STERKIANA

NUMBER 47 COLUMBUS, OHIO SEPTEMBER 1972

CONTENTS PAGE

REPRINTS OF RARE PAPERS ON MOLLUSCA: MINUTES OF THE CONCHOLOGICAL CLUB OF SOUTHERN CALIFORNIA, NOS. 1-10 1

HUGH C. RAWLS, JOHN M. BAUM, AND ROGER L. YATES: FLUORESCENCE IN *BULIMULUS INSCENDENS* BINNEY 19

AUTHOR INDEX TO THE NAUTILUS VOLUMES 76-85 21

L. DANIEL MYERS: PRIMARY AND SECONDARY INFLUENCING AGENTS ON GASTROPOD POPULATIONS OF THREE HABITATS IN WASHINGTON STATE . . 39

REPRINTS OF RARE PAPERS ON MOLLUSCA: GEORGE LEFEVRE AND WINTERTON C. CURTIS: STUDIES ON THE REPRODUCTION AND ARTIFICIAL PROPAGATION OF FRESH-WATER MUSSELS 46

ANNOUNCEMENT

STERKIANA is named after Dr. Victor Sterki (1846-1933) of New Philadelphia, Ohio, famed for his work on the Sphaeriidae, Pupillidae, and Valloniidae. It is fitting that this serial should bear his name both because of his association with the Midwest and his lifelong interest in non-marine Mollusca.

The purpose of STERKIANA is to serve malacologists and paleontologists interested in the living and fossil non-marine Mollusca of North and South America by disseminating information in that special field. Since its resources are modest, STERKIANA is not printed by conventional means. Costs are kept at a minimum by utilizing various talents and services available to the Editor. Subscription and reprint prices are based on cost of paper and mailing charges.

STERKIANA accepts articles dealing with non-marine Mollusca of the Americas in English, French, or Spanish, the three official languages of North America. Contributors are requested to avoid descriptions of new species or higher taxa in this serial as the limited distribution of STERKIANA would probably prevent recognition of such taxa as validly published. Papers on distribution, ecology, and revised checklists for particular areas or formations are especially welcome but those on any aspect of non-marine Mollusca will be considered.

STERKIANA will appear twice a year or oftener, as material is available. All correspondence should be addressed to the Editor.

SUBSCRIPTIONS: 50¢ per number; subscriptions may be entered for not more than 4 numbers in advance; please make checks and money orders payable to the Editor.

STERKIANA est une collection de travaux sur les Mollusques extra-marins des deux Amériques, distribuée par un groupe de malacologues du centre des Etats-Unis. STERKIANA publie des travaux en anglais, en français et en espagnol acceptés par le conseil de rédaction. Prière d'adresser toute correspondance au Rédacteur.

ABONNEMENT: 50¢ le numéro, par chèque ou mandat payable au Rédacteur.

STERKIANA es una coleccion de trabajos sobre los Moluscos extra-marinos viventes y fosiles de las dos Americas, editada por un grupo de malacólogos de los Estados Unidos centrales. Contenirá en el porvenir trabajos en inglés, francés, y español que serán acceptados por la mesa directiva. La correspondencia deberá ser dirigida al Editor.

PRECIO: 50¢ el número.

REPRINTS OF RARE PAPERS ON MOLLUSCA: MINUTES OF THE CONCHOLOGIGAL CLUB OF SOUTHERN CALIFORNIA, NOS. 1-10

FOREWORD

Thirty-one years ago, on July 1, 1941, the Conchological Club of Southern California held its regular meeting at the Los Angeles Museum. The short mimeographed account of this meeting is generally considered as No. 1 of the Minutes which were to continue to No. 200. This was not the first time that the Minutes had been mimeographed for we find in No. 3 that Mr. and Mrs. J.C. Marsh had been given a vote of thanks for printing the Notes 'for the past two years.'

The Minutes for the July 1, 1941 meeting were almost certainly the first to be printed by John Q. and Rose Burch since they were typed on the same typewriter that was used for subsequent numbers of the Minutes for quite a few years. The Burches became official editors and printers to the Conchological Club on October 7, 1941 when the membership voted to reimburse them for 'postage and material used in the preparation of the notes.' (Minutes No. 4, paragraph 2).

As time progressed the Minutes became more than a report of meetings. No. 4 already has an appendix by Dr. W. O. Gregg on non-marine Mollusca of Southern California which is more like a formal paper than a simple report. A glance through the first ten numbers will show the gradual transformation from a news sheet to a periodical of considerable value. The change is even more marked in later issues.

The first few numbers of the Minutes were quite clearly meant for limited circulation to members of the club but copies were being mailed out at least by 1942 when Minutes No. 11 for May 5 of that year were mailed individually to Calvin Goodrich at Ann Arbor and probably to others as well.

The early issues have become brittle and faded. No wonder--paper was so hard to get during the early years of World War II that the Minutes had to be printed on whatever was available. Let us hope that these reprints will preserve their content if not their individuality.

The content, after all, is the main thing and the Minutes record not only formal and semi-formal papers but also news notes which can probably not be found in print elsewhere.

The Minutes almost ceased printing less than a year after they began, as explained in Minutes No. 79, p. 11, April 1948 but printing was resumed in January 1942 and continued throughout the war and until June 1960 when it ceased with Minutes 200. In the meantime, its example had been followed by at least two other periodicals and others followed soon afterwards.

During their twenty years of existence, the Minutes demonstrated the usefulness of informal publications. The distribution increased considerably with the years and the demand for early numbers grew in proportion. Complete sets of the original Minutes are very scarce and their reprinting here has the twofold purpose of making the earliest numbers available and of paying tribute to John Q. and Rose Burch to whom all malacologists are indebted for their work of editing and printing the Minutes for twenty years. The editor of Sterkiana is personally grateful to the Burches

for permission to reprint the Minutes. This is only one of many courtesies and kindnesses which have been received from them by the writer.

It is also a pleasure to acknowledge here the kindness of Allyn G. Smith of the California Academy of Sciences, San Francisco, for providing xerox copies of Minutes 1-11 which were not in the writer's personal set.

In reprinting the Minutes, minor misprints have been corrected as there seemed to be no advantage in perpetuating them. The first eleven numbers of the Minutes were not numbered in the original but the intended numbering, as indicated by the editor and on the copy from which this reprint was made, has been inserted in parentheses with the heading of each number. Serial numbering was started with Minutes No. 12.

The format of the original Minutes has been respected as much as possible. The Minutes are reproduced here page by page as they appear in the originals but the type used here is smaller, hence the reprint has more text per line than the original.

Finally, attention is drawn to the announcement on the inside back cover of MOLLUSCAN DIGEST, vol. 2, no. 5, which states that 'All undistributed copies of this 200 number publication are held by Jack W. Brookshire. Anyone interested in acquiring sets of the Minutes' should contact Mr. Brookshire.' His address is:

2962 Balboa Ave.
Oxnard, Calif.
93030 U.S.A.

Aurèle La Rocque

THE CONCHOLOGICAL CLUB OF SOUTHERN CALIFORNIA (No. 1)

Minutes and Notes- July, 1941- Los Angeles, Calif.

The Conchological Club of Southern California met at the Los Angeles Museum in Exposition Park, Los Angeles, Calif. on July 1, 1941 at 7:30 P.M. The meeting was presided over in the absence of the president by the vice-president, Mr. George Willett.

After three corrections (1) Acmaea triangularis, (2) Bauman instead of Sauman on P. 1, p. 2 and (3) Systematics line 2 p. 4, p. 2 the minutes of the previous meeting were approved.

The picnic of June 29 at the Burch Lath House was reported as a great success with an attendance of 44, abundance of good food, plenty of interesting material for study and a fine day. A unanimous vote of thanks was tendered the hosts by the club.

Two immense Olive-like fossils were shown by Mr. W. C. Marsh. They were collected from what must have been a very old exposure near Orange County Park. No one present could classify them.

Dr. W. Gregg's place on the program was filled in his absence by the Chaces whom we were all glad to have with us again after several months' absence.

Mr. E. P. Chace reported on marine collecting at Monterey and vicinity. He had a table full of specimens to show for his labor almost any one of which would be welcome additions to any of our collections. He gave detailed instructions as to where and when to look for the several species which will be a great help to any club member who succeeds in getting that far from home. He had so many things to report that some of us had difficulty in keeping pace with him.

Mrs. E. P. Chace reported on the land shells and while her list of species was shorter than her husband's, the names on them were so much longer that the balance must have been about even. She certainly exhibited some beautiful shells - several quite rare ones - and some found in considerable quantities.

These two reports used up all the available time so John Burch's serial report on 'How, When and Where to Collect Local Shells' was crowded out to be resumed we hope at a later meeting.

The meeting was then adjourned.

Effie M. Clark, Secretary.

Minutes and Notes- August, 1941- Los Angeles, Calif. (No. 2)

The Conchological Club of Southern California met at the Los Angeles Museum in Exposition Park, Los Angeles, Calif. Tues. Aug. 5, 1941 at 7:30 P.M. with 31 persons present 7 of whom were visitors. In the absence of the president, the vice-president Mr. George Willett presided.

There were no reports from the standing committees.

A card was read from H. Carroll McGowan reporting improvement in health.

The paper of the evening was presented by Mr. and Mrs. Fred Barnett. Its title was 'Collecting in Alamitos Bay' and proved to be a novel and delightful one.

(*Minutes* No. 2, cont.)

It was illustrated by pictures in color, many of them of small species magnified which was quite an innovation for non professionals. The running comments on the pictures were witty and illuminating making it a paper that will long be vividly remembered. Those who saw the picture and who had also attended the 'Lath House Picnic' (which was most of us) had a chance to 'see themselves as others see them.' The 'good night' picture of the Barnetts' young son was a lovely ending indeed for what was a remarkable paper.

Effie M. Clark, Secretary

Minutes and Notes- September 1941- Los Angeles, Calif. (No. 3)

The Conchological Club of Southern California met at the Los Angeles Museum in Exposition Park, Los Angeles, Calif. Tues. Sept. 2, 1941 at 7:30 P.?.

We were glad to have with us again after several months' absence Dr. W. O. Gregg.

The secretary reported a change of address to 403 S. Mariposa St., Los Angeles.

A unanimous vote of thanks was tendered Mr. and Mrs. J. C. Marsh for their labor in preparing and printing the 'Notes' for the past two years.

Since no reports eere forthcoming from the standing committees the paper scheduled was given by Mrs. Mary Borman her subject being 'Tide Pool Collecting.'

Her modest account of her exploits was hardly in accordance with her very beautifully prepared specimens she had to exhibit. Her excuse, as if one were needed, for the artistic arrangement of her shells was that these shells were often used as reference material by High School beginners in shell collecting. So they desired to make them attractive so as to arouse the interest of the young collectors. It would be hard to imagine a better service any conchologist could give to a beloved study.

Two of their most beautiful sets were a tray of Chama of exquisite coloring and a large set of Hinnites gigantea rivaling Spondylus in their intricate decorative spines which were most beautifully colored.

Another chapter of John Burch's 'How, When and Where to Collect Local Shells' was given and discussion by other collectors was given. The meeting then adjourned.

Effie M. Clark, Secretary.

(This page was appended to Minutes No. 3)

All members are urged to be present at the meeting to be held Tuesday, Oct. 7. A large attendance is expected to enjoy a talk on the 'Non marine Molluscan Fauna of Southern California' by Dr. W. O. Gregg and 'Fossil Mollusca of Ellsmere Canyon' by E. V. Edmonds.

Letters have been received from several collectors who attended the recent meeting of the American Malacological Union in Maine. Mr. D. L. Emery of St. Petersburg, Florida, Dr. B. R. Bales of Circleville, Ohio and Mr. and Mrs. F. K. Hadley of Malden, Mass. all report a very successful meeting.

Tom Burch is now Laboratory Assistant in Zoology at the University of Southern California while working for his Master's Degree on 'Fouling of Ship's Bottoms.'

Mr. Sprague, our enthusiastic collector from Santa Ana has been on an extended collecting trip along the coast of British Columbia. Several of the members are hoping to be the first to see him on his return and share some of the loot.

There are some fair collecting tides this month. They are not as deep as the November and December tides but may be recommended for bay collecting. Some Cypraea are already appearing and one good catch reported from along the Palos Verdes Estates.

Sat.	Oct. 18	1:33 P.M.	plus	0.3
Sun.	Oct. 19	2:15 P.M.	minus	0.2
Mon.	Oct. 20	3:00 P.M.	"	0.6
Tue.	Oct. 21	3:46 P.M.	"	0.8
Wed.	Oct. 22	4:37 P.M.	"	0.7

Mr. and Mrs. George Willett have just returned from an interesting trip to Denver where they attended the American Ornithology meeting.

The current issue of Natural History, the Magazine of the Wmerican Museum of Natural History, New York contains a very interesting article on the Polynesian pearl divers in which there are some remarkable pictures and descriptions of the giant Tridacnas and other mollusks. The author is Roy Waldo Miner, curator of invertebrates.

The June-July issue of Nature Magazine contains an article entitled 'Conchs' by Ivan Tomkins. However, the author is not a shell collector. He opens with the comment 'Conchologists are peculiar people for they throw away the animal and worship the remains'.

The August-September issue of Nature Magazine contains a beautifully illustrated article on the fossils of the South Dakota Badlands in which there are figures and descriptions of Scaphites and other fossil Cephalopods.

MINUTES OF THE CONCHOLOGICAL CLUB OF SOUTHERN CALIFORNIA (No. 4)

Called to order by the president, Tom Burch, the Conchological Club convened at the usual time and place Oct. 7, 1941 with 32 present. Three of these were visitors who expressed a desire to become members – Beatruce LaRue, 3814 S. Hill St., Los Angeles, Mrs. Carrie B. Robinson and Mr. Truman Robinson, 1108 Bay View Drive, Manhattan Beach, Calif.

The minutes of the last meeting were approved as printed in the notes, which were kindly mimeographed by Mr. and Mrs. Burch in response to many requests by those unable to be present that the notes be continued. It was moved, seconded and unanimously carried that Mr. and Mrs. Burch be reimbursed for postage and material used in the preparation and distribution of the notes.

No reports from standing committees being given, a nominating committee was appointed to submit candidates for election of officers at the next club meeting. The members of the committee are Mr. George Willett, Mr. Morris E. Caruthers and Mrs. E. P. Chace.

Report was made of the occurrence of Helix aperta in numbers sufficient to constitute a menace to agriculture in San Diego, and members are asked to look out for them in this vicinity.

It was suggested by a member that since many of us have duplicate material but not in sufficient quantity for all members that each of us bring one or more sets properly named to be given as door prizes. The idea was favorably received and will be tried out at the November meeting.

The first paper of the evening was by Mr. E. V. Edmonds whose activity in defense work has made attendance impossible for some months. His subject was 'Fossils Collected at Val Verde, Calif.'. This is a fossil field so far unreported by members of the club. The location is in Los Angeles County Park on the Ventura Road 3 miles west of the Richfield Tower at Castaic and then two miles up the canyon to a rather more accessible place than is afforded by most fossil outcrops. He had, as evidence of his industry, 25 identified species and two as yet unclassified.

Due to moving which rather jarred her from her material the secretary was glad to give way to Dr. W. O. Gregg, who gave his paper originally scheduled for the July meeting. It was good indeed.

To those of us who find so few of these shells and have so much trouble finding names for them it seems incredible that such beautiful shells are so rare in our collections. They are so hard to find, and the road to their identification when we do find them is indeed uphill for descriptions are scarce, scattered and expensive. We are proud to have in our membership so many who do know them and are so willing to help us name our rare 'finds'.

After considerable discussion and examination of material, the meeting was adjourned.

Effie M. Clark, Secretary

The Long Beach Shell Club held a picnic and collecting party at Dana Point on Sunday, Oct. 19. Mr. and Mrs. Fred Barnett were hosts to the members and dinner was enjoyed in their cabin after a successful afternoon of collecting. Several fine Murex trialata Sby. were taken. Mr. E. P. Chace took some very interesting specimens of Lamellaria as yet not definitely classified to species. Ischnochiton regularis Carpenter was another interesting find as well as several other rare chitons. The collecting was generally good.

No. 101, vol. XXVII of Bulletins of American Paleontology has just been received. This is the second paper on 'New Mollusca from the Pleistocene of San Pedro, Calif.' by Dr. S. Stillman Berry and contains descriptions of 7 new species from the Hilltop Quarry. One of these species is Moniliopsis chacei Berry named in honor of our member Mr. Emery Chace.

MINUTES NO. 4, BACK PAGE (No. 4)

It is with great pleasure that we learn of the return of Dr. Howard Hill to his former desk at the Los Angeles Museum. We sincerely trust that there will be no more interference with his department and that students will continue to enjoy the privilege of working on their conchological problems under the able guidance and assistance of Dr. Hill.

Mr. George Willett will have the program for the November meeting which is assurance of a fine lesson for the sincere student of shells. The annual election of officers will also be held.

Among the recently published books on conchology received at the Los Angeles Museum is Bulletin 166 of the Bernice P. Bishop Museum, Parts 3 and 4 of 'Zonitid Snails from Pacific Islands.' The earlier publications in this series are Bulletin 165 in 1940 and Bulletin 158 in 1938. Two other books published by the Bishop Museum should be in the library of any student of the fauna of the Hawaiian Islands. They are: 'A Manual of the Recent and Fossil Marine Pelecypod Mollusks of the Hawaiian Islands' and 'Check List of Hawaiian Land and Fresh Water Mollusca'.

T I D E S

Nov. 5	4:02 P.M.	zero	0.0
Nov. 6	4:36 P.M.	plus	0.1
Nov. 17	5:15 P.M.	plus	0.3
Nov. 15	12:40 P.M.	plus	0.6
Nov. 16	1:22 P.M.	minus	0.2
Nov. 17	2:06 P.M.	"	0.8
Nov. 18	2:52 P.M.	"	1.2
Nov. 19	3:39 P.M.	"	1.3
Nov. 20	4:29 P.M.	"	1.2
Nov. 21	5:22 P.M.	"	1.0
Nov. 29	1:13 P.M.	plus	0.5
Nov. 30	1:47 P.M.	"	0.2
Dec. 1	2:19 P.M.	minus	0.1
Dec. 2	2:49 P.M.	"	0.3

It should be remembered that these tides are approximately an hour later in Newport Bay and an hour and a half later in Morro Bay.

(No. 4) NOTES ON NON-MARINE MOLLUSKS OF SOUTHERN CALIFORNIA

By Dr. W. O. Gregg

The nomenclature of our land and fresh water shells has undergone many changes in the last few years. An effort will be made to list a few of the more important ones with notes on identification and distribution. Typical *Helminthoglypta tudiculata tudiculata* Binney appears to be found only in restricted areas in San Diego County. It is distinguished from other forms of *tudiculata* by its large size, its coarser and heavier malleation. *H. tudiculata angelena* Berry is smaller and has lighter malleation. It is the commoner and widely distributed form found from San Diego County north to Ventura County and east into San Bernardino and Riverside Counties. *Helminthoglypta tudiculata imperforata* Pilsbry is characterized by lighter malleation entirely absent over portions of some specimens, and by its imperforate or nearly imporforate umbilicus. It is reported from Claremont, near Ontario and from Whitewater Canyon. *Helminthoglypta tudiculata subdola* Hemphill is found in sporadic colonies in Riverside County and in adjacent parts of Orange and San Bernardino Counties. It is distinguished by its lighter malleation and its more open umbilicus.

The *Glyptostoma* from Los Angeles County is distinct from the Lower California *G. newberryanum depressum* Bryant. Our species should be called *Glyptostoma gabrielense* Pilsbry. It is found in canyons on the south side of the San Gabriel range, also in the Elysian and Dominguez Hills. According to Berry an anatomical difference exists between the Dominguez and the San Gabriel snails. If this difference is constant the Dominguez snails should be called *Glyptostoma gabrielense binneyanum* Berry.

The little shiny brown introduced snails so common about nurseries and greenhouses now bear the generic name *Oxychilus*. *O. cellarius* Muller is the commonest of these. It is larger than *Zonitoides arboreus* Say and has more rapidly expanding whorls. *Oxychilus alliarius* Muller is somewhat smaller than *O. cellarius*. When alive it can be distinguished by the distinctly garlic-like odor which it gives off, particularly when disturbed. *Oxychilus draparnaldi* Beck is conspicuously larger than *O. cellarius*.

The common native slug of this region is *Deroceras gracile* Raf. For years it was known as *Agriolimax campestris* Binney.

It is doubtful that we have more than three different Succineas: *Succinea oregonensis* Lea, *S. avara* Say, and *S. sillimani* Bland. *Succinea rusticana* Gould has proven to be a synonym of *S. oregonensis*.

We probably have but one *Physa* locally, *Physa osculans* Hald.

Our *Anadonta* found in streams and various park lakes is *Anadonta californiensis* Lea.

Last Sept. 6 and 7, our members Mr. and Mrs. J. C. Marsh and Mr. and Mrs. W. C. Marsh staged a paleontological Exhibition at Cactus Manor, 6719 11th Ave. The showing was such a decided success that we are all looking forward to the next exhibit which will contain 50 additional glass cases and will show specimens representing every period. The Marshes exhibited 1579 specimens in glass covered cases.

MINUTES OF THE CONCHOLOGICAL CLUB OF SOUTHERN CALIFORNIA *(NO. 5, p. 1)*

The Conchological Club of Southern California met as usual at the Los Angeles Museum, Nov. 4, 1941.

The meeting, in the absence of the president, Tom Burch, was presided over by vice-president George Willett. There were 21 members present and one visitor, E. A. Lannice, who is a grand daughter of one of our charter members, and who brought a historic shell collected by her grandfather on Catalina Island and for many years one of but two or three known. It is still a very rare shell and bears the name Tegula regina Stearns (1893) but has been known by other names.

