40 to 108 days and is temperature dependent. Settlement may be synchronous for all larvae in a given geographical region. Metamorphosis takes about three or four days, and the veligers appear to settle preferentially on sediment of silt-clay size range.

Development of *Oenopota fidicula* is similar, although the egg capsules are smaller with fewer eggs. Potentially synchronous settlement was not observed.

NORTH ATLANTIC-PACIFIC NUDIBRANCH COGNATES. **Sandra V. Millen,** University of British Columbia, Vancouver, Canada.

Several cognate species of nudibranchs living in the Atlantic and Pacific oceans were examined using scanning electron microscopy and conventional dissection to determine morphological differences. The cognates *Onchidoris muricata* (Müller, 1776) of the Atlantic and *O. varians* (Bergh, 1878) of the Pacific appear to be identical when similar sized specimens are compared, but in the Norwegian Sea they are larger with the notal tubercles disproportionately larger. These larger specimens are usually confused with *Adalaria lovéni* (Alder & Hancock, 1862). During this study it was discovered that the description of *Onchidoris hystricina* (Bergh, 1878) fell within the description of *O. muricata* and is therefore a junior synonym. The animal that is commonly considered to be *O. hystricina* upon examination was found to be a *Diaphorodoris*. Another Pacific species, which has been referred to as *Onchidoris* sp., was found to have the multiple lateral teeth of an *Adalaria*. A reassessment of Bergh's 1978 criteria for distinguishing the genera *Onchidoris* and *Adalaria* found that all the criteria except the number of lateral teeth were invalid. This is a tenuous distinction as some *Adalaria* have as few as five laterals per side. If intermediate forms are found in the future it will be necessary to synonymise these genera. The second cognates, *Adalaria proxima* (Alder & Hancock, 1854) from the Atlantic and the Pacific *A. pacifica* Bergh, 1880 were found to vary only slightly from each other. The differences may be due to preservation artifacts. It is concluded that these two species are synonymous.

BIOLOGICAL ADAPTATIONS OF INTERSTITIAL MOLLUSCS. **M. Patricia Morse,** Marine Science Laboraory, Northeastern University, Nahant, Massachusetts.

Interstitial molluscs are characteristic of shifting coarse sand environments. Major molluscan taxa represented include solenogasters, acochlidiaceans and species of the nudibranch genus, *Pseudovermis*. These organisms are small (1.5–3.0 mm in length), have reduced numbers of cells, a small number of eggs, often spicules rather than an extensive shell and a variety of adhesive organs. They are distributed in intertidal and subtidal sands of tropical, subtropical and temperate environments. Biological and ecological studies of sites including San Juan, Washington, Crow Neck, Maine, Fort Pierce, Florida, Carrie Bow Cay, Belise and Viti Levu, Fiji have led to defining an assemblage of these molluscs that occur in well-oxygenated coarse to medium sands devoid of sulfides. Associated with the assemblage are interstitial hydroids upon which the solenogasters and nudibranchs feed. Reproductive modifications for this environment include production of spermatophores and deposition of small numbers of encapsulated embryos (Acochlidiacea). Spicule formation is common in the Acochlidiacea and characteristic of all the interstitial solenogasters. All of these interstitial molluscs offer examples of regressive evolution toward vermiformity for living in pore spaces of the environment.

SHELL REDUCTION AND LOSS IN FISSURELLIDS: A REVIEW OF GENERA AND SPECIES IN THE *FISSURELLIDEA* GROUP. **James H. McLean,** Los Angeles County Museum of Natural History, California.

Paper on pages 21–34.

THE EVOLUTION OF BROODING IN ACMAEID LIMPETS. **David R. Lindberg,** Museum of Paleontology, University of California, Berkeley.

Brooding has evolved in only one acmaeid shell structure group, and the methods of fertilization, embryo nourishment, and brooding differ among the brooding species.

REVISION OF HIGHER TAXA IN GENUS *CERITHIDEA* (MESOGASTROPODA: POTAMIDIDAE) BASED ON COMPARATIVE MORPHOLOGY AND BIOLOGICAL DATA. **Richard S. Houbrick,** Smithsonian Institution, Washington, D.C.

Paper on pages 1–20.

BIOGEOGRAPHICAL AFFINITIES OF THE OPISTHOBRANCH GASTROPOD FAUNA OF SOUTHERN AFRICA. **Terrence M. Gosliner,** Department of Invertebrate Zoology, California Academy of Sciences, Golden Gate Park, San Francisco.

The tip of southern Africa provides an important area for the study of the distribution of marine organisms. Not only is it the juncture of the Indian and Atlantic Oceans, but it is a region characterized by abrupt changes in oceanic temperature.

The vast majority of opisthobranch gastropods have planktotrophic veliger larvae that can be dispersed across entire ocean basins. Several factors further influence the distributional patterns of these organisms. Revision of the systematics of taxa can dramatically alter their apparent distributional patterns. For example, synonymy of several taxa with *Aeolidiella indica* produces a single circumtropical species rather than seven endemics. Lack of data with regard to large geographical areas often produces erroneous distributional conclusions. Human interference with distributional patterns may also alter biogeographical inferences. Despite these potential limitations it is possible to determine the distributional patterns of over three hundred species of opisthobranchs from southern Africa with a reasonable degree of confidence.

