Trumpet Shells. S&SL, 16(8):109-110, 1 photo. — $2.50

4054 Mulliner, David K. 1984. Oliva porphyria Linnaeus, 1758. S&SL, 16(8):103, 1 photo. —$2.50

4053 Mulliner, David K. 1984. Simnia. Opisthobranch, 16(4):33-34, 1 photo. — $2.50

4052 Mulliner, David K. Note on Haliotis. Opisthobranch, 16(3):20-22, 11 photos. — $2.50

7133 Murphy, Garth I. 1966. Population biology of the Pacific Sardine (Sardinops caerulea 1-84, 17 figs., 20 tbls. $4.75

0313 Murray, S. Shell Life & Shell Collecting. Explains the best way to approach the hobby of shell collecting. Fully explains the 5 types of mollusks, how to classify and recognize them. Guides you in finding the best specimens and building a first class collection. Illustrated in both color and halftones. 96 pages, color & B&W illus. Hardcover — $7.95

2135 National Geographic 1965. Includes: Tree snails, gems of the Everglades. $2.50

2136 National Geographic 1966. Includes: Marvels of a coral realm. $2.50

2137 National Geographic 1969. Includes: The magic lure of sea shells. $2.50

2140 National Geographic 1973. Includes: Australia's great barrier reef. $2.50

2134 National Geographic July, 1949. Includes: R. Platt, Shells take you over world horizons. $22.00

A845 Nautilus Card Game. sea shell cards by Melvin. $4.95

2772 Nautilus, The Published by American Malacologists. The oldest molluscan quarterly still publishing in America. Volumes 72-93 price / volume $10.95

2280 Nautilus, The Vol. 1-98 used sets available occasionally; write for availability $3000.00

2290 Nautilus, The Vol. 71(2-4) $10.

2771 Nautilus, The Volumes 72-93 (set in parts as issued) $209.95

7239 Neal, M.C. 1934. Hawaiian Helicinidae. Bernice P. Bishop Museum, Bull. 125, p. 1-102, figs. 1-117. Reprint 1976, softbound $18.95

2380 New York Shell Club Notes individual numbers $1.50 ea.

2390 New York Shell Club Notes Nos. 1-263. Some numbers in photocopy. $350.00

7129 Nickles, M. 1950. Mollusques testaces marins de la Cote occidentale d'Afrique. 269pp., illus. WS SB $37.50

2382 North Pacific Shells No. 1- Genus Volutopsius 26p., 12 pls. $7.00

2433 North Pacific Shells No. 10 - Genus Beringius. 25p., 8pls. $7.50

2434 North Pacific Shells No. 11- Genus Ancistrolepis. 6p., 3pls. $2.50

2464 North Pacific Shells No. 11a- Genus Ancistrolepis Supplement. 7p., 3pls. $3.50

2465 North Pacific Shells No. 12. Genus Clinopegma. 49 p.; 18 pls. $16.75

2466 North Pacific Shells No. 13. Genus Parancistrolepis. 9p., 2 pls. $4.00

2600 North Pacific Shells No. 14. 1984. Genus Buccinum Linnaeus, 1758. 64p., 21pls., figs. $18.75

2379 North Pacific Shells No. 2- Genus Arctomelon. 8p., 3 pls. $3.25

2378 North Pacific Shells No. 3- Genus Volutomitra. 5p., 2pls. $2.50

2377 North Pacific Shells No. 4- Genus Pyrolofusus. 18p., 7pls. $6.00

2376 North Pacific Shells No. 5- Genus Voluthapa. 10p., 4pls. $3.25

2380 North Pacific Shells No. 6- Genus Japelion. 14p., 6pls. $4.75

2381 North Pacific Shells No. 7- Genus Plicifusus 29p., 12pls. $8.75

2413 North Pacific Shells No. 7a- Genus Plicifuss Supplement. 6p., 3pls. $2.50

2414 North Pacific Shells No. 8 - Genus Colus. 26p., 13pls. $8.00

2415 North Pacific Shells No. 9- Genus Fusivolutopsius. 9p., 3pls. $3.25

A693 Notecards Color seashells with envelope. by Pete Carmichael. $1.00 ea.