The minutes of the previous meeting were approved with the correction of line 6, paragraph 10 to read *Lepidochiton raymondi* Pilsbry.

The nomenclature committee reported two articles in the October Nautilus contributed by members of the club; 'Notes on Epitonium' by A. M. Strong and 'A Survey of West American Aligenas' by Tom Burch, the name of the new shell being *Aligena redondoensis* Burch. It is a tiny pelecypod dredged from 75 ftms. off Redondo Beach at Burch station no. 3833. The new Epitonium described by Mr. Strong is *Epitonium tinctum bormanni* Strong named in honor of Mr. and Mrs. Ralph Bormann of Long Beach who first collected the species.

It being election night the committee on nominations submitted the follkwing names:

President	John Q. Burch
Vice-president	E. P. Baker
Sec. Treas.	Mrs. Effie M. Clark

It was moved, seconded and carried that nominations be closed and that the ballot be cast as recommended by the committee.

A considerable number of duplicate specimens were contributed by various members and enthusiastically received by those whose collections were lacking these shells.

George Willett then gave his talk on 'California Desert Snails' which was indeed an instructive one since the extensive travels he and Mrs. Willett have taken to find them, and the fine sets he has gotten together and his familiarity with the subject made listening to his talk a delightful experience even to those of us who have not had the opportunity to get many of these elusive little animals.

Following this talk, John Burch took up his serial story of 'How When and Where to Collect' and used up the remaining time listing collecting places of the various species and discussing them with other collectors. This series of talks is proving most worth while to the newer collectors especially and interesting to us all.

The meeting then adjourned.

Mrs. Effie M. Clark - Secy.

TREASURER'S REPORT - 1941

Jan. Balance on hand	Bal. $ 10.28
Received dues $3.50	13.78
Paid J. C. Marsh $3.00	10.78
Feb. dues received $3.25	14.03
Paid J. C. Marsh .75	13.28
March dues received .25¢	13.53
April dues received 50¢	14.03
May dues received 50¢	14.53
June dues received $1.00	15.53
July - Paid J. C. Msrsh $1.50 and Burch 40¢	13.68
August dues received 25¢	13.88
Paid Burch $5.00	8.88

Balance on hand $ 8.88

Mrs. Effie M. Clark - Treasurer

(NO. 5, p. 2)

All members and friends are urged to send all news about shell collectors or shells to Mr. or Mrs. John Q. Burch, 1611 S. Elena Ave., Redondo Beach, Calif.

We were saddened by the death of Mrs. F. R. Aldrich of Balboa on Nov. 11 and extend our deepest sympathy to her husband. Mr. and Mrs. Aldrich have both been members of the Conchological Club for many years.

Mrs. Louise Sherrod, wife of Sterling T. Sherrod passed away Nov. 22 after several months of illness. Mrs. Sherrod was one of the charter members of the Long Beach Shell Club and was one of the most enthusiastic conchologists in Southern California. We all share in the grief of her family.

TIDES

The December tides are the best of the year and collectors should plan to take every advantage of them. It should be remembered that these tides are approximately an hour later in Newport Bay and an hour and a half later in Morro Bay.

Dec. 3	3:19 P.M.	minus	0.4
Dec. 4	3:50 P.M.	''	0.4
Dec. 5	4:23 P.M.	"	0.3
Dec. 6	4:58 P.M.	"	0.2
Dec. 14	12:30 P.M.	plus	0.2
Dec. 15	1:16 P.M.	minus	0.5
Dec. 16	2:00 P.M.	"	1.1
Dec. 17	2:46 P.M.	"	1.5
Dec. 18	3:31 P.M.	"	1.6
Dec. 19	4:17 P.M.	"	1.5
Dec. 20	5:03 P.M.	"	1.2
Dec. 28	1:00 P.M.	plus	0.5
Dec. 29	1:35 P.M.	"'	0.1
Dec. 30	2:07 P.M.	minus	0.2
Dec. 31	2:37 P.M.	"	0.4

Johnsonia is the title of a new series of publications dealing with the marine shells of the east coast of the Americas from Greenland to Patagonia. The plan is to publish this by genera, each genus to contain all of the species known to occur in this area. The cost per genus will depend upon the number of pages included in each. The first number is on the genus Strombus 16 qto. pages, 40¢. Orders may be sent to Dr. Wm. J. Clench, Museum of Comparative Zoology, Harvard College, Cambridge, Mass.

(Appended to Minutes No. 5)

CALIFORNIA DESERT LAND SNAILS

by George Willett

California *Eremariontas* - Genus *Micrarionta*

M. rowelli (Newc.) - Tinajas Altas, Ariz.
r. hutsoni (Clapp). - Dome Rock Mts., near Quartzsite, Ariz.
r. desertorum P. & F. - N. end Dome Rock Mts.
r. acus Pils. - Near Needles, Calif.
r. bakerensis Pils. & Lowe - Near Baker, Calif.
r. amboiana Willett - Bristol Mts., near Amboy, Calif.
r. unifasciata Willett plus hilli W. - Newberry Springs, thru Bullion, Sheep Hole, Coxcomb Mts., Calif. plus - r. granitensis Willett
r. mccoiana Willett - McCoy Mts., Riverside Co., Calif.
r. chuckwallana Willett - N. end Chuckwalla Mts., Riverside Co., Calif.
r. chocolata Willett - Beal Well, Chocolate Mts., Calif.
M. immaculata Willett - Riverside Mts., Calif.
M. millepalmarum Berry - Indio and Mecca hills, Riverside Co., Calif.
M. brunnea Willett - S. end Chuckwalla Mts., Riverside Co., Calif.
M. melanopylon Berry - Black Rock Hills, San Bernardino Co., Calif.
M. argus Edson - Argus Mts.; Slate Range.
M. indioensis wolcottiana (Bartsch) - E. San Jacinto Mts., Calif.
i. indioensis (Yates) - plus cathedralis Willett - E. & SE Sta. Rosas.
i. callinepius Berry - SW Santa Rosa Mts., San Diego Co.
i. xerophila Berry - NE Santa Rosa Mts., near edge of desert floor
i. remota Willett - Borego Mt., San Diego Co.
M. morongoana Berry - NW Little San Bernardino Mts., Calif.
M. baileyi (Bartsch) - S. Nopah Mts., Inyo Co., Calif.
M. avawatzica Berry - Avawatz Mts., San Bernardino Co., Calif.
M. eremita Pils. - SW Panamint Mts., Inyo Co., Calif.
M. rixfordi Pils. plus aetotis Berry plus depressispira Berry - Eastern Little San Bernardino Mts., to Eagle Mts.
M. borregoensis Berry - San Ysidro Mts., San Diego Co., Calif.
M. harperi (Bryant) - San Jacinto Mts.
M. orcuttiana Bartsch - S. end Laguna Mts., San Diego & Imperial counties, Calif.
M. ora Willett - Vallecitos and NE side of Lagunas
o. carrizoensis Willett - Carrizo Mt., Imperial Co., Calif.
M. micrometalleus Berry - El Paso Mts., Kern Co., Calif.
M. aquaealbae Berry - S. end San Bernardino Mts. & N. side San Jacintos (near Cabezon)

Desert *Helminthoglypta*

H. jaegeri Berry - Ord Mts., San Bernardino Co., Calif.
H. crotalina Berry - N. & E. sides Granite Mts., San Bernardino Co.
H. graniticola Berry - S. & W. sides Granite Mts., "
g. arida Pils. & Field - E. side Mojave R. near Oro Grande.
H. mohaveana Berry plus riparia Berry - Both sides Mojave above Victorville, and W. side of river above Oro Grande bridge.
H. fontiphila Gregg - NE San Gabriels, Soledad Canyon to Little Rock.
H. greggi Willett - Hills SW of Mojave
H. caruthersi Willett - E. side Sierras, head of Indian Wells Canyon.
H. fisheri (Bartsch) - 5000 to 7000 ft. Johnson & Surprise Canyons, Panamint Mts., Inyo Co., Calif.

MINUTES OF THE CONCHOLOGICAL CLUB OF SOUTHERN CALIFORNIA (NO. 6)

Regarding No. 6, see No. 79, page 11, April, 1948.

'We have been asked many times for copies of the insignificant card we used in December, 1941. The war had just started, Pearl Harbor, you recall and the only thing we had in mind was whether or not we should continue to function during the wwr. Perhaps that month of December should not have been counted but we had an idea of numbering the minutes by the months.'

' 6 - was actually omitted but counted in our numbering arrangement should have been the minutes of the December meeting. We did not meet in Dec. 1941 but consulted one another regarding the possibility of disbanding for the duration of the war. The museum was immediately closed to us also.'

MINUTES OF THE CONCHOLOGICAL CLUB OF SOUTHERN CALIFORNIA (NO. 7)

The Conchological Club of Southern California met at the home of Mr. and Mrs. George Willett on Jan. 6, 1942. The meeting was called to order by the president Mr. John Q. Burch, who appointed Mrs. Gillis to act as secretary pro tem. The minutes of the last meeting were read and approved, also a characteristic letter from the secretary, Mrs. Effie Clark.

Mr. E. P. Chace reported there was a new paper on North American Shells by Walter Webb, and another on Neritid Mollusks of the Western Atlantic by Henry D. Russell, M.C.Z.

Mr. Morris Caruthers reported that he was in correspondence with two or three outside speakers whom he hopes to get sometime during the year knowing that those on the program would gladly make room for such treats.

After discussion of our future meeting place, due to the emergency, the president said that he would notify the members if we were to meet in a private home, but it was hoped that we would be able to meet in the Hancock Foundation Building.

The motion that we express our thanks to Mr. and Mrs. J.C. Marsh for printing the 1942 programs was unanimously carried.

Mr. George Willett, although 'pinch-hitting', gave an interesting paper on the Neptuneidae and Buccinidae, illustrating with many specimens.

Mr. John Burch, using his card index, talked interestingly on Acmaeidae. He comfortingly indicated that oll of the confusion in classifying Acmaeidae was not confined to the amateurs.

After adjournment the club enjoyed the hospitality of Mr. and Mrs. Willett. Mrs. Willett showed her beautiful polished stones and the light effects from her fluorescent lamp and served delicious refreshments.

Mrs. A.W. Gillis, Sec. pro tem.

NEPTUNEIDAE AND BUCCINIDAE BY GEORGE WILLETT

These two families were formerly combined under the family name Buccinidae, the older of the two names, but are now generally considered to have family characters. The principal external difference between the two groups appears to lie in the operculum, which is larger with apical nucleus in Neptuneidae, and smaller with lateral nucleus in Buccineidae. In fact, in the genus Volutharpa of the latter family, the operculum is so exceedingly small as to be practically imperceptible. In most species of Neptuneidae the outer lip is thin, while in Buccinidae it is frequently thickened and expanded. The family name Chrysodomidae used by Dr. Dall in Bulletin 112 is, at least so far as Pacific coast species are concerned, a synonym of Neptuneidae, the genus Chrysodomus being Neptunea.

The family Neptuneidae is largely boreal in distribution, exceptions being the genera Kellettia, Cantharus, Macron and Exiloidea, with a few species of other genera coming south as far as California in deep water. One example of these is Neptunea tabulata which may be found off our coast in fifty fathoms or more. Several species and races in this family, some of them of doubtful nomenclatural standing have been described from fossil faunas of various localities. An Atlantic species, Neptunea antiqua, is used in Europe for both food and bait, being known commonly as the 'red whelk.'

Both genera of Buccinidae are found on our coast, Buccinum and Volutharpa are restricted to northern latitudes, excepting for species that come farther south in deep water. One species, Buccinum strigillatum, has been taken off San Diego in 822 ftms. and another B. viridum off the Santa Barbara Islands in 414 ftms. Apparently no member of this family has been found fossil in Calif. The genus Buccinum is common in the north Atlantic, and at least one species, B, undatum is used for food. The shells of this genus are peculiarly liable to great variation in size, form and sculpture. This renders the classification of species very difficult.

Minutes of the Meeting of February Second, 1942 (No. 8)

The Conchological Club of Southern California met at the home of Mr. and Mrs. John Q. Burch, 1611 S. Elena Ave., Redondo Beach, California, the evening of February second. The minutes of the previous meeting were approved as printed.

Mr. and Mrs. H.C. Berry, 4185 Garthwaite Ave., Los Angeles were welcomed.

After discussion it was moved and carried that our future meeting place would be Clifton's Cafeteria, 648 S. Broadway, Los Angeles. The meeting to be at 7:30 P.M. with as many as possible coming early at 6:30 P.M. and having differ together.

The membership committee proposed the names of Meade E. and Ruth C. French 792 W. 26th St., San Pedro, Calif. for associate membership. They were so elected.

There being no further business the meeting was turned over to Mr. Tom Burch. His paper on Fouling of Ship's Bottoms was accompanied with most interesting slides.

He reported ----

Fouling diminishes the speed of ships up to 50% and increases the time 10% and fuel consumption 40%. It necessitates one month a year in dry docks and $100000000.00 is spent a year combating fouling.

Methods used in combating fouling are very old. Ships were sheathed with lead plates and the plates removed when badly fouled. The first paint preparation was patented in England in 1867. Various materials were used from arsenic to mercury and from garlic to tobacco. The difficulty is that the poison only reaches those that come in contact with it and it is soon dissolved. The mouths of some of the organisms are relatively far from where they are attached and so do not touch the paint. As the organisms multiply rapidly and attach themselves one upon another the toxicants are only temporary repellents.

Preventive methods to be effective must be against the first sliming film and be based on a knowledge of the life history of the numerous organisms, as--speed of the ship, temperature of the water, time it takes to reach maturity etc.

The organisms that are responsible for so much trouble are commonly called worms (Coral), grass (Hydroids), moss (Algae and Suckers). Barnacles, Terodos and such mollusks as Ostrea lurida, Mytilus edulis, Pecten latiauritus and Saxicava arctica.

Fouling of ships' bottoms is probably responsible for much of the geographical distribution of many species.

After adjournment the Club enjoyed refreshments and a pleasant social time in the new Burch Museum.

There were 26 members present.

Respectively Submitted

Secretary Pro Tem

H. W. Gillis

The Conchological Club is now meeting at Clifton's Cafeteria, 648 S. Broadway, Los Angeles at 6:30 P.M. the first tuesday of each month. The next meeting will be held on April 7.

It is not obligatory that you have dinner with us. Please come to the meetings at your convenience.

Mr. E.P. Chace has just received a letter from our associate member Walter J. Eyerdam of Seattle. Mr. Eyerdam reports that he is working long shifts seven days a week building war ships for the United States. This allows him no spare time for his shell correspondents.

Some time ago Mr. Eyerdam wrote the editor that his nephews are serving as officers in the United States Army. Mrs. Eyerdam and daughter are visiting relatives in the middle west.

Virginia Putney has written from Glendale that she has Red Cross work every tuesday night and regrets her inability to be with us until perhaps in June.

E.V. Edmonds has been working day and night with the medical corps of the California State Guard. While we miss the jovial company of Mr. and Mrs. 'Eve', permit us to add that we appreciate the fact that nothing should be allowed to interfere in any way with the only really important work at this time. Don is serving his country in Honolulu.

The following publications have been received during the past month:

California Fish and Game, Vol. 28, No. 1, January 1942 contains a series of interesting articles about the introduction of exotic fish and animals into California. The 1941 Pismo Clam Census is another article of interest.

'List of Mollusca of Grand Isle, Louisiana, Recorded From the Louisiana State University Marine Laboratory', published Feb. 19, 1942 in the occasional papers of the Marine Laboratory, Louisiana State University, Baton Rougue La. Mr. Harold W. Harry is the author of this well written faunal list and discussion of the ecology.

The bulletin of the American Malacological Union contains a number of papers of interest. This issue not only gives the proceedings of the Eleventh Annual Meeting at Rockland and Thomaston, Maine and the revised membership list but prints the papers presented at the Symposium on Methods of Collecting and Preserving Mollusks. 'Collecting and Preserving Fresh Water Snails' by Frank C. Baker, 'On Collecting Fresh Water Mussels' by Henry van der Schalie, 'Land Shell Collecting' by William J. Clench, 'Shore and Shallow Water Collecting' by B.R. Bales, 'Dredging for Every One' by Tom Burch, 'Four to Four Hundred Feet Beneath the Sea' by Jeanne S. Schwengel, and 'Diving as Applied to Shell Collecting' by Thomas L. McGinty.

Membership in the American Malacological Union is open to anyone interested in the study or collection of shells. The annual dues are one dollar. There is no initiation fee. If you wish to join, send your dollar and name and address to the financial secretary, Mrs. Harold R. Robertson, Buffalo Museum of Science, Buffalo, N.Y.

Two additional numbers of Johnsonia were received this month. No. 2 on the Genus Ficus (Pyrula) and No. 3 on the Genera Dosinia, Macrocallista and Amiantis.

For the convenience of subscribers a yearly rate of $3.00 has been fixed to cover the first 100 pages. Individual copies may, of course, be purchased as issued but the annual rate is not only less expensive but much less trouble for all concerned.

The March meeting of the Conchological Club of Southern California was held on Tues. March 3rd. in the Pine Room of Clifton's Cafeteria and was called to order at 7:30 by President John Q. Burch. On account of illness, our regular secretary Mrs. Effie Clark has been absent and much missed from our Jan., Feb. and Mar. meetings. Mrs. Gillis acted as secretary for the February meeting which was held in the Burch home Shell Room at Redondo Beach, on the regular date, Feb. 3rd. As Mrs. Gillis was not out for the March meeting a brief and informal report was given by Tom Burch to which the temporary secretary begs leave to add that Mr. Tom Burch gave a scholarly and well illustrated talk on 'the causes of fouling of ship's bottoms at the said Feb. meeting and that Mead E. French and Mrs. Ruth C. French were elected to associate membership in this club at that meeting.

There were no formal committee reports. It was moved, seconded, and duly voted that the club continue to meet at the Clifton Broadway Cafeteria. Current collecting notes brought out that the Pleistocene exposure opposite the San Pedro Lumber Co. plant on San Pedro-Wilmington Road is being destroyed as the material is being used for filling and surfacing elsewhere. This is frequently spoken of as the 'New San Pedro Lumber Yard Exposure' to distinguish it from Arnold's 'Lumber Yard Exposure' which was done away with years ago.

Dr. Gregg and Mr. Caruthers reported two trips for land shells. Mr. Strong read two interesting letters- one from Dr. Hertlein reporting progress on papers on Arca, Pteriacea, and Conidae and another letter from Mr. Walter Eyerdam saying it is impossible for him to continue correspondence or exchange.

It was reported that Mr. V.D.P. Spicer, long a member of this club and now returned to active duty in the Navy has made a visit to this neighborhood recently. Also that Leslie Jean Smith, daughter of Allyn G. Smith (one of the first masculine members of the club) is to be married shortly.

Mrs. Thomas Burch, having been introduced to the club a motion was made and carried that a committee of three be appointed to put into tangible form the club's good wishes for Tom and his bride. President Burch appointed Mr. E.P. Baker, Mrs. Effie Clark and Mrs. E.P. Chace.

The business being disposed of Mr. Caruthers, program chairman, presented Dr. Howard Hill in an interesting talk on 'Pholadidae and Related Forms'. He illustrated his talk with some fine specimens.

As Mrs. Clark was unable to be present and give her skeduled talk, Mr. Chace passed around a few Pleistocene specimens brought to accompany Mrs. Clark's notes.

President Burch filled in with notes from his 'Card File'. It should be noted that the form which he has identified as Acteocina infrequens from his local dredgings is almost certainly not that species, which is now believed to range from Corinto, Nicaragua south to Panama.

Adjournment was after the usual manner. There were 26 members present and four guests, Miss Mae Plumb, Miss Verna Mann, Miss Morton and Mrs, Howard Hill.

Respectfully submitted,

Elsie M. Chace,

Secretary Pro. Tem.

MINUTES OF THE CONCHOLOGICAL CLUB OF SOUTHERN CALIFORNIA (NO. 10)

The Conchological Club of Southern California met at the Clifton cafeteria at 640 S. Broadway, Los Angeles at 7:30 P.M., April 7, 1942 with 21 members and a visitor, Mr. Todd Campbell of Santa Monica, present.

The meeting was called to order by the vice-president, Mr. E. P. Baker. Communications consisted of a letter from Mr. J. M. Marsh reporting it to be impossible for he and Mrs. Marsh to attend club meetings in the future. The secretary was directed by a vote of the club members to express their regret at their absence. The serious illness of Mrs. De Rose Rutherford and the death of her mother, Mrs. Mathews, was reported and the sending of flowers in the name of the club for Mrs. Mathew's funeral was reported by the secretary. The club directed the secretary to express to Mrs. Rutherford the sympathy at her illness and bereavement.

A bill was allowed the secretary for an itemized list of expenses incurred for the club in the amount of $15.02.

Mr. E. J. Post returned from his recent trip to Florida bringing a number of interesting shells for club members and a report of many changes there due to war activities.

Mr. A.M. Strong gave a talk, not on Epitonidae because some of the required material was not available, but on Acteocinidae, a family we all know a little about, but generally such a very little. He soothed the vanity of a number of us by saying that, though many persons know many of the species, the genera were in such a decided muddle that no one had as yet been able to straighten them out. He then gave us such clear definitions of the species and their range that there will no doubt be a few less clouds on the conchological horizons of quite a number of collectors. His illustrative material was complete and most interesting.

Following this talk was one by Mr. Ralph Borman. He too, selected a subject other than the one listed, as all members are privileged to do. His chosen subject was Tritonalia, of which he had recently collected some very beautiful and rare specimens.