Traditionally, the Cape of Good Hope has been con-

sidered to constitute a major biogeographical barrier between discrete cold and warm water, largely endemic, faunas. However, approximately three-fourths of the opisthobranchs occurring on the Atlantic side of the Cape Peninsula are also found in False Bay, on the Indian Ocean coast. Far more profound faunal differences occur between the largely endemic fauna of the eastern Cape Province and that of the Transkei coast, which consists largely of Indo-West Pacific taxa.

The opisthobranch fauna of southern Africa is composed of a unique blend of tropical, temperate and Antarctic taxa, which appears to be a result of both vicariant events and recent dispersal.

BURROWING ACTIVITIES OF *PERIPLOMA MARGARITACEUM* (LAMARCK, 1801) (BIVALVIA: ANOMALODESMATA: PERIPLOMATIDAE). Joseph Rosewater, Smithsonian Institution, Washington, D.C.

Paper on pages 35–40.

A REVIEW OF THE BIVALVE GENERA *AXINULUS* VERRILL & BUSH, 1898, *LEPTAXINUS* VERRILL & BUSH, 1898 AND *ADONTORHINA* BERRY, 1947 WITH NOTES ON A NEW SPECIES OF THYASIRIDAE. Paul H. Scott, Santa Barbara Museum of Natural History, California.

A new species of Thyasiridae has been found in deep water in the northeast Pacific. Generic placement of the species proved difficult as it exhibited characters of the genera *Axinulus, Leptaxinus* and *Adontorhina*. Type material of the three genera was examined to determine the correct generic placement for the new species. Inspection of the hinge plate proved to be the most useful character in differentiating the genera.

Distinctive characters of the genera are defined below.

Axinulus Verrill & Bush, 1898 (8 North American species, 7 species examined)
Type species *Axinulus brevis* V & B, 1898
hinge plate thin, smooth and edentulous
—minute hinge tubercles present in some species
Leptaxinus Verrill & Bush, 1898 (1 North American species)
Type species *Leptaxinus minutus* V & B, 1898
hinge plate narrow but well developed
—right valve with small tubercle beneath umbo which fits into corresponding notch in the left valve hinge.
—right valve with long lateral grooves along anterior and posterior of the hinge plate into which the shell margin of the left valve is seated.
Adontorhina Berry, 1947 (1 North American species)
Type species *Adontorhina cyclia* Berry, 1947
hinge plate broad with a unique granular appearance
—hinge granules distinct anteriorly, weakly expressed posteriorly

The new northeastern Pacific species has a broad granular hinge plate placing it in the genus *Adontorhina* Berry, 1947.

PREDATION OF MOLLUSCAN SPECIES BY THE HORSESHOE CRAB, *LIMULUS POLYPHEMUS*. George D. Buckley, Pleasant Bay Field Station, South Orleans, Massachusetts.

The horseshoe crab, *Limulus polyphemus,* has long been regarded to be a major predator on commercial shellfish. Howsoever, biomedical researchers find *Limulus* blood so important that it has a market value of several thousand dollars per processed liter.

As part of a continuing study, the Pleasant Bay Field Station has researched the predator-prey relationship between the horseshoe crabs and molluscan species, at Pleasant Bay, Orleans, Massachusetts.

With the help of Earthwatch Expedition field assistants the following research regime was conducted:

1. Stomach contents were analyzed from 100 *Limulus.*
2. Feeding observations were made in the field on 200 crabs.
3. Predator-prey studies were conducted using young and adult specimens of the polychaete genera *Nereis* and *Glycera*, the glass sea cucumber, *Leptosynapta,* the softshell clam, *Mya,* the quahog, *Mercenaria,* the razor clam, *Ensis,* and the gem clam, *Gemma.*

The results of stomach content analysis showed the horseshoe crab to be a carnivorous scavenger. The crabs fed on *Mya, Mercenaria,* and *Ensis* but also on the small bivalves *Solemya velum* amd most often *Gemma gemma,* the latter easily confused with seed quahogs. Also found were the annelid genera *Nereis, Arenicola, Glycera, Scoloplos,* and *Syllis,* and the holothuroid genus *Leptosynapta.* Quantities tended to be in close proportion to their relative abundance in the area from which the *Limulus* were collected. Small algae remnants were also present.

In the field, feeding observation confirmed the stomach content analysis. In predator-prey studies, *Limulus* "found" the worms and mollusks with equal rates of success. The most preferred bait was *Gemma gemma.* In all cases, prey less than 4 cm was preferred to larger individuals. Horseshoe crabs that were burrowed into the substratum were found not to be feeding in 52% of the individuals studied.

It is apparent that *Limulus* are a significantly lesser threat to commercial shellfish than previously believed. Indeed, they are a major part of the natural predator-prey relationships of bay ecology.

GROWTH IN *MERCENARIA MERCENARIA* (L.). Arnold G. Eversole, Lawrence W. Grimes, Clemson University, South Carolina and **Peter J. Eldridge,** National Marine Fisheries Service, Charleston, South Carolina.

Growth and survival of the hard-shelled clam, *Mercenaria mercenaria,* was determined for 13-month old individuals grown for 4.5 years in protected trays in a subtidal site of Clark Sound, South Carolina. Calculated annual mortality rate was 4%. No increase in mortality could be