A694 Notecards Seashells & envelopes (8 mixed) by Carmichael. $7.50

7160 Nybakken, J. Marine Biology An Ecological Approach. Harper & Row, Publ., Inc., 446 p., illus. Hardcover $31.95

2667 Occasional Papers on Mollusks Mus. Comp. Zool. Harvard, Vol. 2(27-28). $4.50

2666 Occasional Papers on Mollusks Mus. Comp. Zool. Harvard. Vol. 1(1)-2(30) (Nos. 18-21 in photocopy) $75.00

7138 Odum, E.P. 1971. Fundamentals of Ecology. 3rd ed. 574pp., illus. $12.50

2856 Of Sea & Shore individual issues, some reprint. $3.50 ea.

2668 Of Sea & Shore Vol.1-13(2) all issues published, some RPT $125.00

3006 Old, W.E. 1964. Comments on Thais planospira. Abstract AMU Ann. Rep., p. 47-48. $2.00

3042 Old, W.E., Jr. 1965. On the identity of Conus pastinaca. Nautilus, 79(1):23-31, pl. 3. — $2.95

7139 Oldroyd, I. 1924. The Marine Shells of the West Coast of North America. Vol. I. 247pp., 50pls. [original AV] $47.50

7240 Oldroyd, I. Marine Shells of the West Coast of North America. In 4 hardbound volumes. 1530 pages, 165 pages halftone illus. $110.00

7141 Oliver, A. 1975. Guide to Shells of the World. HB $11.95

0190 Oliver, A. The Larousse Guide to Shells of the World. (Hamlyn Guide). Excellent! One of our best books on shells for the price. 320 pages with 156 pages of full color photos arranged with descriptions on facing page from photo for ease of identification. Softbound Order No. 190 $10.50

7395 Olsson, A.A. & Harbison Pliocene Mollusca of Southern Florida. Reprint Hard library binding. $46.95

7252 Olsson, A.A. Neogene Molluscs from Northwestern Ecuador. Fully illustrated in halftones. 251 pages. paperbound $17.25

2054 Opisthobranch 16(2) Feb.84 $2.50

2055 Opisthobranch 16(3) Mar.84 $2.50

2056 Opisthobranch 16(4) Apr.84 $2.50

2053 Opisthobranch Continuation of the Opisthobranch Newsletter 16(1) Jan.84 $2.50

2048 Opisthobranch Newsletter (single issue) $2.50

2050 Opisthobranch Newsletter I-V HB $75.

2049 Opisthobranch Newsletter I-XV HB (3vl.) $200.

2051 Opisthobranch Newsletter VI-X HB $75.00

2001 Opisthobranch Newsletter Vol. 1-15 (ea) $16.50

2052 Opisthobranch Newsletter XI-XV HB $75.00

7142 Orcutt, H.G. 1950. The Life History of the Starry Flounder Platichthys stellatus (Pallas). Fish Bull. 78, 64pp, illus. $4.50

7503 Orr, J. Hong Kong Nudibranchs. Fine introductory guide full of valuable information covering 55 species of these vividly colored Hong Kong mollusks. Recommended. Quality 82 page paperbound book with 56 photos in full color and several line drawings. Softbound — $5.95

7620 Ostergaard, J.M. 1928. Fossil Marine Mollusks of Oahu. Bernice P. Bishop Museum, Bull. 51, p. 1-32, pls. 1-2. $12.25

7675 Ostergaard, J.M. 1939. Reports on Fossil Mollusca of Molokai and Maui. Occ. Pap. Bishop Mus., 15(6):67-77, tbls. $3.75

7144 Palmer, K.V.W. 1958. Viviparous Turritella pilsbryi Gardner. pp.210-213, 1 text fig. $1.00

7681 Parenzan Carta d'Identita della Conchiglie del Mediterraneo. Vol.2- Bivalves part #2 Softbound $15.75

7679 Parenzan Carta d'Identita delle Conchiglie del Mediterraneo. Vol. 2-Bivalve part 1#1 Softbound $15.75

7677 Parenzan Carta d'Identita delle Conchiglie del Mediterraneo. Vol.1-Gastropods. Italian text; Latin names. Halftone illus. Hardbound $17.50