Considerable discussion on various points of identification and collection localities followed his talk about this very beautiful and hard-to-work-out genus. The meeting was then adjourned.

Effie M. Clark, Secretary.

'Natural History Hobbies', a booklet of 24 pages, published by the Cincinnati Museum of Natural History as Miscellaneous Publication No. 3, on April, 1942, was received. In the paper Mr. Ralph Dury has an article entitled 'Shell Collecting' but there are other articles of interest to some of our members such as 'Collecting Fossils', 'Collecting Rocks and Minerals' etc.

This reporter has just had returned to him two more letters addressed to shell collecting correspondents in the Philippine Islands. Both were stamped with the Returned to Sender- Service Suspended. These letters left Redondo Beach stamped Nov. 10,1941 and seem to have been right through the action. A short time ago we received two letters returned addressed to persons in France over a year ago. We wonder where they have been in the meantime. A short time ago we did get a letter from Mr. Wm. Griffith on the Island of Malta. A number of us have exchanged with him in happier times. He reported that he and his were all right at that time. We wish we could be as sure of our friends in Poland, Latvia etc. We have had no word from them since the beginning of the Hitler rampage.

Dr. Maxwell Smith has announced another new shell book to be ready in May- 'A Review of the Volutidae (Volutes'. Those interested may order directly to Maxwell Smith, Box 92, Lantana, Florida. Price $6.00.

Our associate member Mr. A. Sorensen of Pacific Grove has just sent us some very fine photographs of many fine shells which he brought back with him on his recent trip to West Mexico. Some of these plates should be printed and made available to more students of this fauna. Mr. Sorensen has the idea so seldom seen of using a growth series of a species. For example one of the plates of West Mexican Conus is arranged in rows of specimens ranging from the juvenile to the adults with each line devoted to one species. By using this plate it should be an easy matter to classify the following species; Conus princeps, purpurascens, virgatus, regularis, comptus, mahogani, perplexus, orion, gladiator, and nux. He has treated other genera in a similar manner.

We have a note from our secretary, Mrs. Effie Clark advising us that Miss Edna T. Cook had just paid her a visit with 'something less than a pint of Odostomias for classification', and the additional note that 'the afternoon was too short'. The ladies must have spent most of the afternoon visiting.

Mr. and Mrs. E.P. Chace honored us with a visit last sunday afternoon. They brought a tray of specimens of Tritonalia. Mr. and Mrs. Ralph Borman, with their newly classified specimens of T. fusconotata Dall etc. have caused little short of consternation to some of us. We read and studied all the afternoon and regret to report that we are still not too happy about changing all of the old labels in our collections of Tritonalia. It is obvious that IF any of the names in this group are to be finally placed in synonomy the other names in common usage are all older than T. fusconotata Dall 1919.

The editor of this publication would be very happy to publish a report on the relative taxonomic standing of Muricopsis and Muricidea and their exact distinctions. If any of the members think they have Muricopsis erinac--iodes Val. we would appreciate knowing it and why.

The tides for the month of May will be of little use to the collector who does not carry a lantern. The best day time tides follow:

Wed. May 6- 8:31 A.M. minus 0.3
Thur. " 7- 9:43 A.M. " 0.2
Fri. ""8-10:43 A.M. " 0.1

The early risers and those wishing to collect in the bays may be able to do very well the first week in June. These tides follow:

June 1 - 5 A.M. minus 1.5
" 2 - 5:54 " 1.2
" 3 - 6:52 " 0.8
" 4 - 7:55 " 0.3
" 5 - 8:58 plus 0.1

IMPORTANT

All members are urged to please mail all news about shells, shell books, shell collectors, shell trips and localities, etc. etc. to your reporter.

John Q. Burch,
1611 S. Elena Ave.,
Redondo Beach, California.

Our next meeting will be held at Clifton's Cafeteria, 648 S. Broadway, Los Angeles, Calif. on the evening of May 5. We will have dinner at 6:30 P.M. and the meeting will convene at 7:30 P.M. in the Pine Room.

FLUORESCENCE IN *BULIMULUS INSCENDENS* BINNEY

HUGH C. RAWLS[1], JOHN M. BAUM[2], AND
AND ROGER L. YATES[3]

Fluorescence under ultraviolet light has been reported by several authors to occur in the mucus of certain land snails. Turchini (1926) and Fischer and Saddy (1949) described the phenomenon in the mucus of *Helix aspersa* Müller; Rawls and Yates (1971) reported its occurrence in the mucus of certain snails of the family Endodontidae; and Rawls and Baum (1971) reported observing it in the mucus of *Mesodon clausus* (Say). Later papers related the phenomenon in *Anguispira kochi* (Pfeiffer) to the presence of a specific bacterial pigment (Baum and Rawls, 1972) and described its location in the tissues of *A. kochi* (Yates and Rawls, 1972). We now wish to report the discovery of fluorescence in the mucus of specimens of *Bulimulus inscendens* Binney and to relate the phenomenon in this species to the presence of a bacterial pigment.

Our interest in the occurrence of fluorescence in certain land snails has led us to investigate the response to ultraviolet light by mucus samples from snails representing a number of families, including the Bulimulidae. Through the kindness of Mr. Munroe L. Walton, a friend and sometime field companion of the senior author, we earlier had received two living specimens of *Bulimulus inscendens* collected at Cabo San Lucas, Baja California. Our experience with living and preserved specimens of other bulimulids had led us to suspect that fluorescence did not occur in any member of the family, but we also had been conditioned by experience against allowing a suspicion to become an assumption; an extensive survey of polygyrids earlier had led us to believe that none of that family would be found to fluoresce, an idea which could not stand when we found that *Mesodon clausus*, of all the snails examined, exhibited the phenomenon. Consequently, we were not unprepared to find fluorescence in a member of the Bulimulidae, in spite of suspicion to the contrary.

When *B. inscendens* was observed under ultraviolet light, a distinctive fluorescence appeared in the mucus; a bluish-purple color quite unlike the clear blue seen in mucus samples from endodontids and the greenish-blue in the mucus of *Mesodon clausus*. Spectrophotometric examination of mucus samples from *B. inscendens* reveals

[1] Department of Zoology, Eastern Illinois University, Charleston, Ill. 61920
[2] USAF Hospital, Carswell AFB, Texas 76301
[3] University of Illinois College of Veterinary Medicine, Urbana, Ill. 61801

one prominent absorption peak at about 278 nm and a lesser peak at about 315 nm, values which compare favorably with readings obtained from mucus samples from *A. kochi* and *M. clausus*. An examination of mucus samples from our two specimens of *B. inscendens* proved positive for bacteria, and fluorescent colonies were obtained by streaking the mucus of Pseudomonas-B medium. The role of *Pseudomonas* in production of fluorescence in *A. kochi* has been described (Baum and Rawls, 1972), and we are now convinced that pseudomonads are also responsible for fluorescence in *B. inscendens*.

Our study of numerous living and preserved specimens of bulimulid snails leads us to suggest that *B. inscendens* may be the only representative of the family to exhibit fluorescence. Clearly, something in the physiology of members of this species allows the production of fluorescent pigments by pseudomonads, and our investigations now are directed toward determining why such pigments are present in *B. inscendens* and not in other bulimulids available to us.

LITERATURE CITED

BAUM, J.M. & RAWLS, H.C. (1972) Fluorescence caused by Pseudomonas in the mucus of *Anguispira kochi* (Pfeiffer). -- Sterkiana 45: 1-13.

FISCHER, P. H. & SADDY, J. (1949) Examen en lumière de Wood de quelques invertébrés marins des côtes de la Manche. -- Bull. Lab. Mar. Dinard, 32: 23-27.

RAWLS, H.C. & BAUM, J.M. (1971) Fluorescence in *Mesodon clausus* (Say). -- Nautilus 85: 65-67.

RAWLS, H.C. & YATES, R.L. (1971) Fluorescence in endodontid snails. -- Nautilus 85: 17-20.

TURCHINI, J. (1926) Les examens anatomiques et histologiques en lumière ultraparaviolette filtrée de quelques fluorescences jaunes chez les mollusques. -- Bull. Soc. Zool. de Paris 51: 31-35.

YATES, R. L. & RAWLS, H. C. (1972) The anatomical distribution of fluorescence caused by pseudomonads in *Anguispira kochi* (Pfeiffer). -- Sterkiana 45: 14-20.

ACCEPTED FOR PUBLICATION JULY 10, 1972

AUTHOR INDEX TO THE NAUTILUS VOLUMES 76-85

FOREWORD

The *NAUTILUS* has just completed volume 85 (July, 1972) and we learn from an announcement in this number that future numbers will have a different format, namely one that closely approximates that of the Bulletin for 1971 of the American Malacological Union and, by coincidence, of STERKIANA.

This new departure is a welcome one that will undoubtedly enhance the usefulness of the *Nautilus* to all malacologists. The larger page size will permit printing of longer papers, whereas the two-column format will accommodate shorter papers as well as longer ones.

To mark the occasion, the writer offers herewith an index of volumes 75-85 of the *Nautilus*, the last of the small format, in a size which can be bound, if so desired, with the first volume of the new format.

This index is a continuation of the 1963 *Author Index to the Nautilus* .... for vols. 1-75 and follows approximately the same general arrangement of entries.

The 1963 Index is still available from the writer ($2.00 postpaid).

Aurèle La Rocque

ABBOTT, R. Tucker
1963. The janthinid genus *Recluzia* in the Western Atlantic. — 76, 4: 151
1964. Publications received. -- 77, 4: 143-144
1964. *Littorina ziczac* (Gmelin) and *L. lineolata* Orbigny. — 78, 2: 65-66
1966. Ted Nielson. -- 79, 3: iii inside back cover. (Obituary note)
1968. Giant Cowries. -- 82, 1: 32
1969. Dates of the Nautilus. -- 83, 1: 35
1969. *Achatina fulica* invades Florida. 83, 2: 75
1971. *Conus patae*, a new Caribbean gastropod. -- 85, 2: 49-51, 6 figs.

ABBOTT, R.T. & JENSEN, Russell H.
1968. Portuguese marine mollusks in Bermuda. -- 81, 3: 86-89, 5 figs.

ABBOTT, R.T. & LEWIS, Hal
1970. *Cymatium boschi*, new species from the Arabian Sea. -- 83, 3: 86-88, 6 text figs.

ABBOTT, R.T. & WURTZ, Charles B.
1971. Horace Burrington Baker, 1889-1971. -- 85, 1: 1-4, 3 portraits

ADDICOTT, Warren O.
1968. Additional Pacific Coast *Malacobdella grossa*. -- 81, 4: 144.
1970. Biographical sketch of Leo Hertlein. -- 84, 2: 37-41, portrait
1970. Bibliography of Leo George Hertlein for the period of 1925-1970. 84, 2: 43-52

ADEGOKE, Oluwafeyisola S.
1967. New and oldest records of pelecy-

ADEGOKE, O. (cont.)
pod *Mya* from West North America, south of Alaska. -- 80, 3: 91-95, 3 figs., p. 97

ALLEN, J. Frances
1962. Gonad development and spawning of *Brachidontes recurvus* in Chesapeake Bay. -- 76, 1: 9-16

ATHEARN, Herbert D.
1964. Three new unionids from Alabama and Florida and a note on *Lampsilis jonesi*. -- 77, 4: 134-139, pl. 9
1971. *Sphaerium simile* (Say) in Tennessee. -- 85, 1: iii after 36

BAILY, Joshua Longstreth, Jr.
1962. Maxwell Smith 1888-1961. -- 76, 1: 33-34

BAKER, Emmett B. & MERRILL, A.S.
1965. An observation of *Laevicardium mortoni* actually swimming. --78, 3: 104.

BAKER, Horace Burrington
1962. Puerto Rican land operculates. -- 76, 1: 16-22, 1 text fig.
1962. Dates of the Nautilus. -- 76, 1: 34-35
1962. *Nesovitrea* (?) *harimensis*. -- 76, 1: 37-38
1963. *Anthracopupa* and *Maturipupa*. --76, 3: 110
1963. Dates of the Nautilus. -- 77, 1: 29
1963. *Anisus* Studer. -- 77, 1: 32-33
1963. *Planorbarius* Duméril. -- 77, 1: 34
1963. Melampinae. -- 77, 1: 34
1963. Paludomidae (Pleuroceridae). --77, 1: 34-35
1964. Some of Rafinesque's unionid names. 77, 4: 140-142
1964. *Dromus* not a homonym. -- 77, 4: 142
1964. Dates of Nautilus. -- 78, 1: 27
1964. *Carunculina* (Lampsilinae). -- 78, 1: 33
1964. Notes on Sphaeriid names. -- 78, 2: 45-47
1964. On *Lymnaea auricularia* in Colorado. -- 78, 2: 66-67
1964. *Elliptio complanata wheatleyi*. -- 78, 2: 67
1964. *E. (Uniomerus) tetralasmus sayana*. 78, 2: 67.
1964. *Galatea* (Donacidae). -- 78, 2: 67.
1964. *Oxycheilus* (Subulininae?). -- 78, 2: 67-68
1964. *Corbula limatula*, 1846. -- 78, 3: 104-105
1965. *Anisorhynchus* vs. *Ursirivus*. -- 78, 3: 105

BAKER, H.B. (cont.)
1965. *Corbula cuneata* and *C. inaequalis*. 78, 3: 108
1965. *Monomphalus* (Punctidae). 78, 4: 141-142
1965. Dates of the Nautilus. -- 79, 1: 34
1966. *Eduardus* and *Linisa*, 1930. -- 79, 4: 141
1966. *Corbicula manilensis*. -- 79, 4: 144
1966. Dates of the Nautilus. -- 80, 1: 28.
1967. *Nitocris*. -- 80, 3: 108
1967. Dates of the Nautilus. -- 81, 1: 32-33
1967. *Mudalia*. -- 81, 1: 35.
1967. *Juga* and *Melasma*. -- 81, 1: 36
1968. Correction. -- 81, 3: 101
1968. Dates of the Nautilus. --82, 1: 31
1968. Fred R. Tobleman, 1892-1968. -- 82, 2: 72

BARANOWSKI, Walter P.
1971. New northern extension of the range of *Assiminea modesta* (H.C. Lea). -- 84, 4: 143-144

BASCH, Paul F.
1962. Radulae of North American freshwater limpet snails. III. *Ferrissia* and *Laevapex*. -- 76, 1: 28-33, 2 text figs.
1968. A scalariform *Biomphalaria glabrata*. -- 82, 1: 21 4 figs.

BATCH, D.A., jt. auth. See Branson, B.A.

BATES, John M.
1962. Extension of the range of *Corbicula fluminea* within the Ohio drainage. -- 76, 1: 35-36

BAUM, J.M., jt. auth. See Rawls, H.C.

BAYNE, R.A., jt. auth. See Friedl, F. E.

BEASLEY, C.W., jt. auth. See Branson, B.A.

BEETLE, Dorothy E.
1962. Additions to Teton County, Wyoming, Mollusca. -- 76, 2: 74
1965. Molluscan fauna of some small ponds in Grand Teton National Park. --78, 4: 125-130
1967. Mollusks of the Outer Banks, N.C. -- 81, 2: 61-65
1968. *Laevapex fragilis* on the Outer Banks of North Carolina. -- 81, 3: 107

BERNARD, F. R.
1968. Sexual dimorphism in *Polinices lewisi* (Naticidae). -- 82, 1: 1-3, 1 fig.

BICKEL, David
1966. Stranded *Campeloma*. --79, 3: 106-107
1966. *Campeloma crassula* with reversed whorls. -- 79, 3: 107-108
1968. *Goniobasis semicarinata* and *G. indianensis* in Blue River, Indiana. -- 81, 4: 133-138, 5 figs.
1968. *Goniobasis curreyana lyoni*, a pleurocerid snail of west-central Kentucky. -- 82, 1: 13-18, 5 figs.

BIERBAUM, Veronica M.
1964. Oyster chromatogram. --78, 2: 64-65

BINGHAM, Frasier O.
1969. *Littorina nebulosa* in Florida. -- 82, 4: 146-147
1972. Shell growth in the gastropod *Littorina irrorata*. -- 85, 4: 136-141, 9 figs.

BLANKENSHIP, Shaw
1971. Notes on *Alasmidonta fabula* (Lea) in Kentucky (Unionidae). -- 85, 2: 60-61, 1 fig.

BLEAKNEY, J. Sherman
1966. Behavior of calciphilic *Cepaea hortensis* on acidic island off Nova Scotia. -- 79, 4: 130-134, 1 fig.

BLINN, Walter C.
1963. Twisting behavior in *Mesodon thyroidus*. -- 77, 1: 31-32

BOSS, Kenneth J.
1964. Unionidae of Red Cedar River, Michigan. -- 77, 4: 117-118
1964. Notes on a hybrid *Tellina* (Tellinidae). -- 78, 1: 18-21
1965. Note on *Lima (Acesta) angolensis*. -- 79, 2: 54-58
1967. N.S.F. Grants, 80, 4: 141-142
1968. N.S.F. Grants, Fiscal '66. -- 81, 3: 104-105
1968. The conchological papers of Arcangelo Scacchi. -- 82, 1: 35-36
1968. N.S.F. Grants, Fiscal '67. -- 82, 2: 74-76
1969. Lucinacea and their heterodont affinities (Bivalvia). -- 82, 4: 128-131
1969. Nomenclatorial note: Arcticidae versus Cyprinidae (Mollusca: Bivalvia). -- 83, 2: 61-64
1970. Northward range extension of *Cyclinella tenuis* Recluz. -- 83, 3: 112-113
1970. Malacology in mainland China. -- 84, 1: 34-35
1971. Familial affinities of *Hemidonax* (Bivalvia). -- 85, 1: 9-12

BOSS, K. J., jt. auth. See Clench, W.J.; Jacobson, M.K.; Merrill, A. S.; Moore, D. R.

BOSS, K. J., EBBS, N. K., & STEWART, W.C.
1967. *Montacuta floridana* commensal with annelid *Onuphis magna*. --80, 4: 144, iii

BOYER, Paul S.
1967. Some observations on the ecology of *Callocardia texasiana*. --80, 3: 79-81

BRANSON, Branley A.
1963. Notes on snail distribution and leech feeding habits in Oklahoma. -- 76, 4: 148-149
1964. Records and two new species, *Stenotrema abaddona* and *S. glassi*, from Oklahoma. -- 77, 3: 100-105, 1 pl.
1966. *Alasmidonta marginata* and *Ptychobranchus fasciolaris* in Kansas. -- 80, 1: 21-24, 1 fig.
1968. Two new slugs (Pulmonata: Philomycidae: *Philomycus*) from Kentucky and Virginia. -- 81, 4: 127-133, 5 figs.
1968. Genital differences in *Philomycus virginicus* Hubricht and *P. bisdosus* Branson. -- 82, 2: 74
1970. Shell variability in *Polygyra dorfeuilliana*. -- 83, 4: 120-133, 12 figs.
1971. Variation in the shell of *Mudalia potosiensis* (Lea) (Pleuroceridae) from a single locality. -- 85, 1: 26-36, 3 figs.
1972. *Hemphillia dromedarius*, a new arionid slug from Washington. --85, 3: 100-106, 1 fig.

BRANSON, B.A. & BATCH, Donald L.
1969. Notes on exotic mollusks in Kentucky. -- 82, 3: 102-106

BRANSON, B.A. & BEASLEY, Clark W.
1967. Coiling abnormality in *Physa anatina*. -- 80, 4: 144

BRANSON, B.A. & McCOY, Clarence J., Jr.
1962. *Streptostyla toltecorum* and *S. maslini*, spp. nov., from Mexico. -- 76, 1: 7-9, pl. 2
1963. Gastropoda of the 1961 University of Colorado Museum Expedition in Mexico. -- 76, 3: 101-108

BRANSON, B.A. & PETERS, Lewis
1964. *Limax maximus* and *Ferrissia meekiana* in Oklahoma. -- 77, 3: 107-108

BRUNSON, Royal Bruce & KEVERN, Niles
1963. Observations of a colony of *Magnipelta*. -- 77, 1: 23-27

BRUNSON, R. B. & RUSSELL, Richard H.
1967. *Radiodiscus*, new to molluscan fauna of Montana. -- 81, 1: 18-22, map

BRUNSON, R. B., jt. auth. See Russell, R.H.

BRYCE, George W., Jr.
1970. Rediscovery of the limpet, *Acroloxus coloradensis* (Basommatophora: Acroloxidae), in Colorado. -- 83, 3: 105-108

BULLOCK, Robert C.
1966. New northern record for *Papyridea mantaensis* Olsson 1961. -- 79, 4: 143
1969. *Omalogyra atomus* (Philippi) from Maine. -- 83, 2: 70-71
1970. *Latirus varai*, a new fasciolariid gastropod from the Caribbean. -- 83, 4: 133-135, 1 fig.

BURCH, John Q.
1963. *Natica (Tectonatica) clausa*. -- 76, 4: 152
1963. Directory of conchologists of the world. -- 77, 1: 35

BURCH, J. Q. & BURCH, Rose L.
1963. Genus *Olivella* in Eastern Pacific. 77, 1: 1-8, pls. 1-3.
1964. A new species of *Sinum* from the Gulf of California. -- 77, 4: 109-110, pl. 5
1964. The genus *Agaronia* J.E. Gray, 1839. 77, 4: 110-112, 1 fig., pls. 6, 7
1966. Burch collection. -- 80, 1: 36-iii
1967. A new *Ancilla* from Brazil. -- 80, 3: 81-82, 1 fig.

BURCH, J. Q. & CAMPBELL, G. Bruce
1963. Four new *Olivella* from Gulf of California. -- 76, 4: 120-126, pls. 6, 7, and 6 figs.