7678 Parenzan Carta d'Identita delle Conchiglie del Mediterraneo. Volume 1. Gastropods. Italian; Latin names; halftones. Softbound $15.75

7680 Parenzan Carta d'Identita delle Conchiglie del Mediterraneo. Vol.2-Bivalve Part 1. Hardbound $17.50

2385 Pariah, The No. 3 $2.75

2386 Pariah, The No. 4 $2.75

2389 Pariah, The No. 7 $2.75

2390 Pariah, The No. 8 $2.75

0463 Passas, G. Shellcraft. This craft book gives detailed instructions to make mirrors, flowers, nightlights, magnets, animals, clocks and ornamental items. it will be helpful to those interested in making things from shells. Lists availability of kits for most of the items included in the booklet. 54 pages with 2 full color pages. Softcover — $4.95

7242 Pechar, P., C. Prior & B. Parkinson Mitre Shells of the Pacific & Indian Ocean. More than 120 pages with over 680 specimens

WANTED TO BUY

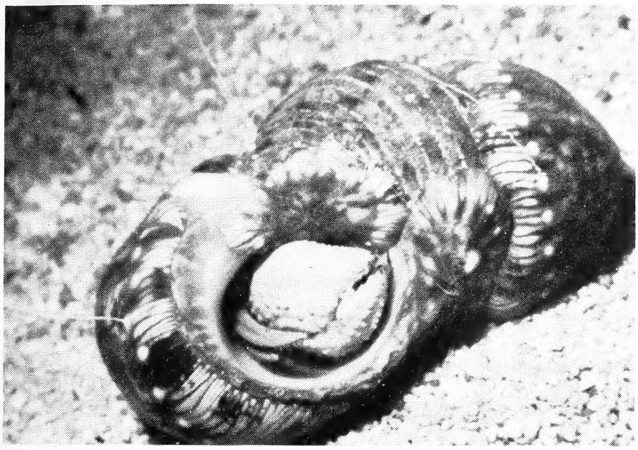


Figure 4 *Dardanus* retreated inside shell; 4 retracted *Calliactis* anemones are visible attached to the shell.

When the legs or antennae of the hermit crab touch the anemone, the crab "perks up," and extends its chelipeds (pinchers) or the forward pair of walking legs to explore the anemone. The crab uses its cheliped and walking legs to gently apply pressure around the middle and upper part of the anemone's column. After about 5-10 minutes of this gentle stroking and squeezing, the anemone relaxes completely. The crab then inserts the tips of its claws or walking legs underneath the anemone, separating it from its former home, and then lifts the anemone onto its new home — the shell of the hermit crab (ROSS, 1970).

These interactions vary between species of anemones and crabs. *Calliactis parasitica* responds to the chemical factor in the molluscan shell; *C. tricolor* can detach itself and transfer to shells with which their tentacles come into contact; *C. polypus* requires the crab's active manipulation for the partnership to be established.

Figure 5 Nematocyst-laden acontia threads of *Calliactis*: further stinging protection for the hermit. (Kahe Pt., Oahu).

The value of the relation seems to be food and protection. The anemone is carried around by the crab, allowing it to trap food items in various places. Whenever I have seen *Dardanus* underwater, the crab either pulls completely inside its shell (Fig. 4), or spins around and presents its backside to the approacher. The backsides happens to be covered by the shell, which is in turn covered by the anemone (Fig. 5).

Anemones have stinging capsules called nematocysts. These harpoon-like devices function offensively for prey gathering and defensively for protection. The hermit crab-anemone mutualist relation would be similar to us carrying a backpack loaded with dart-blowing leprechauns. When attact, we would turn our back to the problem (or flee), and let our hitch-hikers protect us. The nematocysts occur on the tentacles which surround the mouth opening of the anemone, and on filaments called acontia. Although the acontia are attached inside the anemone, these nematocyst-laden strands can be extended through the walls of the anemone's column (Fig. 5) and act as additional defensive weapons (normally they function on prey inside the gut cavity).

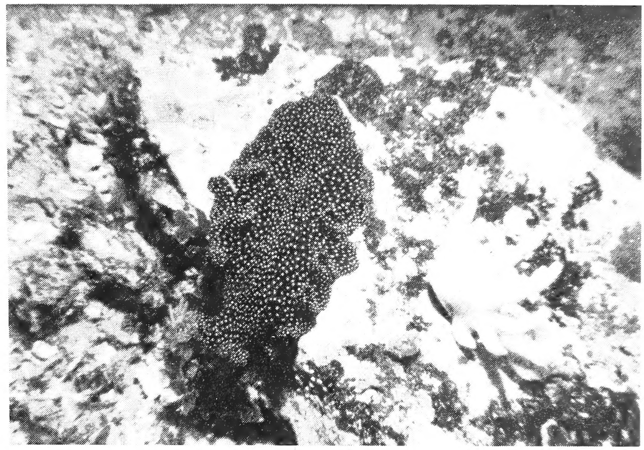


Figure 6 Hydrocoral *Janaria mirabilis* alongside a flatworm. (Punta Gringa, Bahía de los Angeles, Baja California).

In the Gulf of California, Mexico, there is another hermit crab with a coelenterate association (Figs. 6-8). Instead of evolving a symbiotic relationship with cnidarians of the Class Anthozoa (anemones), *Pylopagurus varians* has evolved to live with *Janaria mirabilis* (members of the Class Hydrozoa, family Hydractinidae HILL & WELLS, 1956)). Not much has been written about this association; moreover, the taxonomy and biology of the crab species involved is being studied (see BALL & HAIG, 1974).

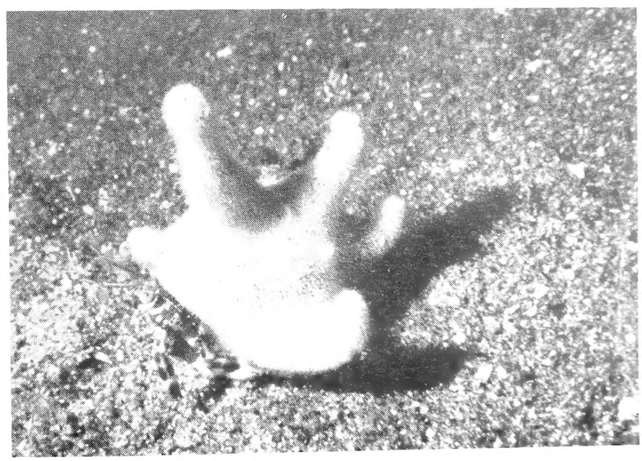


Figure 7 Hermit crab *Pylopagurus varians* covered with *Janaria*, crawling over a sandy-mud substrate. (Bahía de los Angeles)

Pylopagurus varians has been collected in subtidal waters to about 180 m depth, from just above the middle of the Gulf of California to Panama. Specimens have usually been collected in areas of mixed sand and rock habitata (Figs. 6 & 7). The right pincer is flattened and enlarged for sealing the entrance (Fig. 8). Its "shell"

Figure 8 Close-up of enlarged cheliped of *Pylopagurus*, sealing off the entranceway to its coelenterate-built home. The polyps of *Janaria* are visible in the upper right hand corner. (Bahía de los Angeles)

is a "white or tan staghorned hydrocoral which has chemically eroded away the original gastropoda shell" (BRUSCA, 1980: 284). The hermit crab apparently does not need to change homes during its life. As it grows, the hydrocoral also grows. The hermit crab trims excess growth around the opening to allow itself full movement.