BURCH, Rose A. (Mrs. John Q.)
1966. Edwin Perrin Baker: Oct. 15, 1891 - April 24, 1966. -- 80, 2: 69-70
1967. Ruth E. Coats, 1911-1966. -- 80, 4: 140
1968. Harry R. Turver, January 8, 1892 - April 1, 1968. -- 82, 2: 72
1969. Gilbert Grau, 1906-1969. -- 83, 2: 66

BURCH, R., jt. auth. See Burch, J. Q.

BURGESS, C. M.
1965. Two new species of *Cypraea*. -- 79, 2: 37-40, pl. 4, part
1966. Correction. -- 79, 4: 136 (Correction to paper in 79, 2: 39)

BURGESS, C.M. (Cont.)
1967. A new Hawaiian *Cypraea*. -- 81, 1: 6-11, pl. 2

BURGESS, C.M., jt. auth. See Summers, R.

CAMPBELL, G.B., jt. auth. See Burch, J.Q.

CARLETON, J.T., jt. auth. See Roth, B.

CARLISLE, John G., Jr.
1962. Spawning and early life history of *Haliotis rufescens* Swainson. -- 76, 2: 44-48, pl. 4

CARNEY, W. Patrick
1966. Mortality and apertural orientation in *Allogona ptychophora* during winter hibernation in Montana. -- 79, 4: 134-136
1970. Maintenance of land mollusks in the laboratory. -- 83, 4: 136-139, 2 figs.

CASTAGNA, M., jt. auth. See Chanley, P.

CATHER, James N. & CROVO, M. Ellen
1972. The spawn, early development and larvae of *Cyphoma gibbosum* (Cypraeacea). -- 85, 4: 111-114, 1 fig.

CERNOHORSKY, Walter O.
1970. New Mitridae and Volutomitridae. -- 83, 3: 95-104, 12 figs.

CHANLEY, Paul
1969. *Donax fossor:* a summer range extension of *Donax variabilis*. -- 83, 1: 1-14

CHANLEY, P. & CASTAGNA, M.
1966. Larval development of the pelecypod *Lyonsia hyalina*. -- 79, 4: 123-128, 4 figs.

CHEATUM, E. P.
1971. A new species of *Ashmunella* from the Davis Mountains in West Texas. -- 84, 3: 107-109, 4 figs.

CHEN, Chin
1968. Zoogeography of thecosomatous Pteropods in the West Antarctic Ocean. -- 81, 3: 94-101, 4 maps

CHROSCIECHOWSKI, P., jt. auth. See Malek, E.

CLARKE, Arthur Haddleton, Jr.
1963. Supplementary notes on pre-Columbian *Littorina littorea* in Nova Scotia. -- 77, 1: 8-11
1966. Interglacial *Hendersonia occulta* in Canada. -- 79, 4: 137-138

CLARKE, A.H. (cont.)
1967. Unionid introduction in Massachusetts: results. -- 80, 3: 106-108

CLENCH, William J.
1964. *Gulella (Huttonella) bicolor* (Hutton). -- 77, 4: 142-143
1965. Note on *Gastrocopta tappaniana* (C. B. Adams). -- 78, 3: 106-107
1965. Correction. -- 78, 3: 108 (Correction to a paper in Museo Argentino, etc.)
1965. A new species of *Lithasia* from Mississippi. --79, 1: 30-33, 1 fig.
1965. A new species of *Clappia* from Alabama. -- 79, 1: 33-34, 1 fig.
1966. *Pomacea bridgesi* (Reeve) in Florida. -- 79, 3: 105
1966. *Pomacea bridgesi* in Puerto Rico. -- 79, 3: 105-106
1966. *Celetaia*, new genus of Viviparidae from the island of Celebes, Indonesia. -- 79, 4: 137
1966. *Panopea bitruncata* (Conrad). -- 80, 1: 36
1966. A new species of *Kalendyma* from Malaita, Solomon Islands. -- 80, 2: 52-53, pl. 3 (part)
1966. Extension in range for *Dosinia discus*. -- 80, 2: 70
1967. Henry G. Frampton 1902-1966. -- 81, 1: 31-32
1967. Heilprin, Angelo. -- 81, 2: 68
1968. *Ficus carolae* and *F. floridensis*. -- 81, 3: 107
1969. Land shells of Jost Van Dyke. Virgin Islands. -- 82, 4: 144-145
1969. *Melanoides tuberculata* (Muller) in Florida. -- 83, 2: 72
1970. *Corbicula manilensis* (Philippi) in Lower Florida. -- 84, 1: 36
1971. Additions to the Cayman Islands land mollusks. -- 85, 2: 69-70
1972. *Corbicula manilensis* (Philippi) in Oklahoma. -- 85, 4: 145

CLENCH, W.J., jt. auth. See Jacobson, M.K.

CLENCH, W.J. & BOSS, Kenneth J.
1967. Freshwater Mollusca from James River, Va. and a new name for *Mudalia* of authors. -- 80, 3: 99-102

CLENCH, W.J. & JACOBSON, M.K.
1966. On *Ampullina* Guppy. -- 80, 2: 71

CLENCH, W.J. & STANSBERY, D.H.
1966. *Corbicula manilensis* Philippi in the Nolichucky River, Tennessee. -- 82, 4: 146

CLENCH, W.J. & TURNER, Ruth D.
1967. A new species of *Lyria* (Volutidae) from Hispaniola. -- 80, 3: 83-84, 3 figs.

CLOVER, P.W., jt. auth. See Roth, B.

CORGAN, James X.
1966. *Mya* on the Alaska Peninsula. -- 80, 1: 13-16, 1 fig.
1967. *Turbonilla secura*. -- 80, 4: 142
1969. Marine mollusks of Port Moller, Alaska Peninsula. -- 83, 2: 65-66
1969. *Odostomia cassandra* Bsrtsch. -- 83, 2: 71-72
1971. Review of *Parodostomia, Telloda, Goniodostomia* and *Eulimastoma* (Gastropoda: Pyramidellacea). -- 85, 2: 51-60

COSTA, R.R., jt. auth. See Horst, T.J.

COUCH, J.A., jt. auth. See Tubiash, H.S.

CROVO, M.E. jt. auth. See Cather, J.N.

CRUTCHFIELD, Philip J.
1966. Positive rheotaxis in *Goniobasis proxima*. -- 79, 3: 80-86

CURTIN, Thomas J.
1963. Snails from Turkey, Crete and Greece. -- 76, 4: 132-135

D'ATTILIO, Anthony
1967. *Muricanthus melanamathos*, a West African muricid. -- 80, 3: 96-99, pl. 5

D'ATTILIO, A., jt. auth. See Emerson, W.K.

DAVIS, John D.
1964. Lectotype designation for *Mesodesma arctatum*. -- 78, 1: 3-6, pl. 2
1965. *Mesodesma deauratum*: synonymy, holotype and type locality. -- 78, 3: 96-100, pl. 9
1966. *Mesodesma arctatum*: fossil and living specimens on Nantucket. -- 80, 1: 1-3
1969. *Polydora* infestation of *Mercenaria mercenaria*. -- 83, 2: 74

DAWLEY, Charlotte
1966. *Euglandina rosea* in North Carolina. -- 79, 4: 142

DEXTER, Ralph W.
1962. Further studies on the marine mollusks of Cape Ann, Massachusetts. -- 76, 2: 63-70
1967. Marine biological association of India. -- 80, 4: iii afger 144
1968. International symposium on Mollusca. -- 82, 2: 73-74

DEXTER, R.W., jt. auth. See Matteson, M.R.

DIMELOW, E.J.
1962. On the biology of some mollusks

DIMELOW, E. J. (cont.)
from a Nova Scotian deciduous wood. -- 76, 2: 49-51
1962. Land mollusks of Sackville, New Brunswick, Canada. -- 76, 2: 51-53
1963. Mollusks from hardwoods of the Chignecto Isthmus. -- 77, 1: 21-23

DONOHUE, Jerry
1962. Correction. -- 76, 1: 35 (For a paper in April number)

DRONEN, N.O., jr., jt. auth. See Lang, B.Z.

DUNDEE, Dee Saunders
1967. Introduced slugs still spreading. -- 80, 3: 108-iii
1971. United States research trends in malacology. --85, 2: 67-69, 2 figs.
1971. Veronicellids still on the move in the Gulf Coast. -- 85, 2: 72

DUNDEE, D.S., jt. auth. See Hermann, P.W.

DUNDEE, D.S. & HARMAN, Walter J.
1963. *Corbicula fluminea* (Müller) in Louisiana. -- 77, 1: 30

DUNDEE, D.S. & HERMANN, Patti Watt
1965. Malacological problems: 1. -- 78, 3: 81-83

DUNDEE, D. S., HERMANN, P. W., & HERMANN, Henry R.
1968. New records for introduced mollusks. -- 82, 2: 43-45

DUNDEE, D.S., PHILLIPS, Paul H., & NEWSOM, John D.
1967. Snails on migratory birds. -- 80, 3: 89-91

EBBS, N.K., jt. auth. See Boss, K.J.

EDITORS
1962. Error in Naut. 75, 4: iii. -- 76, 2: iii after 74
1963. Pages. -- 76, 3: 110. (Extra 4 pages contributed by Dr. Dorothea Franzen)
1965. Ruth Ingersoll Baily. -- 78, 4: 139 (Obit. note)
1971. Horace Burrington Baker, 1889-1971. (Obit. note) 84, 4: 113
1972. Important notice to subscribers and contributors to *The Nautilus*. -- 85, 4: vi (of index)
1972. The American Malacological Union's 38th annual meeting .... -- 85, 4: 146
1972. Dr. John Teng-Chien Yen. -- 85, 4: iii after 146 (Obituary)

EDITORS (cont.)
1972. Dr. Leo G. Hertlein. -- 85, 4: iii after 146 (Obituary)
1972. The Hall of Shells .... -- 85, 4: iii after 146. (Delaware Museum of Natural History)

EISNER, T. & WILSON, E.O.
1970. Defensive liquid discharge in Florida tree snails (*Liguus fasciatus*). -- 84, 1: 14, figs. 1, A-E

EMERSON, William K.
1968. *Azumomorula*, new name for *Morulina* Dall, 1923, not Boerner, 1906. (Gastropoda: Muricacea). -- 81, 4: 125-127, 1 fig.
1969. Second annual meeting of the Western Society of Malacologists. --82, 4: 144
1969. Galapagan records for *Morum veleroae* (Gastropoda: Tonnacea). -- 83, 1: 19-22, 4 figs.
1971. *Niso (Neovolusia) imbricata* (Sowerby, 1834) rediscovered (Gastropoda) Eulimidae). --85, 1: 30-32, 2 figs.
1971. *Cadulus (Gadila) perpusillus* (Sowerby, 1832), an earlier name for *C. (G.) panamensis* Sharp and Pilsbry, 1898. -- 84, 3: 77-81, figs. 1-4

EMERSON, W. K. & D'ATTILIO, Anthony
1965. A new *Latiaxis* from the Western Pacific (Muricidae). -- 78, 3: 101-103, pl. 10
1965. *Aspella (Favartia) angermeyerae*, n. sp. -- 79, 1: 1-4, pl. 1
1970. *Aspella myrakeenae*, new species from western Mexico. -- 83, 3: 88-95, 11 figs.

EMERSON, W.K. & OLD, William E., Jr.
1963. Remarks on *Cassis (Casmaria) vibexmexicana*. -- 76, 4: 143-145, pl. 10.
1964. Additional records from Cocos Island. -- 77, 3: 90-92
1965. New molluscan records for the Galapagos Islands. -- 78, 4: 116-120
1965. New records for *Cypraea surinamensis*. -- 79, 1: 26-30, pl. 3
1966. *Cypraea (Propustularia) surinamensis* Perry from Brazil. -- 80, 2: 70-71

ERDMAN, D.S., jt. auth. See Warmke, G.L.

EWALD, Joseph Jay
1963. Living examples of *Auriculastra pellucens* and its larval history. -- 77, 1: 11-14

EYERDAM, Walter J.
1968. Fresh-water mollusks eaten by trout and other fish. -- 81, 3: 103-104

FECHTNER, Frederick R.
1963. Check list of East Central Illinois Unionidae. -- 76, 3: 99-101
1966. *Corbicula* from the Mississippi River. -- 79, 4: 138-139

FEINBERG, Harold S.
1970. One more sinistral *Mesodon*. -- 84, 1: 12-13

FOGAN, M., jt. auth. See McMillan, N.F.

FOX, Ralph Olen
1970. *Corbicula* in Baja California. --

FRANKENBERG, Dirk
1966. Southern limit of *Nassarius trivittatus*. -- 79, 3: 89-90

FRANZ, David R.
1967. On the taxonomy and biology of the Dorid nudibranch *Doridella obscura*. -- 80, 3: 73-79, 1 fig.
1968. Occurrence and distribution of New Jersey Opisthobranchia. --82, 1: 7-12, 3 figs.
1970. The distribution of the nudibranch *Doris verrucosa* Linnë in the Northwest Atlantic. -- 83, 3: 80-85, 3 figs.

FRANZEN, Dorothea S.
1963. Variations in the anatomy of the succineid gastropod *Oxyloma retusa*. -- 76, 3: 82-95, 4 figs.
1964. Anatomy of the succineid gastropod *Oxyloma haydeni*. -- 77, 3: 73-81, 1 fig.
1966. Anatomy of the succineid gastropod *Oxyloma salleana* (Pfeiffer). -- 80, 2: 59-69, 3 figs.
1969. Structural characteristics of succineid gastropod *Oxyloma sanibelensis*. -- 82, 3: 77-83, 2 figs.
1971. Anatomy and geographic distribution of the succineid gastropod, *Succinea vaginacontorta* Lee. -- 84, 4: 131-142, 3 figs.

FRANZEN, D.S., jt. auth. See Murray, H.D.

FRIEDL, Frank E. & BAYNE, Ronald A.
1965. *Otala lactea* from Tierra Verde, Florida. -- 79, 2: 69-70

FRIENDS OF LEO GEORGE HERTLEIN
1970. Leo George Hertlein Honor Issue. -- 84, 2: 37

GALE, William F.
1971. *Sphaerium lacustre* in Oklahoma. -- 85, 2: 71

GALLAGHER, JOHN L. & WELLS, Harry W.
1969. Northern range extension and winter mortality of *Rangia cuneata*. -- 83, 1: 22-25, 1 fig.

GENTNER, H.W., jt. auth. See Little, J.W.

GETZ, Lowell L.
1962. Localities for New Hampshire land mollusks. -- 76, 1: 25-28
1962. Color forms of *Arion subfuscus* in New Hampshire. --76, 2: 70-71, pl. 5
1966. An 1870 collection of mussels from the Calumet River, Illinois. -- 79, 4: 118-120
1968. *Arion fasciatus* in Wisconsin. -- 82, 1: 32-33

GETZ, Lowell L. & WAKEFIELD, Robert H.
1963. *Arion* in New England. -- 77, 1: 14-16

GILBERTSON, Lance H.
1969. Notes on the biology of the snail *Sonorella odorata* in Arizona. --83, 1: 29-34, 1 fig.

GORE, James F.
1967. A northernmost record and ecological data on *Hydrobia salsa* in Maine. -- 80, 4: 112-113

GOULD, Stephen J.
1971. Environmental control of form in land snails a case of unusual precision. -- 84, 3: 86-93, 2 figs.

GRANDY, John W. IV
1972. Winter distribution of *Melampus bidentatus* (Say) on a Cape Cod salt marsh. -- 85, 3: 106-109

GREGG, Wendell O. & MILLER, Walter B.
1969. A new *Sonorella* rom Phoenix, Arizona. -- 82, 3: 90-93, 2 figs.

GRIMM, F. Wayne
1963. *Triodopsis fosteri* in Ohio. --77, 2: 72
1964. *Striatura meridionalis* in Michigan. -- 77, 3: 108
1964. *Otala lactea* in Virginia, Texas, and California. -- 77, 3: 108-109
1967. New species of *Helicodiscus* from Virginia. -- 80, 4: 119-124, pl. 8
1968. A note on *Catinella oklahomarum*. -- 81, 3: 84-85, 1 fig.

GRIMM, F. Wayne, (cont.)
1971. Two new *Stenotrema* with notes on *S. hirsutum* and *S. barbatum*. -- 85, 1: 12-17, 1 fig.

GROSSCUP, G., jt. auth. See Roscoe, E.J.

GUNNING, Gerald E. & SUTTKUS, Royal D.
1966. Occurrence and distribution of Asiatic Clam, *Corbicula leana*, in Pearl River, Louisiana. -- 79, 4: 113-116

HAAS, F., jt. auth. See Solem, A.

HABE, Tadashige & ITO, Kiyoshi
1971. New *Ancistrolepis* from the Bering Sea (Buccinidae). -- 84, 3: 84-86, 1 fig.

HABE, T. & KOSUGE, Sadao
1971. New Typhid species from the South China Sea. -- 84, 3: 82-83, 2 figs.

HABE, T., jt. auth. See Robertson, R.

HAMPSON, George R.
1964. Redescription of a commensal pelecypod, *Rochefortia cuneata*, with notes on ecology. -- 77, 4: 125-128, 1 fig.

HANNA, G. Dallas
1962. Olive Hornbrook MacFarland 1872-1962. -- UY, 2: 73-74. (Obituary)

HANNA, Murray
1969. Dispersal of *Helix aspersa* with container grown in nursery stock. -- 82, 4: 145

HARMAN, Walter J., jt. auth. See Dundee, D. S.

HARMAN, Willard N.
1967. Unionid fauna of Canandaigua Lake Outlet, New York. -- 81, 2: 67-68
1968. Replacement of pleurocerids by *Bithynia* in polluted waters of central New York. -- 81, 3: 77-83, 4 figs.
1968. *Valvata piscinalis* in Cayuga Lake, N. Y. -- 81, 4: 143-144
1968. Interspecific competition between *Bithynia* and pleurocerids. -- 82, 2: 72-73
1969. The effect of changing pH on the Unionidae. -- 83, 2: 69-70
1970. *Anodontoides ferussacianus* (Lea) in the Susquehanna River watershed in New York State. -- 83, 3: 114-115

HARMAN, W.N. (Cont.)
1970. Alterations in the molluscan fauna of a meromictic, marl lake. -- 84, 1: 21-30, 1 fig.
1971. Mollusks of Otsego Lake New York -- 85, 2: 70-71

HARMAN, W.N., jt. auth. See Lanciani, C.A.

HEARD, William H.
1963. Reproductive features of *Valvata*. --
1964. *Corbicula fluminea* in Florida. -- 77, 3: 105-107
1964. Litter size in the Sphaeriidae. -- 78 2: 47-49
1966. Subgeneric classification of *Pisidium* in North America. -- 79, 3: 86-89
1966. Further records of *Corbicula fluminea* (Müller) in the southern United States. -- 79, 4: 142-143
1969. Hinge tooth reversals in sphaeriid clams. -- 82, 4: 137-144
1970. Hermaphroditism in *Margaritifera falcata* (Gould) (Pelecypoda: Margaritiferidae). -- 83, 3: 113-114

HEBARD, Edgar B.
1967. Pleistocene mollusks from New Providence Island, Bahamas. -- 81, 2: 41-44

HENDERSON, C., jt. auth. See Ingram, W.M.

HENRARD, J.B.
1964. Identification of *Helix steursiana*. -- 77, 4: 112-116

HERMANN, H.R., jt. auth. See Dundee D.S.

HERMANN, Patti Watt & DUNDEE, D.S.
1964. *Helix aspersa* in Louisiana. -- 78, 1: 16-17
1969. Notes on a light-colored specimen of *Philomycus carolinianus* (Bosc). -- 82, 4: 135-137, 1 fig.

HERMANN, P. W., STRICKLAND Bennie C. & DUNDEE, D.S.
1965. Baton Rouge greenhouse gastropods. -- 78, 4: 131-133

HERMANN, P.W., jt. auth. See Dundee, D.S.

HERRINGTON, H.B.
1965. Corrections of sphaeriid nomenclature. -- 79, 2: 42-45

HERRINGTON, H.B., jt. auth. See Reigle, N.J.

HERRINGTON, H.B. & REIGLE, N.J., Jr.
1967. New Brunswick Sphaeriidae. -- 80, 4: 109-111

HORNING, W.B. & KEUP, L.
1964. Decline of Asiatic clam in Ohio River. -- 78, 1: 29-30

HORNING, W.B., jt. auth. See Keup, L.

HORST, Thomas J. & COSTA, R.R.
1971. Distribution patterns of five selected gastropod species from McCargo Lake. -- 85, 2: 38-43, 3 figs.

HOUBRICK, Joseph
1967. Notes on *Cyclostremiscus schrammi*. -- 80, 4: 131-133, 3 figs.

HUBRICHT, Leslie
1962. *Mesomphix vulgatus* and its allies. -- 76, 1: 1-7, pl. 1, 2 figs.
1963. *Carychium exile* and *Carychium exiguum*. -- 76, 3: 108-109
1963. *Otala lactea* at Vicksburg, Miss. -- 76, 3: 110
1963. *Lyogyrus granum* (Say) in Mississippi. -- 76, 3: 112
1963. Some Succineidae, with a new species. -- 76, 4: 135-138
1963. New species of Hydrobiidae. --76, 4: 138-140, pl. 8
1963. Four new species of *Paravitrea*. -- 76, 4: 140-143, pl. 9
1963. *Notogillia wetherbyi* (Dall) in Alabama. -- 76, 4: 152
1963. *Triodopsis hopetonensis* (Shuttleworth) in the Gulf States. -- 76, 4: 152
1963. The range of *Succinea ovalis*. -- 77, 1: 30-31
1963. *Corbicula fluminea* in the Mobile River. -- 77, 1: 31
1963. Notes on the genus *Discus*. -- 77, 2: 62-63
1964. *Corbicula fluminea* at Vicksburg, Mississippi. -- 77, 4: 143
1964. *Strobilops aenea* west of the Mississippi River. -- 78, 1: 27-28
1964. *Helicodiscus tridens* and *H. aldrichiana*. -- 78, 1: 28
1964. *Stenotrema magnifumosum* in the Cumberland Mountains. -- 78, 2: 70
1965. *Corbicula manillensis* in the Alabama River. -- 78, 3: 106
1965. *Eupera singleyi* in Oklahoma. --78, 3: 106
1965. Notes on Zonitidae. --78, 4: 133-135
1965. Four new land snails from the southeastern United States. --79, 1: 4-7, pl. 2

HUBRICHT, L. (cont.)
1966. Some land snail records from Arkansas and Oklahoma. -- 79, 4: 117-118
1966. *Corbicula manilensis* (Philippi) in the Alabama River system. -- 80, 1: 32-33
1966. Habitat of *Eupera singleyi* Pilsbry. 80, 1: 33
1966. A portable shell collection. -- 80, 1: 33-34
1966. Four new land snails. -- 80, 2: 53-56, pl. 3
1967. Some land snail records from Oklahoma and Arkansas--81, 2: 65-67
1968. The land snails of Mammoth Cave National Park, Kentucky. -- 82, 1: 24-28
1968. Four new species of land snails. -- 82, 2: 63-70, 2 figs.
1969. Revaluation of *Vallonia excentrica*. -- 82, 3: 107-108
1969. *Succinea bakeri* Hubricht. -- 83, 2: 42-44
1971. New Hydrobiidae from Ozark Caves. -- 84, 3: 93-96, 6 figs.
1972. *Gastrocopta armifera* (Say). -- 85, 3: 73-78, 1 fig.

HURLEY, P.A., jt. auth. See Metcalf, A.L.

IMLAY, Marc J.
1968. Resistance of fresh-water operculate snails to desiccation. -- 81, 4: 138-140
1972. Reproduction of *Amblema costata* (Rafinesque) in Moose River, Minnesota. -- 85, 4: 146

INGRAM, William Marcus, KEUP, Lowell, & HENDERSON, Croswell
1964. Asiatic clams at Parker, Arizona. -- 77, 4: 121-125

INGRAM, W.M., jt. auth. See Keup, L.

JACOBSON, Morris K.
1964. On *Rhytidothyra jacobsoni* Alcalde. -- 77, 3: 97-99, 1 pl.
1964. Correction. -- 77, 4: 142 (Correction to 77: 101)
1965. New records for New York and New Jersey. -- 78, 3: 83-86
1965. On some land shells of Eleuthera, Bahamas. -- 78, 4: 120-125
1966. A new *Streptostyla* from Nicaragua. -- 79, 3: 101-103, 1 fig.
1968. On a collection of terrestrial mollusks from Nicaragua. -- 81, 4: 114-119, 2 figs.
1969. On *Lymnaea pseudopinguis* (F. C. Baker). -- 82, 3: 110-112

JACOBSON, M.K., jt. auth. See Clench, W.J.

JACOBSON, M.K. & BOSS, K.J.
1971. On a sinistral Chondropomine from Jamaica. -- 84, 4: 127-128, 1 fig.

JACOBSON, M.K. & CLENCH, W.J.
1971. On some *Helicina* from the Dominican Republic. -- 84, 3: 101-107, 2 figs.

JACOBSON, M.K. & USTICKE, G.
1966. What is *Arca caelata* Reeve? --80, 1: 10-13, 2 figs.

JENSEN, R.H., jt. auth. See Abbott, R.T.

JOHNSON, Donald Lee
1971. Pleistocene land snails on the channel islands, California: a call for research. -- 85, 1: 32-35, 2 figs.

JOHNSON, Richard I.
1967. *Carunculina pulla* (Conrad), an overlooked Atlantic drainage unionid. -- 80, 4: 127-131, 4 figs.
1968. *Elliptio nigella*, overlooked unionid from Apalachicola River system. -- 82, 1: 22-24, 6 figs.
1969. The Unionacea of William Irvin Utterback. -- 82, 4: 132-135
1969. Further additions to the unionid fauna of the Gulf drainage of Alabama, Georgia and Florida. --83, 1: 34-35
1969. Illustrations of Lamarck's types of North American Unionidae, mostly in the Paris Museum. -- 83, 2: 52-61, figs. 1-14

JOHNSON, Robert L., jt. auth. See Tuthill S. J.

JONES, David T.
1965. Collections deposited. -- 78, 3: 108. (Jones and Eggleston collections deposited in Ohio State Museum, Columbus, Ohio)

JOY, James E.
1971. The influence of light conditions upon the egg-laying of the planorbid snail, *Biomphalaria glabrata*. -- 85, 2: 43-49, 5 figs.

JUNG, Peter
1971. *Strombus gigas* Linnaeus from the Bowden Formation, Jamaica. --84, 4: 129-131, 1 fig.
1972. The collection of Karl Mayer-Eymar. -- 85, 4: iii after 146

KAICHER, Sally Diana
1972. A second ovoviviparous *Nassarius*. -- 85, 4: 126-128, 3 figs.

KAY, E. Alison
1965. The Reverend John Lightfoot, Daniel Solander, and the Portland Catalogue. -- 79, 1: 10-19

KEKAUOHA, Willard
1966. Life history and population studies of *Achatina fulica*. -- 80, 1: 3-10
1966. Life history and population studies of *Achatina fulica* (Continued from July number). -- 80, 2: 39-46, 1 fig.

KEUP, Lowell, HORNING, W. B., & INGRAM, William M.
1963. Extension of range of Asiatic Clam to Cincinnati reach of the Ohio River. -- 77, 1: 18-21

KEUP, L., jt. auth. See Horning, W. B.; Ingram, W.M.

KEVERN, Niles, jt. auth. See Brunson, R.B.

KLAPPENBACH, Miguel A.
1964. A new species of *Olivancillaria* from Uruguay and Brazil. -- 77, 4: 132-134, pl. 8

KONDO, Yoshio
1964. Growth rates in *Achatina fulica* Bowdich. -- 78, 1: 6-15
1968. Partulidae: preview of anatomical revision. -- 81, 3: 73-77

KOSUGE, S., jt. auth. See Habe, T.

KRAKAUER, Janet M.
1971. The feeding habits of Aplysiid opisthobranchs in Florida. -- 85, 2: 37-38

KRAUSS, N. L. H.
1964. Investigation on biological control of Giant African *(Achatina fulica)* and other land snails. -- 78, 1: 21-27

KRIEGER, K. A.
1972. *Somatogyrus alcoviensis*, new gastropod species from Georgia (Hydrobiidae). --85, 4: 120-125, 4 figs.

KRUCZYNSKI, William L. & PORTER, Hugh J.
1969. A new northern record for *Bursatella leachii pleii* Rang (Opisthobranchia), with notes on its biology. -- 83, 2: 40-42

LAIRD, W.M., jt. auth. See Tuthill, S.J.

LANCIANI, Carmine A. & HARMAN, Willard N.
1968. Snail shells as oviposition sites of water mites. -- 82, 1: 34-35

LANG, Bruce Z.
1968. Note on the ecology of *Goniobasis proxima* in North Carolina. -- 82, 1: 3-5

LANG, B.Z. & DRONEN, Norman O., Jr.
1970. Eggs and attachment sites for egg capsules of *Valvata lewisi*. -- 84, 1: 9-12, 3 figs.

LEONARD, A. Byron
1972. New gastropods from the Pleistocene of Illinois. -- 85, 3: 78-84, 9 figs.

LEVIN, N.L., jt. auth. See Schaefer, C.W.

LEWIS, Hal, jt. auth. See Abbott, R. T.

LITTLE, John W. & GENTNER, Harry W.
1970. Growth of *Amblema perplicata* Conrad (Pelecypoda) in a Texas River. -- 84, 1: 16-21, 2 figs.

LITTLE, M.D., jt. auth. See Malek, E.A.

LYONS, William G.
1972. A new *Fasciolaria* from the northeastern Gulf of Mexico. -- 85, 3: 96-100, 1 fig.

MACKENTHUN, K. M., jt. auth. See Thomas, N. A.

MacNEIL, F. Stearns
1970. New Pliocene *Chlamys (Swiftopecten)* and *Beringius* from the Alaska Peninsula. --84, 2: 69-74, figs. 1-5

MAES, Virginia Orr
1966. Sexual dimorphism in the radula of the muricid genus *Nassa*. -- 79, 3: 73-80, pl. 5, 2 figs.
1967. Radulae of two species of *Pleuroploca* (Fasciolariidae) from the Indo-Pacific. -- 81, 2: 48-54, 6 figs.

MALEK, Emile A. & CHROSCIECHOWSKI, P.
1964. *Lymnaea (Pseudosuccinea) columella* from Venezuela, and notes on distribution of *Pseudosuccinea*. -- 78, 2: 54-56

MALEK, E.A. & LITTLE, M.D.
1971. *Araopyrgus colombiensis* n. sp. (Gastropoda: Hydrobiidae), snail intermediate host of *Paragonimus caliensis* in Colombia. -- 85, 1: 20-26, 2 figs.

MALONE, Charles R.
1965. Dispersal of aquatic gastropods via the intestinal tract of water birds. -- 78, 4: 135-139

MARCUS, Ernst
1964. A new species of *Polycera* (Nudibranchia) from California. --77, 4: 128-131, 4 figs.

MASTERS, Frank
1968. Marine technology Society. -- 81, 4: 143

MATTESON, Max R. & DEXTER, Ralph W.
1966. Changes in pelecypod populations in Salt Fork of Big Vermilion River, Illinois, 1918-1962. -- 79, 3: 96-101

McCLARY, Andrew
1965. *Helix pomatia* in Wisconsin. --79, 1: 35-36

McCOY, C.J., Jr., jt. auth. See Branson, B. A.

McGINTY, Thomas L.
1962. Caribbean marine shells. -- 76, 2: 39-44, pl. 3

McMICHAEL, Donald F.
1964. The genus *Amimopina* Iredale, 1933. -- 78, 2: 52-54

McMILLAN, Nora F. & FOGAN, Marjorie
1966. Anonymous catalog of Ohio River Uniones. -- 80, 1: 20-21

MEAD, A. R., jt. auth. See Miles, C. D.

MENZEL, R. W.
1968. Chromosome number in nine families of marine pelecypod mollusks. -- 82, 2: 45-50, 53-58, 17 figs.

MERRILL, Arthur S.
1963. Mollusks from a buoy off Georgia. -- 77, 2: 68-70
1970. *Fluxina* Dall is a *Calliostoma* Swainson. -- 84, 1: 32-34

MERRILL, A.S., jt. auth. See Baker, E.B.; Ropes, J. W.

MERRILL, A.S. & BOSS, Kenneth J.
1964. Reactions of hosts to proboscis

MERRILL, A.S. & BOSS, K.J. (cont.)
penetration by *Odostomia seminuda* (Pyramidellidae). -- 78, 2: 42-45, pls. 4, 5

MERRILL, A. S. & PETIT, Richard E.
1965. Mollusks new to South Carolina. -- 79, 2: 58-66
1969. Mollusks new to South Carolina: II. -- 82, 4: 117-122

MERRILL, A.S. & PORTER, Hugh S.
1966. Further note on distribution of Cymatiidae in Western Atlantic. -- 80, 1: 31-32

METCALF, Artie L.
1966. *Corbicula manilensis* in the Mesilla Valley of Texas and New Mexico. -- 80, 1: 16-20

METCALF, A.L. & HURLEY, Patricia A.
1971. A new *Ashmunella* (Polygyridae) from Doña Ana County, New Mexico. -- 84, 4: 120-127, 2 figs.

METCALF, A.L. & SMARTT, Richard
1972. Records of introduced mollusks: New Mexico and western Texas. -- 85, 4: 144-145

MICHELSON, Edward H.
1968. Permanent whole-mounts of snail genitalia. -- 81, 3: 106-107
1969. Concerning Rawson's *Physa*. -- 83, 1: 36

MILCH, F., jt. auth. See Schaefer, C.W.

MILES, Charles D. & Mead, Albert R.
1963. Type material of the slug *Pallifera pilsbryi*. -- 76, 3: 112-113

MILLER, Bruce A.
1968. Field method for following locomotory activities of sand-burrowing gastropods. -- 81, 3: 102-103

MILLER, Walter B.
1966. Three new *Sonorella* from southwest Arizona. -- 80, 2: 46-52, pls. 1, 2
1967. Two new *Sonorella* from Sonora, Mexico. -- 80, 4: 114-119, pl. 6, 7
1967. Two new *Sonorella* from Sonora, Mexico, and notes on southern limit of genus. -- 81, 1: 1-6, pl. 1, figs. A-H
1968. New *Sonorella* from Arizona. -- 82, 2: 50-52, 59-63
1969. A new *Sonorella* from the Salt River Mountains of Phoenix, Arizona. -- 82, 3: 87-89, 1 fig.

MILLER, W.B. (cont.)
1971. The reproductive anatomy of *Tryonigens remondi* (Tryon, 1863): Helminthoglyptidae. -- 85, 2: 61-65, 2 figs.
1972. *Greggelix*, a new genus of autochtonous land snails (Helminthoglyptidae). 85, 4: 128-135, 4 figs.

MILLER, W.B., jt. auth. See Gregg, W.O.

van MOL, J.-J. & TURSCH, B.
1968. Distinctions between *Conus juliae*, *C. daucus* and *C. brasiliensis*. -- 82, 1: 5-6

MOORE, Donald R.
1965. New species of Vitrinellidae from Gulf of Mexico and adjacent waters. -- 78, 3: 73-79, pl. 7, 8
1969. A new *Caecum* from the tropical Western Atlantic. -- 83, 1: 26-28, 1 fig.
1971. A deep water *Omalogyra* in the Western Atlantic. -- 84, 4: 113-117, 1 fig.

MOORE, D.R. & BOSS, K.J.
1966. Records for *Parabornia squillina*. -- 80, 1: 34-35

MORRISON, Joseph P. E.
1963. *Cecina* from the state of Washington. -- 76, 4: 150-151
1964. Notes on American Melampidae. -- 77, 4: 119-121
1964. Formation of an epiphragm and true aestivation in Melampidae. -- 77, 4: 139-140
1971. *Athearnia*, new name for a genus of pleurocerid snails. -- 84, 3: 110-111

MORSE, M. Patricia
1969. On the feeding of the nudibranch, *Coryphella verrucosa rufibranchialis*, with a discussion of its taxonomy. -- 83, 2: 37-40

MOYER, William W.
1965. Brief census of log-associated snails in Berks County, Pennsylvania. -- 78, 3: 107-108

MURRAY, Harold D.
1968. *Otala lactea* in San Antonio, Texas. -- 81, 4: 141-143
1971. New records of *Corbicula manilensis* (Philippi) in Texas. -- 85, 1: 35-36

MURRAY, H.D. & WILEY, Sally
1968. New locality for *Limax marginatus*. -- 81, 3: 105-106

MYERS, Paul Robert & FRANZEN, Dorothea S.
1970. Histological studies on the nephridium and pericardial lining of *Quadrula nodulata*. -- 83, 4: 139-144, 4 figs.

NICOL, David
1964. Lack of shell-attached pelecypods in Arctic and Antarctic waters. -- 77, 3: 92-93
1964. The present not always key to the past. -- 78, 1: 17-18
1965. A new *Thyasira* (Pelecypoda) from the Ross Sea, Antarctica. -- 78, 3: 79-80, pl. 8
1965. An ecological analysis of four Permian molluscan faunas. -- 78, 3: 86-95
1965. Ecologic implications of living pelecypods with calcareous spines. -- 78, 4: 109-116
1966. Size of pelecypods in Recent marine faunas. -- 79, 4: 109-113
1967. How to distinguish between *Limopsis* and *Glycymeris*. -- 81, 2: 45-46
1968. A new *Meiocardia* (Pelecypoda, Glossidae) from the Eocene of Florida. -- 81, 3: 89-93 5 figs.
1968. Are pelecypods primarily infaunal animals? -- 82, 2: 37-43
1969. *Meiocardia floridana*, an overlooked Eocene pelecypod. -- 82, 4: 115-116
1970. Mode of life of *Conocardium*, a Paleozoic pelecypod. -- 83, 3: 77-80, 5 figs.
1970. Pelecypods, successful invaders of the infauna. -- 84, 2: 75-76 and iii after 76

OLD, William E., Jr.
1965. On the identity of *Conus pastinaca*. -- 79, 1: 23-26, pl. 3
OLD, W.E., Jr., jt. auth. See Emerson, W. K.

PAGOT, Oliver E.
1967. Unitas Malacologica Europaea. -- 81, 1: 35

PANITZ, Eric
1965. Paleoecologic interpretation and the import of Recent faunas. -- 79. 2: 45-47

PARODIZ, J. J.
1962. On South Atlantic Columbellidae. -- 76, 2: 74 and iii after 74

PARODIZ, J.J. (cont.)
1963. New fresh-water Mollusca from the Eogene of Chile and Patagonia. -- 76, 3: 145-148, pl. 11
1966. Two new subspecies of *Potamolithus*. -- 80, 2: 56-58, pl. 4

PERCHARDE, Peter L.
1972. Observations on the gastropod, *Charonia variegata*, in Trinidad and Tobago. -- 85, 3: 84-92, 3 figs.

PETERS, L., jt. auth. See Branson, B. A.

PETIT, R.E., jt. auth. See Merrill, A. S.

PHILLIPS, P. H., jt. auth. See Dundee, D.S.

PORTER, Clarence A.
1965. *Cassis madagascariensis spinella* off North Carolina coast. -- 78, 3: 106
1965. Comparison of genitalia of two sympatric species of *Haplotrema*. -- 79, 1: 19-23, 3 figs.

PORTER, Hugh J.
1970. The occurrence of Cymatiidae and Cypraeidae in North Carolina. -- 84, 1: 1-8

PORTER, H.J., jt. auth. See Kruczynski, W. L.; Merrill, A. S.

PRATT, William Lloyd, Jr.
1964. Two eastern land snails new to Texas. -- 78, 1: 31-32
1964. *Anguispira alternata crassa* Walker. -- 78, 1: 32
1964. Some Texas localities for Helicidae. -- 78, 1: 32-33
1965. Notes on land snail distribution in Texas. -- 78, 4: 142-143
1965. Carnivorous habits in *Mesodon indianorum* (Pilsbry). -- 78, 4: 143
1965. Additional locality for *Mesodon kiowaensis*. -- 78, 4: 143
1965. Sinistral *Mesodon roemeri*. -- 78, 4: 143-144
1965. An introduced slug new to Texas. -- 78, 4: 144

RADWIN, George E.
1968. The systematic position of *Glyptaesopus*. -- 82, 1: 18-19, figs. A-E

RAWLS, Hugh C.
1969. Concerning the type locality of *Micrarionta rowelli hutsoni* (Clapp). 82, 3: 83-87

RAWLS, H.C. & BAUM, John M.
1971. Fluorescence in *Mesodon clausus* (Say). -- 85, 2: 65-67

RAWLS, H.C. & YATES, Roger L.
1971. Fluorescence in endodontid snails. 85, 1: 17-20

REIGLE, Norman J.
1962. Sinistral Polygyridae. -- 76, 1: 36-37
1963. Northern records of *Gastrocopta procera*. -- 77, 1: 16-18, 1 fig.

REIGLE, N. J., jt. auth. See Herrington, H.B.

REIGLE, N. J. & HERRINGTON, H. B.
1967. Localities for New Brunswick land mollusks. -- 80, 3: 102-105

RICHARDS, C. S.
1964. Apertural lamellae as supporting structures in *Australorbis glabratus*. -- 78, 2: 57-60, 1 fig.

RISER, Nathan W.
1969. Feeding behavior of some New England marine gastropods. -- 82, 3: 112-113

ROBERGE, Armand G.
1968. *Odostomia dianthophila* (Gastropoda, Pyramidellidae) from Buzzard's Bay, Mass., a northern range extension. -- 81, 4: iii after 144

ROBERTSON, Robert
1963. Bathymetric and geographic distribution of *Panopea bitruncata*. -- 76, 3: 75-82, 1 fig.
1963. *Brachystyloma* Weisbord a synonym of *Anachis* H. & A. Adams (Columbellidae). -- 77, 1: 32

ROBERTSON, R. & HABE, Tadashige
1965. *Alexania* replaces *Habea* (Epitonidae). -- 78, 4: 140-141

ROPES, John W.
1966. *Pitar morrhuana*, new host for *Malacobdella grossa*. -- 79, 4: 129-131, 2 figs.
1972. Chromosome number of the surf clam, *Spisula solidissima*. -- 85, 3: 93-95, 1 fig.

ROPES, J.W. & MERRILL, A.S.
1967. *Malacobdella grossa* in *Pitar morrhuana* and *Mercenaria campechiensis*. -- 81, 2: 37-40, 1 fig.