When two different kinds of organisms live together without harming each other, the relationship is symbiotic. The hermit crabs and coelenterates we have just discussed have evolved symbiotic relationships that are mutualistic: the species involved are nearly always associated with each other, and both benefit. These are excellent examples of coevolution: "In its broadest sense, coevolution refers to the joint evolution of two (or more) taxa that have close ecological relationships but do not exchange genes, and in which reciprocal selective pressures operate to make the evolution of either taxon partially dependent upon the evolution of the other" (PIANKA, 1978: 222). The role of the original home owner — the shellmaker gastropod — in this evolutionary scenario is reduced. There is no adaptive advantage in a dead snail's shell to a snail species, because traits involved in the hermit crab-coelenterate relationship cannot be selected for nor passed on to future snail generations. The evolutionary advantages of this interaction are only affecting the crab and the coelenterate. These latter two are the coevolvers to a structure that had suited another organism (the snail), and to which they have evolved adaptations.

Literature cited

Ball, E.E. & J. Haig 1974. Hermit crabs from the tropical eastern Pacific. I. Distribution, color, and natural history of some common shallow-water species. Bull. S. Calif. Acad. Sci. 73(2):95-104

Brusca, R.C. 1980. Common intertidal invertebrates of the Gulf of California, 2nd edition. Univ. Arizona Press, Tucson xx + 513 p.

Devaney, D.M. & L.G. Eldredge 1977. Reef and shore fauna of Hawaii. Section 1: Protozoa through Ctenophora. Bishop Mus. Spec. Pub. 64(1):278 p.

Hill, D. & J.W. Wells 1956. Hydroida and Spongiomorphida. *In:* Treatise of Invertebrate Paleontology, Section F: Coelenterata. Geol. Soc. America p. F 81-89.

McLaughlin, P. 1981. Revision of *Pylopagurus* and *Tomopagurus* (Crustacea: Decapoda: Paguridae), with the descriptions of new genera and species. Bull. Mar. Sci., 31(1):1-30; 31(2):329-365; 32(4):823-855.

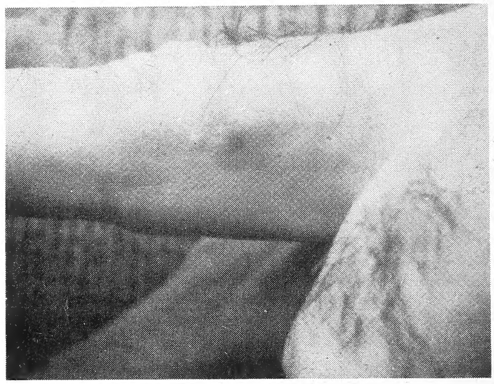
Pianka, E.R. 1978. Evolutionary ecology. Harper & Row, Publ., New York xii + 397 p.

Ross, D.M. 1970. The commensal association of *Calliactis polypus* and the hermit crab *Dardanus gemmatus* in Hawaii. Canadian Jour. Zool., 48:351-357.

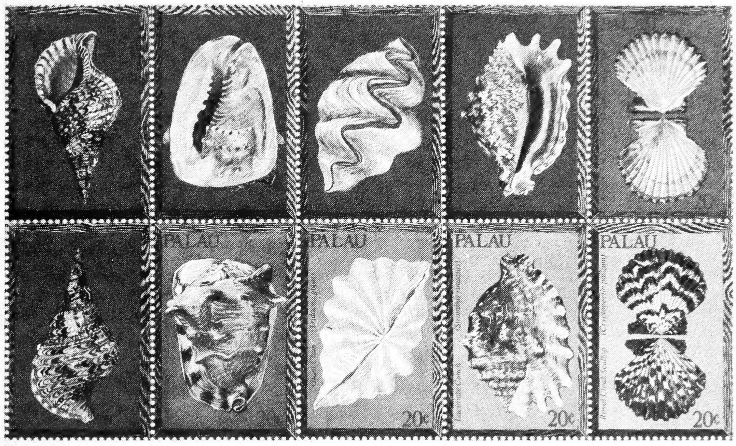
TELL ADVERTISERS YOU SAW THEM IN S&SL!