ROSCOE, Ernest J.
1962. Additional Wisconsin records of *Viviparus contectoides*. -- 76, 1: 36
1963. Some Goniobases in Western United States. -- 77, 2: 43-47

ROSCOE, E.J. & GROSSCUP, Gordon
1964. Mollusca from East Tavaputs Plateau, Grand County, Utah. -- 77, 3: 93-97

ROSE, Kenneth D.
1972. A mollusk new to Lake Birket Qarun, Egypt. -- 85, 4: 141-143

ROSEWATER, Joseph
1963. Resistance to desiccation in dormancy by *Tectarius muricatus*. -- 76, 3: 111
1966. Reinstatement of *Melarhaphe* Menke, 1828. -- 80, 2: 37-38
1969. George Mitchell Moore. 1906-1968. -- 83, 1: iii after 36 (Obit.)
1970. Another record of insect dispersal of an ancylid snail. -- 83, 4: 144-145

ROSS, Landon T.
1964. The land mollusks of Siesta Key, Sarasota County, Florida. -- 78, 2: 50-52
1965. Two new land mollusk records from Florida. -- 79, 2: 70-71
1966. *Lehmannia* in Massachusetts. -- 80, 2: 71-72

ROTH, Barry
1970. Names proposed by Leo George Hertlein. -- 84, 2: 52-69

ROTH, Barry, and others
1970. Taxa proposed in honor of Leo George Hertlein from 1926 to 1969. --

ROTH, Barry & CARLTON, James T.
1970. A forgotten periodical of West American Conchology. -- 84, 1: 31-32

ROTH, Barry, & CLOVER, Phillip W.
1972. Locomotion of *Marginella oliviaeformis* Kiener. -- 85, 3: 110

ROWAN, W.B.
1966. Autumn migration of *Helisoma trivolvis* in Montana. -- 79, 3: 108-iii

RUSSELL, Henry D.
1964. New England nudibranch notes. -- 78, 2: 37-42

RUSSELL, H.D. (cont.)
1966. Kelaart's Ceylon Opisthobranch species. -- 79, 4: 120-122
1968. *Chromodoris californiensis* and *C. calensis*. -- 81, 4: 140-141

RUSSELL, Richard H.
1967. A new subspecies of *Lymnaea stagnalis* from Montana. -- 80, 4: 125-126, pl. 9
1971. The appearance of *Pseudosuccinea columella* (Say) in Arizona. -- 85, 2: 71
1972. The type locality of *Stagnicola montanensis* (Baker) 1913. -- 85, 4: 145

RUSSELL, R.H., jt.auth. See Brunson, R.B.

RUSSELL, R.H. & BRUNSON, R.B.
1967. *Acroloxus coloradensis* from Montana. -- 81, 1: 33

SARASUA, Hortensia
1969. A double tentacle in *Viana regina* (Morelet) (Mollusca: Prosobranchia: Helicinidae). -- 82, 4: 126-127, 1 fig.

SCHAEFER, Carl W.
1969. Feeding and chemoreception in mud-snail *Nassarius obsoletus*. -- 82, 3: 108-109

SCHAEFER, C.W., LEVIN, Norman L., & MILCH, Peter
1968. Death from desiccation in the mud-snail, *Nassarius obsoletus:* effects of size. -- 82, 1: 28-31

SCHAEFER, C.W., MILCH, P., & LEVIN, N.L.
1968. Death from desiccation in the mud-snail, *Nassarius obsoletus:* effect of temperature. -- 81, 4: 109-114

SCHELTEMA, Amelie H.
1965. Two gastropod hosts of the pyramidellid gastropod *Odostomia bisuturalis*. -- 79, 1: 7-10, 1 fig.

SCHELTEMA, Rudolf S.
1964. Reproduction of *Nassarius trivittatus* off the coast of Georgia. -- 78, 2: 49-50

SCHNEIDER, Robert F.
1967. Range of the Asiatic Clam in Florida. -- 81, 2: 68-70

SCOTT, D.C., jt. auth. See Thomas, G.J.

SHASKY, Donald R.
1966. Range and bathymetric extensions for *Olivella inconspicua* and *Nassarius limacinus*. -- 80, 1: 35-36

SHAW, William N.
1963. A method of tagging channelled whelks. -- 77, 1: 28-29, pl. 4, part.

SHOEMAKER, Alan H.
1971. *Strombus* range extensions. -- 85, 2: 72

SHUSTER, Carl N., jt. auth. See Tubiash, H. S.

SINE, Terry L.
1966. *Cecilioides acicula* (Müller) in Kutztown, Berks County, Pennsylvania. -- 79, 4: 138

SMALLEY, Alfred E.
1970. *Littorina* in Louisiana. -- 84, 1: 35-36

SMARTT, R., jt. auth. See Metcalf, A.L.

SMITH, Allyn G.
1966. Harold Hannibal 1889-1965. -- 80, 1: 29
1971. New record for a rare Galápagos land snail. -- 85, 1: 5-8, 1 fig.

SOLEM, Alan
1970. Fritz Haas 1886-1969. -- 83, 4: 117-120, portrait

SOLEM, A. & HAAS, Fritz
1964. *Adelopoma costaricense* Bartsch & Morrison, 1942, not an inhabitant of the United States. -- 78, 2: 68-69

STANSBERY, D.H., jt. auth. See Clench, W. J.

STEWART, W.C., jt. auth. See Boss, K.J.

STRICKLAND, B.C., jt. auth. See Hermann, P.W.

SUBBA RAO, D. V.
1969. Occurrence of *Cymbulia peroni* de Blainville, a pseudothecosomatous pteropod, in the Bay of Bengal. -- 82, 4: 123-125, 1 fig.

SUMMERS, Ray & BURGESS, C.M.
1965. A new *Cypraea* from Easter Island. -- 79, 2: 41-42, pl. 4, part

SUTTKUS, R.D., jt. auth. See Gunning, G.E.

TALMADGE, Robert R.
1963. Revision of a West African Haliotid. -- 77, 2: 55-58
1967. Notes on coastal land snwils. -- 80, 3: 87-89

TESKEY, Margaret C.
1962. American Malacological Union Meetings, 1962. -- 76, 2: 71-73
1963. Further comment on the debated species, *Strombus canaliculatus* Burry. -- 76, 3: 111-112
1963. American Malacological Union Twenty-ninth Annual Meeting. -- 77, 2: 70-72
1964. A.M.U. at New Orleans. -- 77, 4: 145
1964. American Malacological Union, Inc. -- 78, 2: 62-64
1965. American Malacological Union Thirty-first Annual Meeting. -- 79, 2: 68-69
1967. Thirty-second Annual Meeting of the American Malacological Union. -- 80, 3: 105-106
1967. The American Malacological Union. -- 81 2: 70-71
1968. Thirty-fourth Annual Meeting of the American Malacological Union. -- 82, 2: 70-71
1969. The Thirty-fifth Annual Meeting of the American Malacological Union. -- 82, 3: 106

THOMAS, Grace Jean
1963. Study of a population of sphaeriid clams in a temporary pond. --77, 2: 37-43, 3 figs.
1965. Growth in one species of sphaeriid clam. -- 79, 2: 47-54, R figs.

THOMAS, G.J. & SCOTT, Donald C.
1965. Note on *Elliptio spinosa* in Georgia. -- 79, 2: 66-67

THOMAS, M.L.H.
1967. *Thracia conradi* in Malpeque Bay, Prince Edward Island. -- 80, 3: 84-87

THOMAS, N.A. & MACKENTHUN, K.M.
1964. Asiatic clam infestation at Charleston, West Virginia. --78, 1: 28-29

THOMAS, Ronald Frank
1971. A scanning electron microscope study of the marginal teeth of *Nerita peloronta* Linnaeus. -- 84, 4: 118-119, 4 figs.

THOMPSON, Fred G.
1962. A new endodontid land snail from Guatemala. -- 76, 1: 23-25, 1 fig.
1963. Two Mexican species of *Guillarmodia* s. s. -- 76, 3: 95-99, 4 figs.
1963. Correction of the type locality of *Euglandina dorsalis*. -- 77, 2: 72
1966. A new Pomatiasid from Chiapas, Mexico. -- 80, 1: 24-28, 7 figs.
1967. New helicid snail from Zscatecas, Mexico. -- 81 1: 22-25, figs. 1-4, A-B
1967. Two new species of *Pachycheilus* from northeastern Mexico. -- 81, 1: 25-31, 15 figs.
1968. Two noteworthy achatinids from Panama. -- 81 3: 105
1969. *Bulimulus unicolor* and *Bulimulus ocraspiris*. -- 82, 3: 106-107

TOWNES, George F.
1971. Protection of the type locality of *Clappiella saludensis* (Morrison). -- 85, 1: 36-iii after 36

TUBIASH, Haskell S., SHUSTER, Carl N., Jr., and COUCH, John A.
1968. Anomalous siphons in two species of bivalve mollusks. -- 81, 4: 123-125, 3 figs.

TURNER, R.D., jt. auth. See Clench, W.J.

TURSCH, B., jt. auth. See van Mol, J.-J.

TUTHILL, Samuel J. & Johnson, Robert L.
1969. Nonmarine mollusks of the Katalla region, Alaska. -- 83, 2: 44-52

TUTHILL, S. J. & LAIRD, Wilson M.
1963. Molluscan fauna of some alkaline lakes and sloughs in southern central North Dakota. -- 77, 2: 47-55, 2 figs.; 77, 3: 81-90, fig. 2

USTICKE, G., jt. auth. See Jacobson, M.K.

VOKES, Harold E. & VOKES, Emily H.
1962. Pelecypods from Barra de Navidad, Mexico. -- 76, 2: 61-63

VOKES, E.H., jt. auth. See Vokes H.E.

WAKEFIELD, R.H., jt. auth. See Getz, L.L.

WALTON, Munroe L.
1963. Length of life in West American land snails. -- 76, 4: 127-131
1970. Longevity in *Ashmunella, Monadenia* and *Sonorella* -- *83, 3: 109-112*

WARMKE, Germaine L.
1964. A new Caribbean muricid mollusk,

WARMKE, G.L. (cont.)
Typhis puertoricensis. -- 78, 1: 1-3, pl. 1
1966. Two species of the bivalve gastropod *Berthelinia* found in Puerto Rico. -- 79, 4: 139-141

WARMKE, G.L. & ERDMAN, Donald S.
1963. Records of marine mollusks eaten by Bonefish in Puerto Rican waters. -- 76, 4: 115-120, 2 figs.

WEBB, Glenn R.
1964. Stream dispersal of *Mesodon*. -- 78, 1: 30
1964. Courtship between two species of *Helminthoglypta*. -- 78, 1: 30-31
1964. Freezing versus *Polygyra septemvolva* Say. -- 78, 1: 31
1965. Matings between *Polygyra cereolus carpenterianus* and *P. septemvolvis*. -- 79, 1: 34-35
1966. Courtship between *Monadenia fidelis* and *M. infumata*. -- 79, 3: 103-105
1966. *Haplotrema concavum* vs. *Deroceras gracile*. -- 79, 4: 143
1966. Land snail resistance to cold. -- 80, 1: 29
1966. Birth frequency in *Lsctecluna selenina* (Gould). -- 80, 1: 29-30
1966. Copulations between *Xolotrema (Wilcoxorbis) fosteri* and *Triodopsis tridentata frisoni*. -- 80, 1: 30-31
1967. Erotology of three species of *Praticolella*, and of *Polygyra pustula*. -- 80, 4: 133-140, figs. 1-6, 8, 11
1967. Erotology of three species of *Praticolella*, and of *Polygyra pustula*. -- 81, 1: 11-18, figs. 18-32
1967. Ecology of *Bulimulus dealbatus* at Everman, Texas. -- 81, 1: 34-35
1968. Attempted sinistral - dextral mating. -- 82, 2: 76
1968. Intraspecies aggression. -- 82, 2: 76

WEISBORD, Norman E.
1967. Further comments on *Brachystyloma csribbeana*. -- 80, 4: 143-144

WELLS, Harry W.
1969. Hydroid and sponge commensals of *Cantharus cancellarius* with a 'false shell.' -- 82, 3: 93-102, 4 figs.

WELLS, H.W. & WELLS, Mary Jane
1969. New host and distribution records of *Odostomia dianthophila*. -- 82, 3: 109-110

WELLS, M.J., jt. auth. See Wells, H.W.

WHEELER, Mary J.
1963. Type of *Unio luteolus* Lamarck, 1819. -- 77, 2: 58-61, 1 pl.

WIGLEY, Roland L.
1966. New records of *Cadulus* (Scaphopoda) from the New England area. -- 79, 3: 90-96, 3 figs.

WILEY, S., jt. auth. See Murray, H.D.

WILSON, E.O., jt. auth. See Eisner T.

WOEMMEL, John R.
1966. Unione peeling. --79, 4: 141-142.

WOLFE, Douglas A.
1967. *Cassis madagascariensis* and *C. m. spinella* offshore at Beaufort, North Carolina. -- 81, 2: 47-48

WOODRING, Wendell P.
1964. *Psilarius*, new name for *Leptarius* Woodring, 1964, not *Leptarius* Gill, 1864 (Gastropoda, Nassariidae). -- 77, 4: 143

WURTZ, Charles B.
1962. Zinc effects on fresh-water mollusks. -- 76, 2: 53-61

WURTZ, C.B., jt. auth. See Abbott, R.T.

YATES, R.L., jt. auth. See Rawls, H.C.

ZEIGLER, Rowland, F.
1969. Two infrasubspecific forms in *Oliva*. -- 83, 1: 14-19, 2 figs.

ANONYMOUS
1963. New mollusk research journal. -- 76, 3: 109-110 (Malacologia)
1963. Publications received, 1960. -- 76, 3: 113-114
1963. Publications received, 1962. -- 77, 1: 35-36
1963. Dr. Merrill E. Champion. -- 77, 2: 72
1964. Publications received. -- 77, 3: iii
1964. Richard Winslow Foster. -- 78, 2: 70. (Obit. note)
1964. Abstract reports on oceanography. -- 78, 2: 68
1965. No title (Obit. note: Albert B. Bronson). -- 78, 4: 144
1966. Dr. Leslie Reginald Cox. --79, 4: 136

ANONYMOUS (cont.)
1967. Pedro de Mesa. --80, 3: 108 (Obit. note)
1967. Joyce Allan. -- 80, 4: 141 (Obit. note)
1968. Margaret M. Teare. -- 81, 3: 101 (Obit. note)
1969. (No title; change of editors of the Nautilus). 83, 1:iii after 36
1969. (No title; Wolfgang C. Sterrer, new director of Bermuda Biological Station). -- 83, 2: 66
1969. Johannes C.L. van der Riet. 1920-1969. -- 83, 2: 66 (Obit.)
1969. (No title; George M. Davis, Associate Curator of Malacology at ANSP 1970). -- 83, 2: 67
1969. The American Malacological Union's 35th annual meeting. .... -- 83, 2: 67-68
1970. Percy A. Morris .... -- 83, 3: 116 (Obit. note)
1970. A symposium on the Indian Ocean and adjacent seas ....-- 83, 4: 146
1970. d'Alte Aldridge Welch. -- 83, 4: 146 (Obit.)
1970. Dates of the Nautilus. -- 84, 1: 36
1970. A Newsletter, entitled *Achatina* .... -- 84, 1: 36
1970. (George F. Kline, obit.) --84, 2: iii after 76
1971. (Fourth Annual Meeting of the Western Society of Malacologists). --84, 3: 111-112
1971. (Fourth European Malacological Congress). -- 84, 3: 112
1971. (Ernest Marcus, 1893-1968, obit.) -- 84, 3: 112
1971. Green Snail protected. -- 84, 4: 144
1971. (Obit., G. Dallas Hanna). -- 84, 4: 144
1971. (Obit. Dennis Harper Kennelly). -- 84, 4: 144
1971. (Obit. Harold Sellers Colton). -- 84, 4: 144
1971. (Obit. Gunnar Thorson). -- 84, 4: 144
1971. Dates of the Nautilus. -- 85, 1: iii after 36
1972. The Western Society of Malacologists. -- 85, 3: 109-110

OBITUARIES IN THE NAUTILUS,

VOLUMES 76 - 85

ALLAN, Joyce (-1966) 80, 4: 141
BAILY, Ruth Ingersoll (-1965) 78, 4: 139
BAKER, Edwin Perry (1891-1966) 80, 2: 69-70
BAKER, Horace Burrington (1889-1971) 84, 4: 113; 85, 1: 1
BARNARD, Keppel Harcourt (-1964) 78, 3: 104
BRONSON, Albert B. (-1965) 78, 4: 144
CHAMPION, Merrill E. (-1963) 77, 2: 72
COATS, Ruth E. (1911-1966) 80, 4: 140
COLTON Harold Sellers (-1970) 84, 4: 144
COX, Leslie Reginald (-1965) 79, 4: 136
FOSTER, Richard Winslow (-1964) 78, 2: 70
FRAMPTON, Henry G. (1902-1966) 81, 1: 31
GRAU, Gilbert (1906-1969) 83, 2: 66
HAAS, Fritz (1886-1969) 83, 4: 117
HANNA, G. Dallas (-1970) 84, 4: 144
HANNIBAL, Harold (1889-1965) 80, 1: 29
HERTLEIN, Leo George (1898-1972) 84, 2: 37; 85, 4: iii after 146
KENNELLY, Dennis Harper (-1971) 84 4: 144
KLINE, George F. (1907-1970) 84, 2: iii after 76
MacFARLAND, Olive Hornbrook (1872-1962), 76, 2: 73
MARCUS, Ernest (1893-1968) 84, 3: 112
de MESA, Pedro (-1966) 80, 3: 108
MOORE, George Mitchell (1906-1908) 83, 1: iii after 36
MORRIS, Percy A. (1899-1969) 83. 3: 116
NIELSON, Ted (1928-1965) 79, 3: iii inside back cover
van der RIET, C.L. (1920-1969) 83, 2: 66
SMITH, Maxwell (1888-1961) 76, 1: 33-34
TEARE, Margaret M. (-1967) 81, 3: 101
THORSON, Gunnar (-1971) 84, 4: 144
TOBLEMAN, Fred R. (1892-1968) 82, 2: 72
TURVER, Harry R. (1892-1968) 82, 2: 72
WELCH, d'Alte Aldridge (1907-1970) 83, 4: 146
YEN, John Teng-Chien (1903-1972) 85, 4: iii after 146

PRIMARY AND SECONDARY INFLUENCING AGENTS ON GASTROPOD POPULATIONS OF THREE HABITATS IN WASHINGTON STATE

L. DANIEL MYERS

Foundation for Illinois Archeology

INTRODUCTION

The effects of the micro-environment upon the population size of snails has for many years been recognized by malacologists. Accordingly, an attempt has been made to determine the primary and secondary limiting factors which influence the numbers of gastropods within specific areas.

The purpose of this investigation was twofold: the first was to examine the possible primary and secondary influencing agents within the soil which affect the population size of snails. The second was to identify some of the snails indigenous to the northwestern portion of the state of Washington.

Sampling was done in Skagit County, Washington, on November 12, 1971. This county, bordered by the Cascade Mountain Range to the east and Puget Sound to the west, is noted for its moderate climate and abundant rainfall (26.6 inches per year) throughout most of the year. The general areas sampled are located in Township 34 North, Range 3 East, west of the city of Burlington. Specific areas sampled were three micro-habitats: a Red Alder *(Alnus)* stand, a Western Red Cedar *(Thujus plicata)* stand and a Douglas Fir *(Pseudotsuga menziesii)* stand. The first two, the Alder and Cedar habitats, are located five miles west of Burlington and the Fir habitat is three miles farther west.

METHODS

It was first necessary to select a general area in which the macro-environment could be considered constant. Such is the case with the Skagit County area. Although this was restrictive in that it allowed only for sampling within a small area, it was advantageous in that only micro-environmental variability had to be taken into account.

After the selection of the Skagit area, further restrictions were placed upon the specific areas to be sampled. The focal point chosen was a decomposing tree of a species particular to that area. Two other prerequisites were also placed upon this selection. The first was that no other species of tree would be within the immediate area of the focal point. Secondly, the focal point would be located upon a level ground area (allowing drainage and exposure to the sun to be considered as constants).

Starting from the focal point four areas, based on direction (North, East, South, and West) were sampled approximately five feet from the foci. In each area two samples, one for soil analysis, the other for gastropod interpretation, were taken from a one square foot area. As each sample was extracted it was placed in a plastic container, sealed, and labeled.

In the laboratory, samples were placed

on drying sheets and allowed to stand for three days. Soil samples were then run through a forty mesh screen and then transferred to individual containers. In all, fifteen samples were analyzed, five from each habitat, four being the original samples, the fifth a composite of the four.

A LaMotte Soil Analysis kit was used in the actual analysis. This particular kit was originally designed to measure fifteen properties within the soil. Of the fifteen, ten were analyzed, and six were used for purposes of this paper. These six are soil acidity (pH), phosphorus, potassium, humus, calcium carbonate, and magnesium, all considered macro-properties within the soil.

The gastropods were studied by water screening the samples and then sorting through the screening with a ten power magnifying glass and a paint brush. After sorting, individuals were identified under a binocular microscope.

Final identification was based on Pilsbry's (1939-48) monograph. A second reference, Keep (1935) was also used but only as a superficial guide to snails of this area.

RESULTS

The following sets of histograms (Figures 1-6) were developed to depict the results of the analyses run on the macro-properties of the soils sampled. (See pp. 41-43)

Two factors which were observed appear to have considerable significance in this study. The first is the amount of organic matter present at the sample areas. Of the three areas sampled, organic matter was found to be the most abundant in the Cedar stand. The Alder habitat was found to be intermediate in abundance, whereas the Fir habitat had the least amount.

The second factor which could be of importance is soil texture with regards to water retention. M.E.W. Jaehnig, archeomalacologist, determined that the soil texture of the Cedar habitat was a silty loam, while the Alder and Fir soils were of a loamy texture. Inspection of these textures reveals that the silty loam has high water retention, whereas loamy soils have a lower moisture retention (Buckman & Brady, 1969: 42-51).

Fifteen species of snails were found in the three habitats. Fourteen species were identified, the fifteenth remains undetermined.

In the Cedar habitat a total of 929 individuals, representing thirteen species were identified. Of this total, 250 or 26.8% were adults and the remaining 682 or 73.2% were juveniles. Below (p. 44) is a list of the species and number of individuals per sampled area.

In the Alder habitat 367 individuals of ten species were identified. Of these, 125 or 34% were adults and 242 or 65.9% were juveniles. Table 2 (p. 44) shows the distribution of gastropods in each sample taken from the Alder habitat.

In the Fir habitat 255 individuals of ten species were found. Of these 50 or 22.2% were adults and 175 or 77.8% were juveniles. (See Table 3, p. 44).

DISCUSSION

Examination of the eight soil properties mentioned and the results of the gastropod investigation show that two factors exhibit qualities of primary influence. The first, quantity of organic matter present, appears to have a direct correlation with the number of gastropods within the habitats sampled. The second, soil texture with relation to moisture retention, also correlates directly at each sampled area.

Of the remaining six properties analyzed, only calcium was seen to display an indirect relation with the population size. Of the three areas sampled, the Alder and Cedar habitats both showed high quantities of calcium carbonate within the soil. The Alder habitat showed over 2800 parts per million and the Cedar habitat 2100 parts per million. Population was highest in the Cedar and second in the Alder. The Fir habitat showed low readings for the amount of calcium present and also had the lowest population size. Such an occurrence might seem to indicate that calcium, although not a primary influencing factor, is of importance as a secondary factor.

Burch (1955: 65) indicated that the amount of magnesium present in the soil was an influencing agent of population size.

(TEXT CONTINUED P. 45)

FIGURE 1. SOIL ACIDITY ANALYSIS

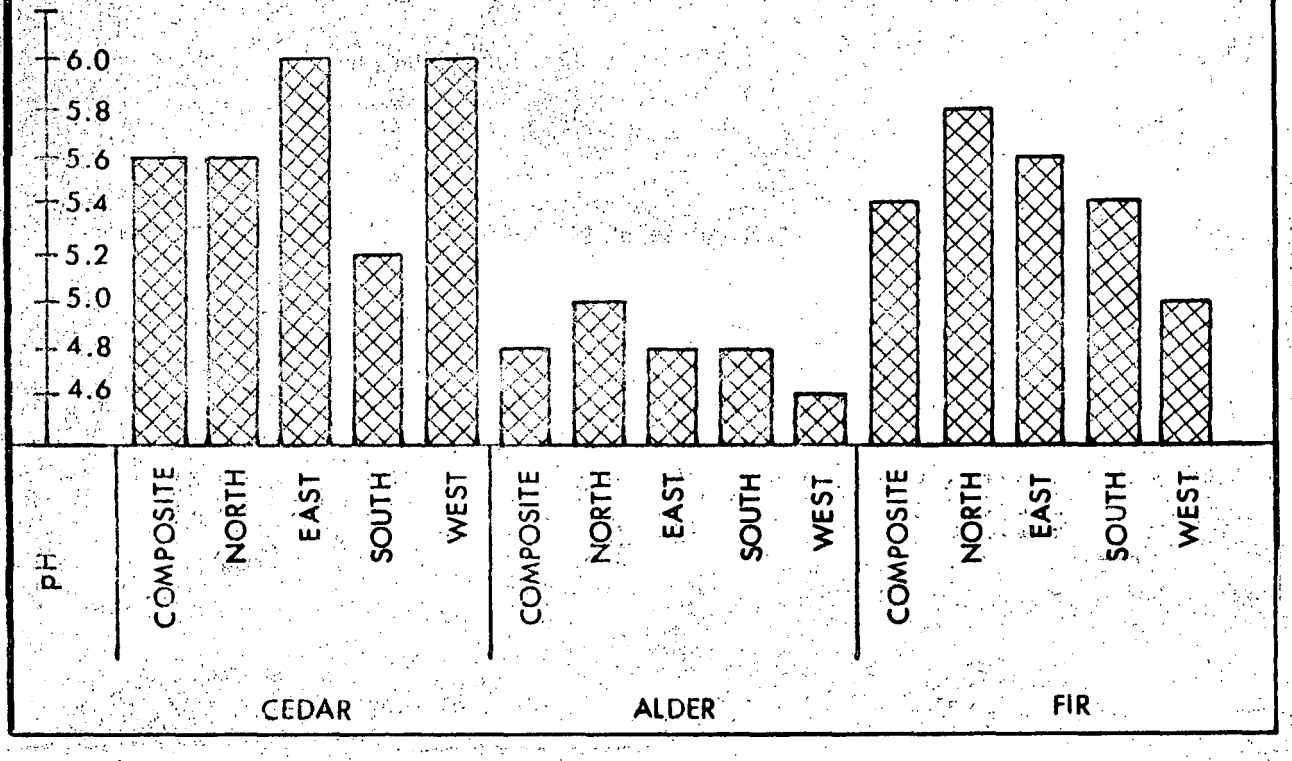

FIGURE 2. PHOSPHORUS ANALYSIS

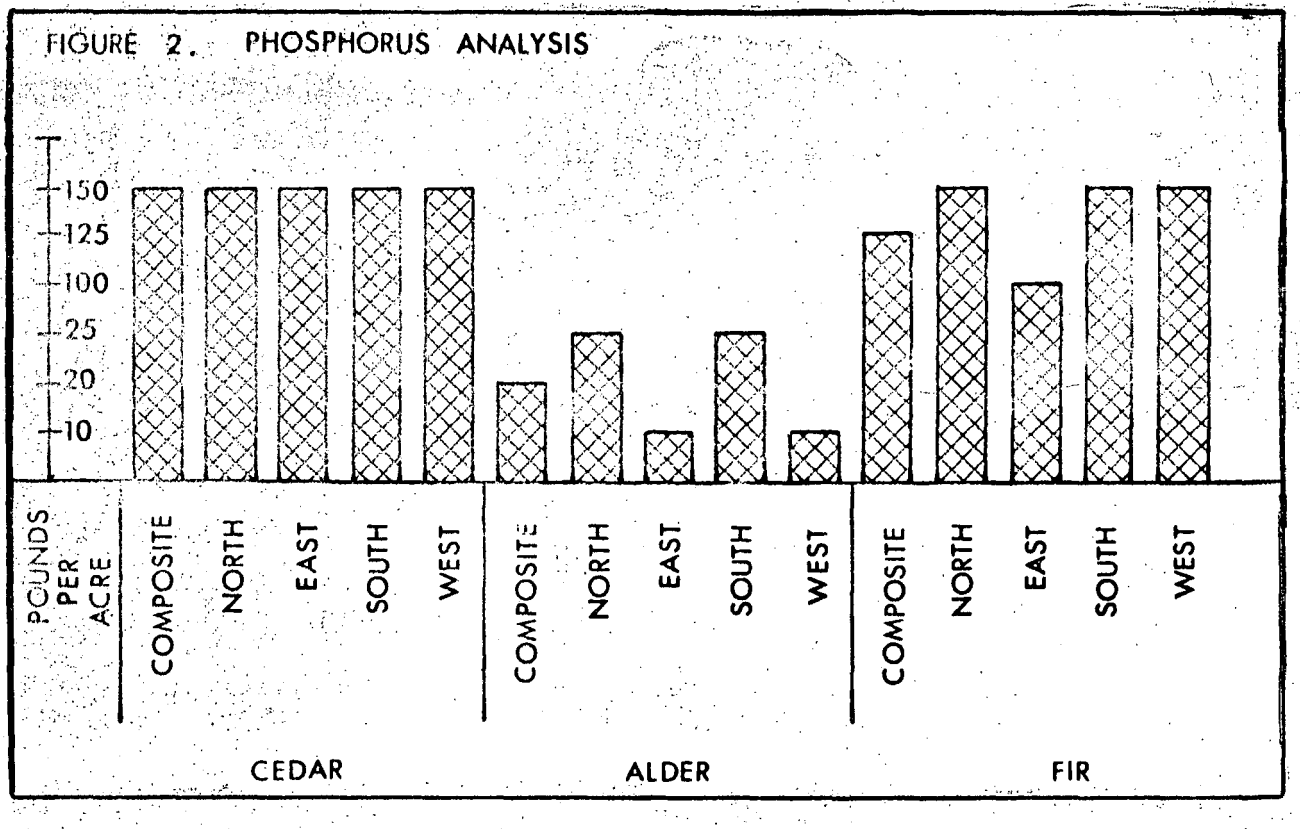

FIGURE 3. POTASSIUM ANALYSIS

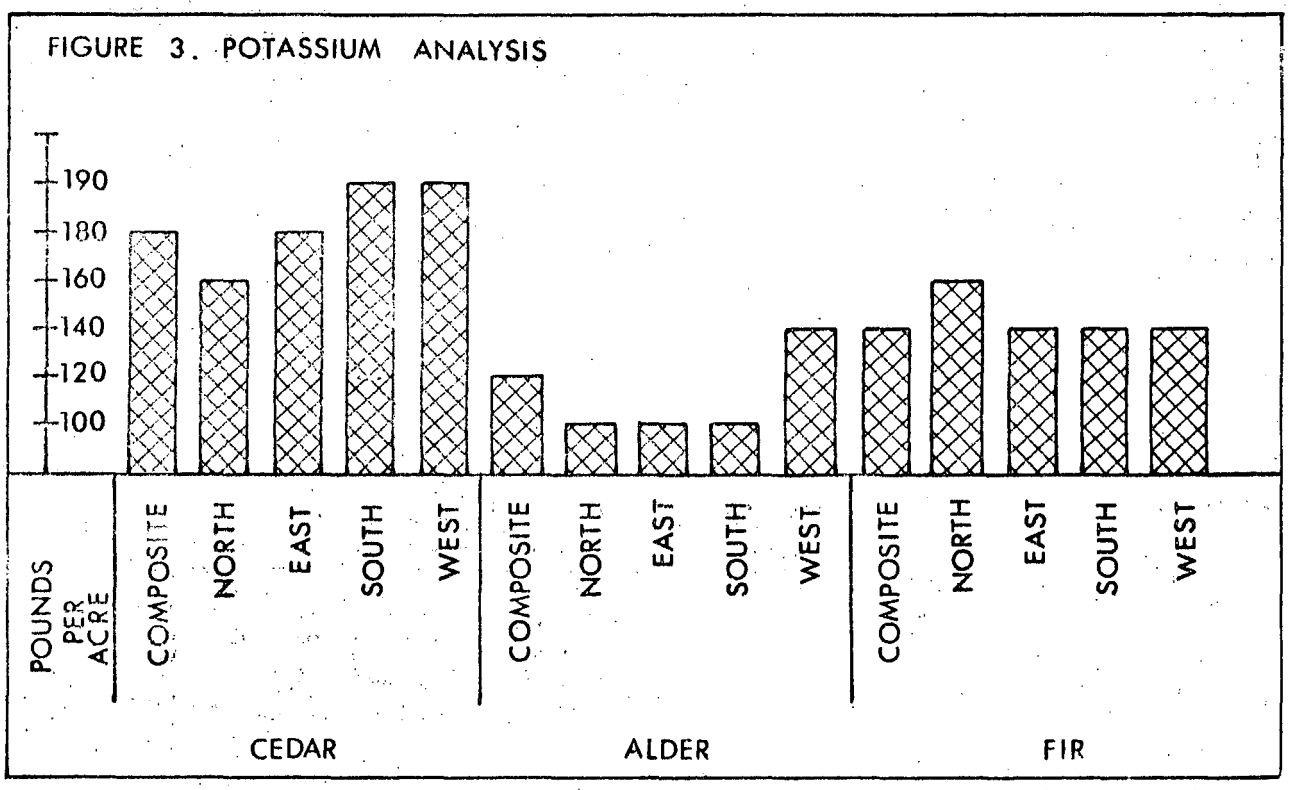

FIGURE 4. HUMUS ANALYSIS

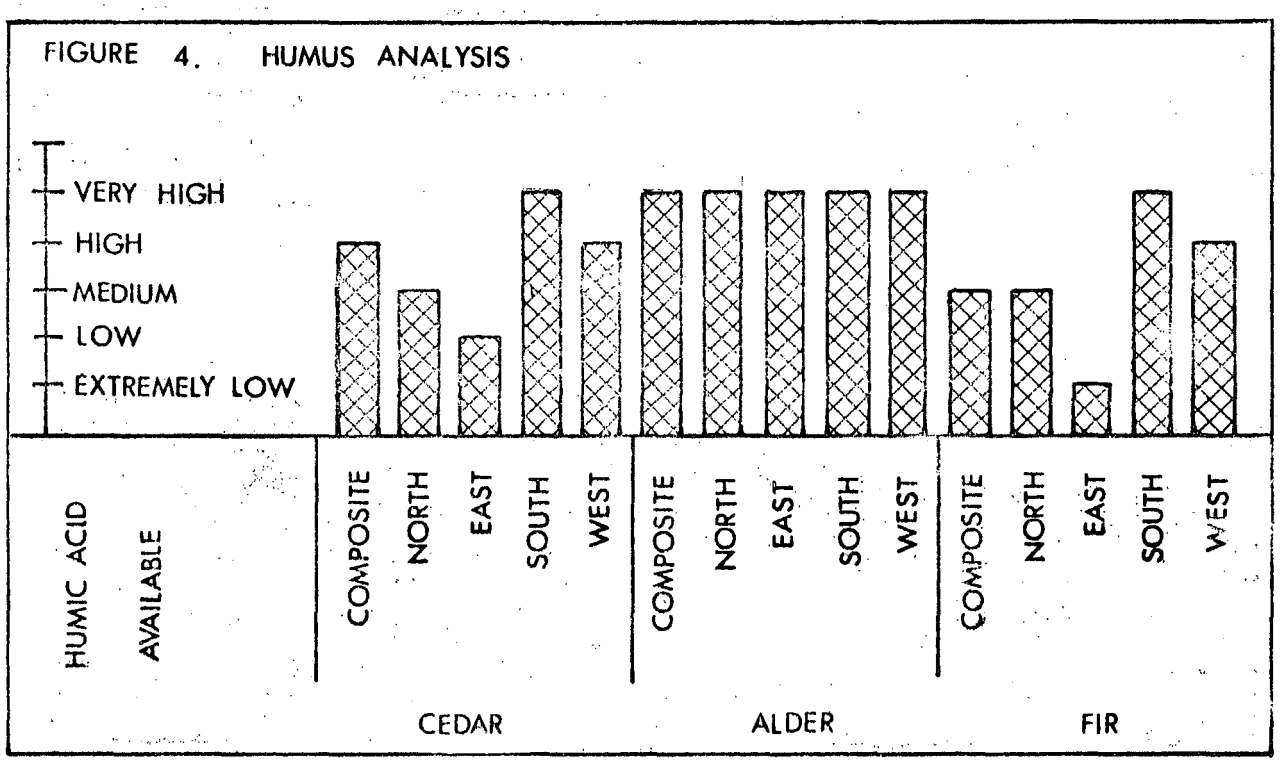

FIGURE 5. CALCIUM CARBONATE ANALYSIS

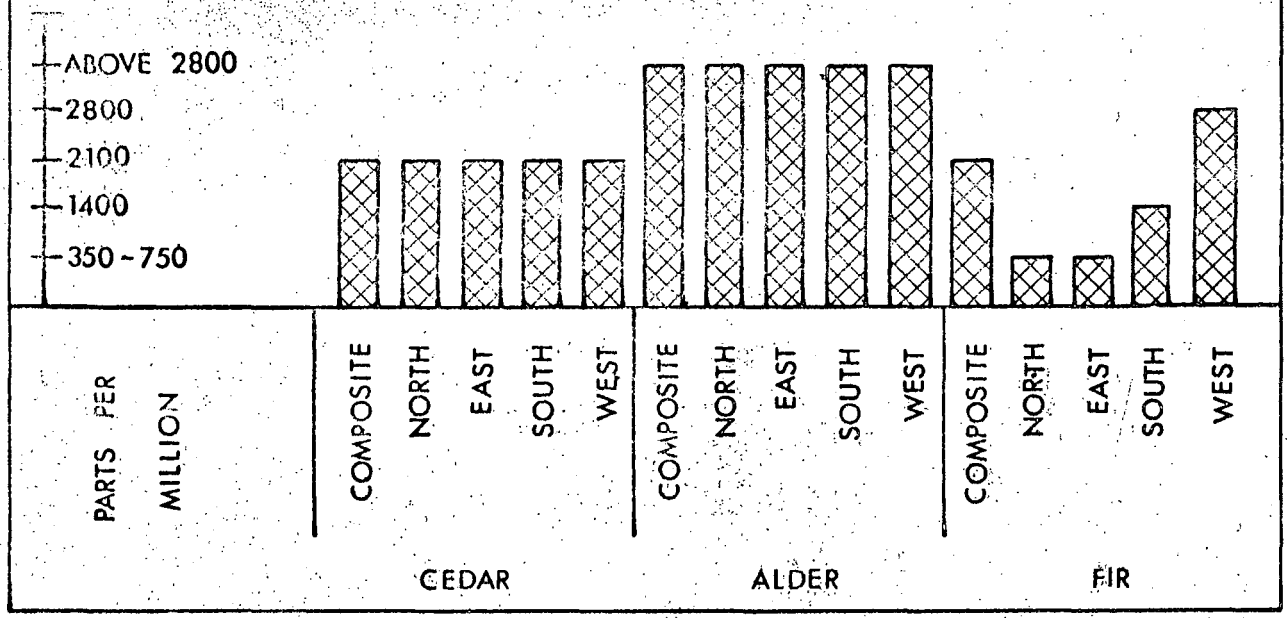

FIGURE 6. MAGNESIUM ANALYSIS

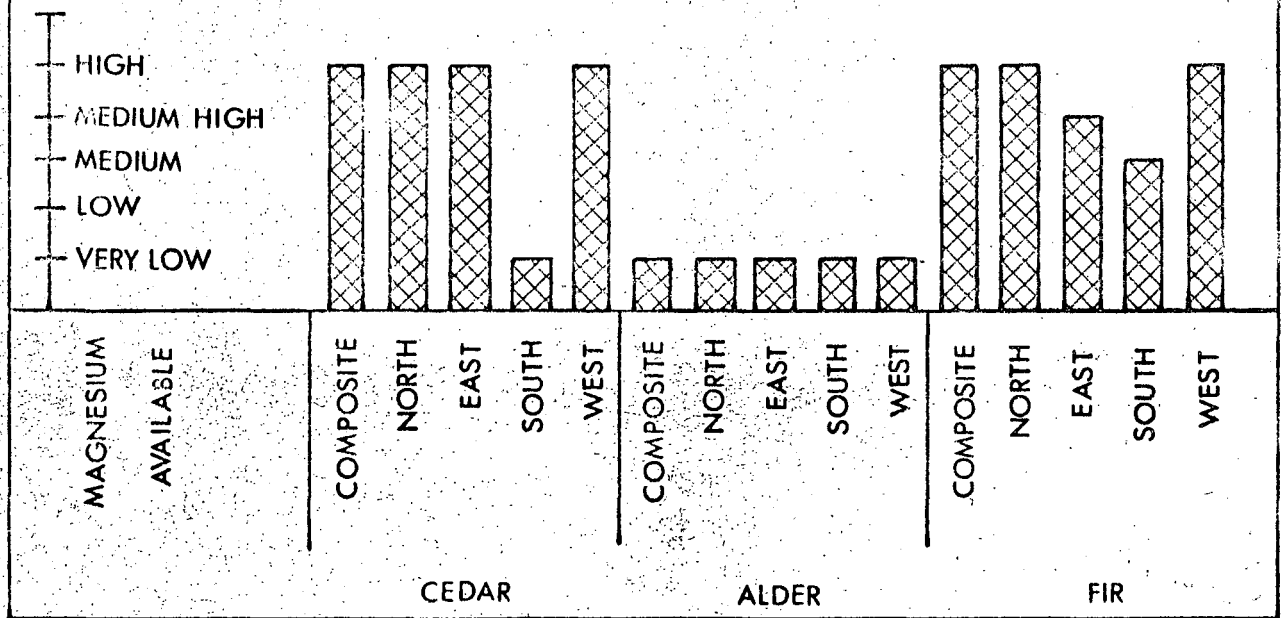

TABLE 1. GASTROPODS OF THE CEDAR HABITAT

	N	E	S	W	TOTAL
Carychium occidentale Pilsbry	44	12	19	50	125
Columella edentula (Draparnaud)	00	01	00	01	002
Euconulus fulvus (Müller)	02	02	00	11	015
Haplotrema sportella (Gould)	00	01	00	00	001
Monadenia fidelis (Gray)	00	01	00	00	001
Pristiloma lansingi (Bland)	48	28	54	63	193
P. stearnsi (Bland)	01	00	00	00	001
Punctum randolphi (Dall)	28	32	86	76	222
Retinella binneyana occidentalis (Baker)	03	03	00	09	015
R. electrina (Gould)	02	05	00	02	009
Striatura pugetensis (Dall)	52	55	89	125	321
Vertigo columbiana Sterki	06	05	00	12	023
Unidentified species	00	00	01	00	001
TOTALS	186	145	249	349	929

TABLE 2. GASTROPODS FROM THE ALDER HABITAT

	N	E	S	W	TOTAL
Columella edentula (Draparnaud)	00	01	00	00	001
Euconulus fulvus (Müller)	03	01	03	02	009
Pristiloma lansingi (Bland)	14	14	04	13	045
Punctum conspectum alleni Pilsbry	18	03	10	07	038
P. randolphi (Dall)	15	06	05	20	046
Retinella binneyana occidentalis Baker	02	00	01	03	006
R. electrina (Gould)	06	05	03	00	014
Striatura pugetensis (Dall)	48	45	50	50	193
Vertigo columbiana Sterki	00	10	03	00	013
Unidentified species	00	01	01	00	002
TOTALS	106	086	080	095	367

TABLE 3. GASTROPODS FROM THE FIR HABITAT

	N	E	S	W	TOTAL
Columella edentula (Draparnaud)	00	00	02	00	002
Euconulus fulvus (Müller)	00	02	00	01	003
Haplotrema sportella (Gould)	00	00	01	00	001
Pristiloma lansingi (Bland)	28	26	20	30	104
Punctum conspectum alleni Pilsbry	03	02	01	01	007
P. randolphi (Dall)	02	07	03	06	018
Retinella binneyana occidentalis Baker	01	02	00	00	003
R. electrina (Gould)	03	01	03	03	010
Striatura pugetensis (Dall)	14	25	12	17	068
Vitrina alaskana (Dall)	00	03	04	02	009
TOTALS	51	68	46	60	225

Although this was not evident in this particular sampling, it is recognized that in different areas, different properties have differing effects upon different species.