PERSONAL NOTES

Ovulidae Gary Rosenberg has changed his major research to the Ovulidae and is working under Dr. Kenneth Boss at the Museum of Comparative Zoology at Harvard. Gary is very interested in obtaining research material on the ovulids. — Gary Rosenberg, Mollusk Dept., Museum of Comparative Zoology, Cambridge, MA 02138



Octopus bites: One of the employees of the Seattle Aquarium was bitten recently by a very small (2.4 g) *Octopus rubescens*. Enclosed is a photo of the bite scar one month after it occurred. I would appreciate hearing from others who have been bitten by West Coast octopuses, particularly *O. rubescens* and *O. dofleini* in order to learn how these bites may have affected other people. — Roland Anderson, The Seattle Aquarium, Pier 59, Seattle, WA 98101



© REPUBLIC OF PALAU
POSTAL SERVICE 1984

Deborah Dudley Max (designs Palau seashell stamps).

Daniel Keren

Courtesy of Inter-Governmental Philatelic Corp., New York. [Stamps illustrated here courtesy of Golden Associates Stamp Co.]

Deborah Dudley Max has, ever since her high school days, enjoyed the hobby of collecting seashells. In recent years, the 33 year-old Bay Shore, New York artist has specialized in executing paintings of her seashells. This year on the Ides of March (March 15th) Deborah saw months of intensive research and careful illustrating work come to fruition with the release of 10 Palauan seashell stamps that were based on her original artwork.

Palau, a chain of islands situated in the Western Pacific Micronesian area has since the end of the second world war had been administered by the United States as a special United Nations Trust Territory. The postal officials of Palau decided that since their island group is blessed with numerous attractive seashell species, the subject would be especially appropriate as the theme for a marine life philatelic salute.

To date, there have not been too many academic studies made of the Palauan seashells. Therefore, Ms. Max approached Dr. William Emerson, a noted malacologist who is a member of the American Museum of Natural History staff in New York City. Dr. Emerson directed the artist to Dotty and Bob Janowski, a Long Island couple engaged in selling seashells. They had at that time just received an inventory from a diver who was operating out of Palau.

All of the seashells that Ms. Max illustrated for the Palau Postal Service were found in the Pacific island group by this diver who regularly collects these species for sale to dealers in the United States. With the subsequent information that was received from the diver, it was possible for the Janowskis and Deborah to figure out just where each of the shells could be found in Palau itself.

Ms. Max has long had an interest in art and nature studies. Born in Bangor, Maine, she grew up in Baldwin, Long Island, New York. Reflecting on her artistic interest, she recalls, "I was drawing ever since I can remember. I made up my mind to be an artist when I was five years old. That goal never changed." Neither of her parents were artists themselves. Yet, both were very supportive of their daughter's ambitions. Ms. Max's mother was at the time head acquisitions librarian for Hofstra University.

Frequently, she would bring back from the library for her daughter, the latest and most informative art books. In this manner, Deborah was able to at a young age gain a better grasp of the subject matter.

While studying in the School of Visual Arts in Manhattan, Deborah majored in the fine arts. After graduation in 1972, she briefly attended graduate school at Hofstra University where she had the first exhibition of her paintings at the University's gallery.

In 1978, shortly after her marriage to Stephen Max, Deborah moved to Baltimore where her husband was finishing up his own studies in marine engineering.

Upon her arrival in Maryland, Ms. Max for the first time became involved in the field of commercial or graphic art. She initially worked for the state's Highway Administration. Her assignment consisted of translating complex engineering information into concepts that the general public could more easily comprehend. Following this stint, she obtained employment as the art director of an advertising agency serving clients in the Baltimore-Washington, D.C. regional area.

When asked of how she first became interested in illustrating seashells, Deborah remembers that ever since her grammar school years, she truly enjoyed participating in nature studies. Today, in addition to collecting seashells which she employs as models for her actual paintings, Ms. Max has also acquired a large library of reference books from which she enjoys studying about her subjects.

Currently she is involved in a special project for the "Save the Beaches Fund," a non-profit organization that is based in Oak Beach, Long Island, New York. Her goal is to design special posters which will illustrate the beauties of beaches in an effort to arouse greater public interest in the campaign to protect them from property developers and other possible ecological threats.