Of the remaining four properties analyzed, none showed any correlation, direct or indirect, with population size. Accordingly, properties such as humus, soil acidity (pH), potassium, and phosphorus exhibit neither a primary nor secondary influence upon the population size and may be regarded as very indirect agents in this area.

CONCLUSION

In summary, this investigation attempted to determine primary and secondary influencing agents of gastropod population size and to examine species of snails indigenous to the northwestern portion of Washington State.

The results of this investigation indicate that two factors may be considered as primary in influencing population sizes, macro-environment being constant. These two factors, quantity of organic matter and soil texture (moisture retention) appeared to have high influencing power upon those snail populations sampled. Of the remaining six properties analyzed, only calcium gave an indication of being a secondary influencing agent. The remaining five, soil acidity (pH), phosphorus, potassium, humus, and magnesium, indicated no measurable influence within these three habitats.

Past investigators have recognized a number of factors which appear to be primary influencing agents. Properties such as soil acidity, calcium, moisture, organic matter, and magnesium have all been suggested as primary influencing agents (Burch, 1955; Newell, 1967, Lozek, 1958). If such is the case, it would appear that different limiting factors affect different species of snails. It should then be possible to assume that in different areas with different species of gastropods, investigations would show that the primary influencing agents would also be different.

ACKNOWLEDGMENTS

I would like to thank M.E.W. Jaehnig, Sangamon State University, for his endless patience in helping me; without his help this paper would not have been possible. I would also like to thank S. D. Smith, Central Washington State College, J. M. Jaehnig, Mr. and Mrs. A. M. Noyes, and M. J. S. Noyes.

LITERATURE CITED

BUCKMAN, H.O. & BRADY, N.C.
1969. The nature and properties of soils. -- Macmillan Co.

BURCH, J.B.
1955. Some ecological factors of the soil affecting the distribution and abundance of land snails in eastern Virginia. -- Nautilus 69 (2): 62-69

LOZEK, V.
1958. Soil conditions and their influence on terrestrial Gasteropoda in central Europe. -- IN: Murphy, P.W. (editor), Progress in Soil Zoology. Butterworths.

KEEP, J.
1935. West Coast Shells. -- Revised by J. L. Baily. -- Stanford University Press.

NEWELL, P.F.
1967. Mollusca. -- IN: Burges, A. (editor), Soil Biology. Academic Press.

PILSBRY, H.A.
1939-1948. Land Mollusca of North America: north of Mexico. -- Academy of Natural Sciences, Philadelphia, 2 vols.

ACCEPTED FOR PUBLICATION JULY 26, 1972

REPRINTS OF RARE PAPERS ON MOLLUSCA: GEORGE LEFEVRE AND WINTERTON C. CURTIS: STUDIES ON THE REPRODUCTION AND ARTIFICIAL PROPAGATION OF FRESH-WATER MUSSELS

In 1912, the United States Bureau of Fisheries published the above paper in the Bulletin, vol. 30 (1910) issued May 10, 1912. In the introduction to the work, the authors, both professors of zoology at the University of Missouri, modestly set forth the results of 'several years' of work during which they had studied the life history of river mussels with the aim of replenishing the beds which had been intensively exploited in the first decade of this century by the demands of the pearl button industry. The authors stated (p. 111) that when their data had been analyzed the report '.... would constitute one of the most important ecological studies ever made on any group of animals.' The report of Coker, Shira, Clark, and Howard (1921), also published by the U.S. Bureau of Fisheries (vol. 37, p. 79-181), bore out that prediction. Sterkiana's reprinting will appear in several issues, starting with this one, and continue as space is available.

A. L.

STUDIES ON THE REPRODUCTION AND ARTIFICIAL PROPAGATION OF FRESH-WATER MUSSELS

From BULLETIN OF THE BUREAU OF FISHERIES, Volume XXX, 1910

Document No. 756 : : : : : : : : : : : : : : : : : : : *Issued May 10, 1912*

WASHINGTON : : : : : : GOVERNMENT PRINTING OFFICE : : : : : : : : : : 1912

STUDIES ON THE REPRODUCTION AND ARTIFICIAL PROPAGATION OF FRESH-WATER MUSSELS

By George Lefevre and Winterton C. Curtis
Professors of Zoology in the University of Missouri

CONTENTS.

	Page.
Introduction	109
I. Historical	111
II. Reproduction	114
The marsupium	116
Use of the marsupium in classification	116
General structure of the marsupium	120
Internal structure of the marsupium	125
Phylogeny of the marsupium	135
Conglutination of the embryos	136
Stratification of unfertilized eggs	138
Abortion of embryos and glochidia	138
Breeding seasons	139
Long period of gravidity	141
Short period of gravidity	143
III. The larva	145
Structure of the glochidium	145
The hookless type	146
The hooked type	149
The Proptera or axe-head type	150
The larval thread	151
Behavior and reactions of glochidia	152
Reactions of hookless glochidia	153
Reactions of hooked glochidia	155
IV. The parasitism	156
Artificial infection of fish	156
Infections with hooked glochidia	158
Infections with hookless glochidia	160
Susceptibility of fishes to infection	162
Behavior of fishes during infection	163
Infection of fish in large numbers	164
Conditions necessary for successful infection	166
Duration of the parasitic period	167
Implantation and cyst formation	169
Metamorphosis without parasitism in *Strophitus*	171
V. Attempt to rear glochidia in culture media	174
VI. Post-larval stages	175
Beginning of the growth period and life on the bottom	175
Juvenile stages and the origin of mussel beds	177
Rate of growth	179
Growth of mussels in wire cages	180
An artificially reared mussel	182
The origin and age of mussels in artificial ponds	184

Page.
VII. Investigations on the upper Mississippi River 187
VIII. Economic applications 189
Protective laws 189
Selection and maintenance of a fish supply 190
The best seasons for infections 191
The mussel supply 191
Rearing and distributing young mussels 192
IX. Conclusion 193
Bibliography 195
Explanation of plates 198

STUDIES ON THE REPRODUCTION AND ARTIFICIAL PROPAGATION OF FRESH-WATER MUSSELS.

By GEORGE LEFEVRE and WINTERTON C. CURTIS,

Professors of Zoology in the University of Missouri.

INTRODUCTION.

The threatened extinction in the upper Mississippi River and its more important tributaries of those species of the Unionidæ whose shells have been taken in enormous numbers in recent years, both for the manufacture of pearl buttons and for the pearls which they occasionally contain, has led the United States Bureau of Fisheries to undertake an extensive investigation of the possibility of artificially propagating the commercial species and of devising practicable means of restocking depleted waters which present favorable conditions for their maintenance. The general direction of the investigation has been placed in the hands of the writers, who for several years have devoted as much time as their regular duties have allowed to the work, in certain important phases of which, however, many others have collaborated.

It was recognized at the outset that if the investigation was to be of any practical value it must be wide in scope and must extend over a period of at least several years. At that time much remained to be learned concerning the breeding habits and seasons of the commercial species, the biological and physical conditions under which they live, their distribution throughout the Mississippi Valley, and many other essential matters, while it was yet to be discovered whether artificial propagation could be successfully carried out. At the very inception of the work, therefore, a comprehensive plan was outlined which was designed to include every subject that might bear even remotely upon the central problem—the restoration of the exhausted mussel beds—and, although many parts of this program have scarcely been touched, much progress has been made in some of the more important lines.

The plan of work contemplated, besides a thorough investigation of the conditions under which artificial propagation might be possible, a detailed study of the life history and ecology of the Unionidæ, with special reference to the geographical distribution of the group throughout the Mississippi Valley, the breeding seasons and habits, the

physical conditions of the waters in which different species thrive and attain their maximum growth, food supply, enemies and diseases, rate of growth and the influence of environmental factors upon it, and the behavior of glochidia and fishes as parasites and hosts, respectively.

The results that have already been obtained, although far from complete, will serve as a basis for future investigations, while the lines of attack in the main problems have been definitely indicated. We have proceeded far enough to make it clear that the ultimate end of the investigation is assured, and with adequate facilities for the infection and care of large numbers of fishes and for the maintenance of the young mussels during the early stages of growth following the metamorphosis, the final success of the work can no longer be in doubt. The essential facts in the life history of the Unionidæ are known; the breeding seasons and habits of the commercial species have been sufficiently determined; the general conditions of infection and of the parasitism of the larva have been learned experimentally; and the entire feasibility of artificially propagating at least certain species of fresh-water mussels has been clearly demonstrated; while the requisite conditions for placing artificial propagation on a practical basis are now thoroughly understood.

The writers' personal attention has in the main been directed to a study of the conditions of reproduction in the group and the parasitism of the larva in their bearing upon the problem of artificial infection of fishes with glochidia, while such phases of the investigation as geographical distribution, systematic studies, and a number of special ecological problems have been in the hands of other investigators.

At the recently established biological station of the Bureau of Fisheries at Fairport, Iowa, while construction was still in progress, the work of propagating some of the commercial species was inaugurated, and the excellent facilities of the station, which has been especially designed for the purpose, are now being utilized by members of the staff in attacking fundamental problems of both a scientific and an economic nature.

For the past five summers a number of field parties have been equipped and sent out each year by the Bureau to collect fresh-water mussels and to obtain the fullest

NOTE.—It is a pleasure to state that a generous grant of money made by the National Association of Pearl Button Manufacturers in the interest of the investigations enabled us to purchase a collection of books and pamphlets, dealing with the literature on the Unionidæ, which has been of invaluable assistance in the course of the work. To individual members of this association, especially to Mr. J. E. Krouse, of Davenport, Iowa, Messrs. W. F. Bishop and Henry Umlandt, of Muscatine, Iowa, and Mr. D. W. MacWillie, of La Crosse, Wis., we are indebted for many courtesies and for shipments of live mussels which they have repeatedly secured for us. Many others have at times assisted us by sending us material, and in this connection we take especial pleasure in thanking Prof. U. O. Cox, of the State Normal School at Terre Haute, Ind., who has kindly furnished us on several occasions with valuable lots of gravid mussels from the Wabash River.

To a number of our students, who in various capacities have been of service to the investigations, we owe much, and among them should be mentioned Miss Daisy Young, Messrs. Howard Welch, F. P. Johnson, W. E. Dandy, L. E. Thatcher, and especially Mr. W. E. Muns, who acted as our assistant in this work for over two years.

Lastly, it is a pleasure to acknowledge our obligation to Mr. G. T. Kline, the biological artist of the University of Missouri, who has contributed much to the value of our work by the beautiful and accurate drawings with which he has illustrated this and previous papers published by us.

By permission of the Commissioner of Fisheries, we have had the privilege of publishing, in advance of this more detailed report, the following papers of a preliminary nature: Experiments in the artificial propagation of fresh-water mussels (Proceedings of the Fourth International Fishery Congress, Bulletin of the Bureau of Fisheries, vol. XXVIII, 1908); The marsupium of the Unionidæ (Biological Bulletin, vol. XIX, no. 1, 1910); Reproduction and parasitism in the Unionidæ (Journal of Experimental Zoology, vol. IX, no. 1, 1910); Metamorphosis without parasitism in the Unionidæ (Science, vol. XXXIII, no. 857, 1911).

possible data bearing upon their distribution, their habits, and the physical and biological factors of their environment, as well as information concerning the industries which depend upon the mussel. Surveys of this character have now been carried out on the Mississippi River and nearly all of its more important tributaries from Minnesota to Tennessee, and as a result of these investigations an enormous amount of material and information has been collected which, when examined and analyzed, will not only have the greatest economic value, but will constitute one of the most important ecological studies ever made on any group of animals.

I. HISTORICAL.

As has long been known, the Unionidæ carry their young in the gills, which function as brood pouches until the completion of the embryonic development. At the close of this period the larva or so-called glochidium is fully formed and escapes from the egg membrane while still within the gill. In some species the discharge of the glochidia takes place at once, while in others they remain in the brood pouches for several months without further change before being set free into the water.

The glochidium, long thought to be a parasite infesting the gills and known as *Glochidium parasiticum*, was proved by Carus in 1832 to be the larva of the mussel itself, although many years earlier Leeuwenhoek had given it the same correct interpretation. In 1866 Leydig made the important discovery that the glochidium, after leaving the parent, completes its development as a parasite on fishes.

The earliest observations of importance in the development of our knowledge concerning reproduction in the Unionidæ are those of Leeuwenhoek, made about 1695 [a] and recorded in the Arcana Naturæ. During the two preceding centuries the belief had gained ground that the mollusks had sexes like the higher animals, and this no doubt helped to arouse a certain skepticism regarding the existence of any process of spontaneous generation among the representatives of this phylum. The observations of Redi (1668), in disproval of spontaneous generation in insects, furnished collateral evidence and appear to have been the direct incentive for Leeuwenhoek's examination of the reproductive processes in certain mollusks, among others the fresh-water mussels, and the discovery by Leeuwenhoek of eggs and sperm in these mollusks convinced him that their reproduction must be effected by such means rather than by spontaneous generation.

It is surprising to find how accurate were Leeuwenhoek's conclusions regarding the general course of the development as far as the larval stage, later known as the glochidium, and a survey of the subsequent literature shows that not until the work of Carus, in 1832, were there published conclusions more in accord with the facts as now known, nor a better summary of what we now term the embryonic period. The correctness of these early observations, so far as they went, and of the conclusions drawn from them have not been sufficiently recognized in most accounts of the literature, and for this reason an explicit statement of their important features is desirable.

[a] The date of the publication referred to in the literature list is somewhat later, 1722.

Approaching the subject unhampered by any preconception in favor of the older views, but rather with the belief that the conclusions of Redi would also hold for the bivalves, Leeuwenhoek records, in the 83d and 96th letters of his Arcana Naturæ, the presence of separate sexes in *Anodonta* and *Unio*, as evidenced by the presence of eggs and spermatozoa in separate individuals, and gives some account of the development. That he clearly apprehended the main course of events is evident if we read his description of eggs found floating free in the fluid obtained by puncturing the upper part of the foot upon either side, of similar eggs in more advanced stages within the outer gills, and of various stages in the formation of the glochidial shell. Finally, he observed the snapping of the valves, now so well known as a sign of the last stages in this embryonic development, and upon seeing the rotation of the embryo in the egg membrane he concluded that it must be unattached. He further observed that the individuals, when ready for their egg laying (passage of eggs from ovary to gills), placed themselves in spots where the water was shallow and where they were in direct sunlight—a fact which seems to have been confirmed by other observers of the European species (Schierholz, 1888, p. 8, *Unio* and *Anodonta*). Observing the general similarity between the bivalved larva and the adult, he seems never to have doubted that the glochidia, as they were subsequently called, were the young of the mussel in which they were found and therefore that these mollusks were viviparous, conclusions which so naturally followed from all the facts that it is hard to see how convincing evidence could have been manufactured for any other opinion. Upon removing these fully formed larvæ and setting them aside in dishes of clean water, with a view to observing their further development, Leeuwenhoek met the stumbling block of all observers before the discovery of the parasitism upon the fish was known, for the larvæ lived but a short time, soon becoming infested with a variety of animalcules, which he rightly concluded were the immediate cause of their death.

These conclusions of Leeuwenhoek, so nearly in accord with our present knowledge, were not entirely accepted, because they did not become known to some investigators even a century later and because there was still a considerable recrudescence of the older conception of spontaneous generation. The opinion of Poupart (1706) that these mussels were hermaphroditic gained ground and dominated during the eighteenth century, although the larvæ, when found in the outer gills, were always regarded as the young of the mussel until, in 1797, Rathke offered an entirely different explanation and erected for them a new genus, *Glochidium*, and a species, *parasiticum*. According to this explanation, which came to be known as the Glochidium Theory, it was supposed that these multitudinous larvæ were not the young of the mussels at all, but parasites with which they had become infested. Since Rathke's theory attracted considerable attention at the time and was later supported ardently by Jacobson (1828), and since it has given us the term glochidium, we may note in passing the evidence upon which it was based as stated by its later champion.

1. The form and organization of the little shells is entirely different from that of the adult *Unio* and *Anodonta*.

2. They are of exactly the same form and size in the two genera and in the individuals of diverse size and age.

3. They are always of the same size and shape when they have reached their complete development.

4. Their valves are of a consistency and hardness in no wise related to their size, as should be the case were they the young of *Unio* and *Anodonta*.

5. Their development is not related to any season of the year nor to a certain age of the animal in which they are found; that is to say, one finds in a single locality at the same time individuals containing eggs, others with little bivalves, and some containing even the fully developed organisms.

6. The enormous numbers which are found at one time in an individual are in no wise proportionate to the number of the adults in any locality.

7. One can not conceive of organs so delicate as the gills being able to serve as a sort of brood pouch, and there is no other example in the animal series of such a condition, although these organs are often the seat of animal parasites.

Jacobson's statement is thus a curious jumble of half truths and of statements which have since been shown to be entirely incorrect.

The importance attached to the dispute thus raised was so great that the Academy of Sciences at Paris appointed two of its members, De Blainville and Dumeril, a committee with instructions to examine into and report upon the whole matter. This report (De Blainville, 1828) presents an exhaustive review of the early literature and details certain experiments performed by the committee with a view to testing the matter by direct observation. These experiments, while tending to confirm the earlier views of Leeuwenhoek, were insufficient for the complete overthrow of Rathke's Glochidium Theory, for although the report was unequivocal in its conclusion that the observations of all previous authors and the evidence advanced by Rathke himself did not justify the Glochidium Theory, its lack of evidence from original observations rendered it not entirely conclusive. Viewed in the light of our present knowledge, its skillful and logical arraignment of Rathke's conclusions shows clearly the scant foundation upon which the Glochidium Theory rested, but it was not until the work of Carus (1832) that the question was finally set at rest. This author was able, in the brightly colored eggs of *Unio littoralis*, to see the passage of the eggs from the ovary to the external gills and their development there to the mature glochidia, and thus to prove beyond any doubt that the innumerable larvæ which crowded the outer gills were the young of the mussels in which they were found.

The paper by von Baer (1830) anticipated some of the points which Carus made the more clear, and from this time on the serious difficulty for students of the embryology was found in the failure to secure, either within the gills of the mussel, or upon removal of the embryos to water, any developmental stages beyond the glochidium.

The period from Carus's paper (1832) to the date of the discovery by Leydig (1866) of glochidia embedded upon the fins of fishes shows little progress toward a more complete account of even the embryonic stages. De Quatrefages, who in 1836 described

the glochidium as having a very complex structure and possessing many of the organs of the adult mussel, made a distinctly backward step; and his account of hearts, stomachs, livers, intestines, and aortas, all highly developed and double in each individual, reminds one of the description of elaborate systems of organs in the infusoria as given by Ehrenberg in his monograph published during the same year. Pfeiffer (1821, taf. II, fig. E) was the first to observe the minute outline of the glochidium at the umbo of a young shell—a fact which, had it become generally known, would have saved Jacobson his defense of the Glochidium Theory. There remained, however, the unexplained gap between the glochidium and such a stage of the young mussel, and this was filled only by Leydig's discovery of the parasitism. With the clue thus given, the stages by which the glochidium becomes the miniature adult, during the course of its parasitism, were studied by Braun (1878), Schmidt (1885), Schierholz (1878 and 1888), and more recently by Harms (1907–1909). All of these investigators obtained their material in great abundance by the artificial infection of fish with the glochidia, and in their several accounts the structure of the glochidium and the organogeny of the common European species will be found very completely given.

The embryonic stages attracted new attention with the rise of cytological studies, and the paper of Flemming (1875) was exhaustive for the period in which it was written, although Lillie's more detailed and modern account (1895) of the cell lineage and the formation of the glochidium in *Unio complanatus* and *Anodonta cataracta* has rendered Flemming's paper of historical interest only, and has apparently left undone nothing of importance in a description of the early stages in these species.

Further reference to the literature will be made as the several stages of the development are discussed in the species we have followed. Since an excellent summary of the literature, particularly that published since the paper by Carus (1832), may be found in the work of Harms (1909), we omit further elaboration here. The report to the Paris Academy (De Blainville, 1828) gives a good account of the literature for the earlier period, and from this we have obtained a summary of the facts in such early papers as have not been accessible.

II. REPRODUCTION.

The sexes are normally separate in the Unionidæ, but in *Anodonta imbecillis* and in a few other species of this genus the occurrence of hermaphroditism has been occasionally recorded (cf. Sterki, 1898; Ortmann, 1911). Although in the majority of the genera of the Unionidæ the sexes are indistinguishable externally, in a few, notably in *Lampsilis*, the shell of the female differs from that of the male in its greater convexity in front of the posterior ridge and in more or less well-marked differences in the posterior outline of the shell. In such cases the males and females may be readily assorted without recourse to an examination of the soft parts.

At ovulation the eggs pass from the oviducts to the cloaca, and thence back into the suprabranchial chambers, in which they are probably fertilized by spermatozoa brought in by the respiratory current of water. From the suprabranchial chambers they are conducted directly into those portions of the gills in which they are to remain.