When asked just why she was so enthusiastic about painting seashells, Deborah answers that "The reason why I became interested in painting seashells is that they have a special kind of rhythm that is in the actual shape of the shell. This communicates a strong essence of the object's life force and how it reflects the unique patterns of nature."

Although a veteran of numerous seashell paintings, Ms. Max admitted that her recent commission to design the Palauan stamps was her first philatelic assignment and that it was in itself a unique challenge. It was not just a matter of simply illustrating five different species of seashells. Deborah wanted each of the individual shells to easily corollate effectively alone and with each other.

Ms. Max arranged with the Janowskis to purchase from them some of the actual seashells that are found in the island territory. In this manner, she was able to model her stamp artwork on the actual shells themselves and not on secondary photographs. Deborah further wanted the Palauan seashell stamps to have a three-dimensional appearance in order that the viewer might be tempted to try and pick up the various shells depicted.

While numerous seashells have been depicted by many postal administrations around the world in recent years, Ms. Max's designs are somewhat unique. All 10 of the 20 cent Palauan stamps are illustrated in one single sheetlet that had been designed by Deborah to resemble a collector's cabinet. Each of the five Palauan seashell species is featured on a pair of stamps that highlight their ventral and dorsal positions respectively. It is Deborah's hope that as a result of her illustrating these Palauan seashells, the viewer will gain a clearer sense of the shell's natural essence.

Designing postage stamps is markedly different from preparing a painting of the same subject. One of the challenges, the artist faced was that of composing the artwork in a much smaller size format.

For the Palauan seashell issue, Ms. Max employed guache, rather than the more common method of watercolors. She felt that the colors would come out more vibrant and better communicate the subject matter when photographed.

Each stamp labels the seashell species with both its common and Latin names. Featured in vertical pairs from left to right is the Triton Trumpet, the Horned Helmet, the Giant Clam, the Lacinate Conch and the Royal Cloak Scallop.

Deborah regards these stamps as one of her more interesting commissions as it allowed her to integrate aspects of both her fine art and graphic art backgrounds.

LIVING CLOCKSPRINGS, part 3.

Chris Illert, 2 Tern Place, Semaphore Park, South Australia 5019

The extent to which mathematically well defined tensile spring geometries are employed in modern gastropod shell architecture is only now becoming apparent despite the fact that significant observations were made as early as 1890 and 1908. One elementary zoology text, by R.D. Barnes (1974), observes that *"the larger bottom dwelling carnivores, the neogastropods and some mesogastropods, commonly feed upon bivalved mollusks, other gastropods and echinoderms. Such carnivores, many of which burrow into the sand to reach their prey, include volutes, bonnets, helmets, olives, harps and whelks"*. We have already seen that many of these predatory mollusks use their shells like tensile springs in the normal course of feeding.

Dr. R. Tucker Abbott's recent book *"Kingdom of the Seashell"* (page 43) gives a further example of a small American bonnet (*Cypraecassis testiculus*, Linne) which has a thickened apertural varix that it uses to help remove sea-urchin spines before eating the insides. Research into gastropod predators that eat echinoderms would have been more urgent if the present Crown of Thorns starfish plague, on Austealia's Great Barrier Reef, had been due to reduction in the number of tritons. As it happens, echinoderm plagues the world over (be they starfish or sea-urchins) are caused by domestic sewage emptied into the ocean. The "absence of a local predator" hypothesis arises from a narrow parochial perspective. In any event, the study of shell shape, and the relation of shape to life-habits, has again fallen into quiet obscurity. This article attempts to rectify this imbalance.

It is important to realise that bivalved shells also need to grow in optimally strong tensile spring shapes in order to be able to withstand attack by predators or merely to close tightly together. In order to measure the forces involved, Wainwright (1969) bonded strain gauges to living bivalves. When the adductor muscle was stimulated by a fine probe, and the valves prevented from closing by a small wedge, near breaking strains were recorded. In his experiments with *Dosinia* and *Spisula* he found that *"the muscular closure that followed was sufficient to crack and break the shell from its ventral margin to the ligament"*.

There can be little doubt that the dynamic forces acting on shells are considerable, and that the tensile spring analogy is relevant. Some mollusks use their shells to bore through sand, wood, or even solid rock!

The common abalone has a muscular foot capable of supporting 4000 times its body weight; have you tried to pry one off a rock lately?

So bivalved and single component shells probably all function in some way like tensile spiral springs during the course of their lives; even though they may not all be spectacular carnivores using their shells like the whelks, murexes and helmets so far discussed. That this is indeed the case, can be seen from the studies done in the 1930's by Helen Schmidt. She saw that brachiopod shell valves often grow in strange humped shapes; curving in toward the commissure line more rapidly than expected at the onset of adulthood.

A more exaggerated example of this incurving occurs in the familiar cowrie shell. Juvenile cowries are simple normal spiral shells but the adults have a grossly incurved apertural lip; quite the opposite to the outflared apertures previously shown in Figures 2 and 3.

The cowrie shell lip, and bodywhorl, are merely the outer portion of a multiple whorled elastic spring. The creatures roam about with their shell exterior covered by a fleshy skin, the mantle, emanating from the apertural slit. They retract this skin when attacked but, by Newton's Law of "equal and opposite reaction", the shell must rotate in the opposite sense (counter-clockwise). If a predator had a mouthful of cowrie mantle flesh, and would not let go, then the mollusk could only withdraw into its shell aperture by levering on its rigid shell. In this grim tug of war, the fulcram of forces is the shell lip, and that is perhaps why so many cowrie apertures have corrugated "teeth" to enhance grip during contraction. Whereas the cowrie only attains drastic curvature in its bodywhorl once during ontogeny, the murex and helmet do so repeatedly - but at the cost of discontinuity in their shells.

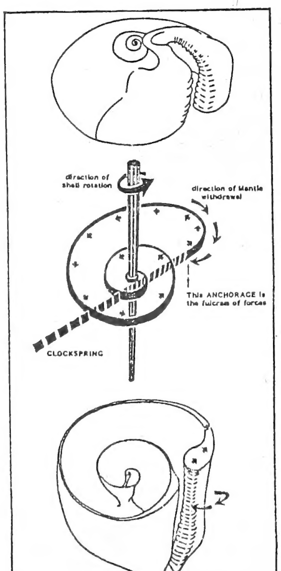
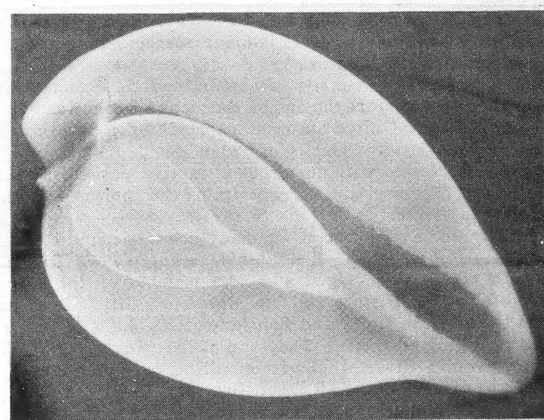


Figure 4.
sectioned cowrie shell and its dynamically equivalent tensile spring. Note the incurved outermost whorl.

Either the shell grows in a pure and entire tensile spring curve (e.g. the cowrie) or else it repeatedly uses a sufficiently large portion of a suitably shaped spring (e.g. the murex in Figure 2).

The reason why bivalved mollusks and brachiopods have shell valves which are slightly incurved (a little like the cowries but nowhere near as pronounced) lies in the fact that there are always two valves opposing each other along the commissure line. Just as there is a static tug of war in the cowrie, about the shell lip, so too is there a fulcram of forces at avery point along the bivalve commissure line. On the one hand internal muscles pull the valves together whilst, on the other hand, each valve pushes against its counterpart preventing further closure. So we again have counteracting forces about an anchor point; actually a continuous locus of anchor points which is called the commissure. And what better shape for a shell valve than an optimally strong tensile spring geometry?



Cowrie shell X-ray showing the regular inner whorls and the strongly incurved apertural lip with "teeth" (by courtesy of Chris Illert 1985).